

**CLASSROOM LEARNING ENVIRONMENT AND SELECT
AFFECTIVE VARIABLES IN RELATION TO ACHIEVEMENT IN
PHYSICAL SCIENCE OF STUDENTS OF SINGLE - SEX
AND COEDUCATIONAL SECONDARY SCHOOLS**

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Thesis submitted for the Degree of
DOCTOR OF PHILOSOPHY
in EDUCATION

**DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT**

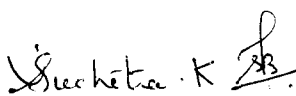
2004

DECLARATION

I, **SUCHITRA. K.**, do hereby declare that this thesis **CLASSROOM LEARNING ENVIRONMENT AND SELECT AFFECTIVE VARIABLES IN RELATION TO ACHIEVEMENT IN PHYSICAL SCIENCE OF STUDENTS OF SINGLE - SEX AND COEDUCATIONAL SECONDARY SCHOOLS** has not been submitted by me in this university or any other university for the award of a Degree, Diploma, Title or Recognition before.

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20th August 2004



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CERTIFICATE

I, **DR. P. USHA**, do hereby certify that this thesis **CLASSROOM LEARNING ENVIRONMENT AND SELECT AFFECTIVE VARIABLES IN RELATION TO ACHIEVEMENT IN PHYSICAL SCIENCE OF STUDENTS OF SINGLE - SEX AND COEDUCATIONAL SECONDARY SCHOOLS** is a record of bonafide study and research carried out by **Suchitra. K.** under my supervision and guidance. The report has not been submitted by her for the award of a Degree, Diploma, Title or Recognition before.

Calicut University
26th August, 2004


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(Supervising Teacher)

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INTRODUCTION

Suchitra K. “Classroom learning environment and select affective variables in relation to achievement in physical science of students of single - sex and coeducational secondary schools ” Thesis. Department of Education, University of Calicut, 2004

INTRODUCTION

- **Need and Significance**
- **Statement of the Problem**
- **Definition of Key Terms**
- **Variables**
- **Objectives**
- **Hypotheses**
- **Procedure**
- **Scope and Limitations**
- **Organisation of the Report**

CHAPTER I

INTRODUCTION

1.1 GROUP DIFFERENCE IN HUMAN BEHAVIOUR AND UNEVEN EDUCATIONAL PROGRESS

Education has become increasingly regarded as a major instrument of social change. On the one hand, education develops the personality and rationality of individuals. The knowledge, skills, interest and values thus acquired through education are expected to bring about certain economic, political and cultural changes in the society and consequently improve their socio-economic status. It is therefore expected that education will bring about reduction of many inequalities that exist in society. Based on this argument, the Universal Declaration of Human Rights has included education as 'One of the basic rights of every human being' and the Constitution of the UNESCO diverts its efforts to achieve 'the ideal of equality of educational opportunity, without regard to race, sex or any distinctions, economic or social'. In the post – independence period in India, not only constitutional guarantees (Bhatia, 1988) have been provided to realise the ideal of equalisation of educational opportunities in the country, but also various educational plans have been developed and implemented to achieve the desired end as early as possible. In spite of the world-wide efforts for removing inequalities that prevail in educational opportunities, uneven educational progress caused by group differences in human behaviour caught the attention of psychologists and educationists. Modern researches have helped to give greater precision and validity of the study of group differences. The alleged deficits and differences manifested by ethnic, sex, language and socio-economic group members led to a renewed recognition that in a democratic society, education should provide for a fullest development of these diverse people.

Gender Issues in Education

Of the varied disparities in human behaviour, gender difference in basic psychological traits has assumed a great significance in modern psychology and gender is considered to be one of the important dimensions contributing to differences in scholastic achievement by educationists. It is now believed that apart from biological reasons causing differences among male and female, disabilities and inequalities have been imposed on women in the total context of a society. Education is considered to be the most significant instrument for changing the subjugated position of women in society. Keeping in view of the goals, intensive effort have been made to make education accessible to girls all over the world by national leaders, missionaries and some philanthropists. The programmes include (i) increasing the involvement of girls and women in various levels of education, (ii) adopting ways and means of preventing wastage and stagnation, (iii) expanding the number of educational institutions, (iv) expanding institutional facilities for girls and women, (v) admitting women students to new and varied academic and professional courses, (vi) increasing the number of women teachers, (vii) improving the system of supervision and inspection of schools and colleges and (viii) strengthening the social support for girls' education. In spite of all the above mentioned efforts, various investigations reveal that imbalance still exists in the educational development of girls all over the world.

1.2 NEED AND SIGNIFICANCE OF THE STUDY

There is a renewed interest in the research in the last two decades on (i) gender difference in school performance especially in science and mathematics and (ii) performance of boys and girls in Single-sex and Coeducational institutions at both pre-college and college level. Sandra (1990) and the American Association of University Women (AAUW, 1992) have observed that there is clear evidence that the educational system is not meeting girls' needs. Although girls and boys enter school roughly equal in

measured ability, twelve years later, girls have fallen behind their male classmates in key areas such as higher level mathematics and measures of self-esteem. Licht and Dweck (1983) after analysing a number of studies from 1960 onwards observed that there are striking sex differences in achievement orientations – (i) girls tend to enter novel situations of intellectual achievement with lower expectations of success; (ii) when success is achieved, girls are less likely than boys to interpret it as due to their intellectual ability; and (iii) girls are more likely to avoid tasks which they have experienced difficulties earlier. Reanalysing the data of National Assessment of Educational Progress Survey (USA), 1978 by Kahle and Lakes (1983), it was reported that the initial interest in science and favourable attitude towards science gradually declines during adolescence stage and girls increasingly develop a restricted view of science; especially a negative view of science classes, and science careers. On the contrary, Greenfield (1997) observes that girls believe that they are also capable of studying science and becoming scientists; that they now participate actively in science classes and interact freely with teachers and gender difference may be due to other social reasons.

American Association of University Women (1995) considers that the educational system is not meeting girls' needs citing gender bias as a major problem at all levels of schooling. In 1990s, only five per cent of about three million scientists in the U.S.A are female (Rosser, 1990). While some people may think this small representation on the part of women in science is natural or acceptable, others insist that our society can no longer afford to use only half the potential of its population. A review of literature related to differences of boys and girls in science performance (Combs & Keeves, 1973; Pelz, 1990; Brickhouse, 1990; and Bob Moon, 2000) reveal the following: (i) In the elementary years, similarities between the sexes in maths and science achievement were found whereas in high school stage, differences in achievement become significant. Both boys and girls have begun to see

science as the domain of males. (ii) Female students tend to be less confident in their science and maths abilities. (iii) Cultural biases have a great impact on a woman's performance in science. (iv) For boys, success in sciences courses can build self-esteem during puberty, but girls must consider their feminine image and social support. They are working against culturally perceived social roles. (v) Even when there are no sex difference in the performance and abilities, girls tend to feel less adequate in maths and science and to have less confidence in their abilities than boys. Attitude towards science are strongly differentiated by the time a student reaches eleven years of age. One of the efforts suggested and implemented in the third quarter of twentieth century in the U.S.A., third and fourth quarter of twentieth century in India and other developing countries is to meet the imbalance in the educational development of girls had been the opening of separate schools for girls.

Coeducational Versus Single-sex Schooling

Single-sex education refers to three types of schooling classified according to the gender composition of the school, classroom and teaching staff. The present type of single-sex education is where the entire student body of the school and the teachers are of the same sex. Examples are traditional Christian Convent school for girls or elite boarding school for boys. The next type of single-sex configuration includes a mixed-sex teaching staff. A third type of single-sex education occurs when school buildings are coeducational but all instruction occurs in gender segregate classes. This form of instruction is common in many coeducational schools in developing countries. Provision of single-sex education is of interest for certain justifiable reasons. Equity in education is of essential concern in a democratic society where female participation in schooling is low as in many of the underdeveloped countries. Single-sex education enhances the probability of female school participation. The second point of concern is the comparative performance of boys and girls especially in science and mathematics. Many

educationists and social reformers are of the view that single-sex schools offer an environment that is more conducive to learning than coeducational schools, especially for women; they lead to higher achievement and self-esteem of women, encourage women to pursue traditional male – dominated careers; provide an academic climate for girls to flourish and alleviate some of the disadvantages women may suffer in a coeducational setting (Tidball, 1980; Riordan, 1990; & AAUW, 1992). When compared with girls at coeducational schools, it is reported that all girls' school students participate fully in and out of class; develop measurably high levels of self-esteem; graduate in maths and science fields at 1.5 times the rate of coeducational institutions, exhibit greater satisfaction than their coeducational counterparts in almost all measures of experience such as academic, developmental and personal.

Supporters of coeducation argue that single-sex education is a barrier to successful adolescent cross-sex socialisation. Single-sex educational opportunities may be justified in a very limited circumstance only. A.A.U.W. in 1998 made a comprehensive review of research on single-sex education and reported that there is no evidence that single-sex education is better than coeducation. Several studies found that although single-sex schools seem to have positive effects on girls' achievement compared with coeducational schools, once the findings were adjusted for: student socio-economic status, pre-enrolment ability, selectivity of the school and certain other variables, the differences diminished or disappeared. Studies are still going on in western countries to assess the progress towards gender equity, and seeking answers to questions such as 'Does single-sex education work?', 'Should we abandon single-sex initiatives?', 'Does coeducation profit females?' and the like. Lockheed and Lee (1992) observe that most of the studies are conducted in the United States and other developed western countries. Only very few studies have examined single-sex education in developing countries.

Fifth Survey of Educational Research (1988-1992) reported the paucity of studies on women's education in India.

In India, the Secondary Education Commission, 1953, National Committee on Women's Education, 1959 and Report of the Committee on the Status of Women in India, 1974, recommended that coeducation should be adopted as a general policy in primary stage and separate schools may be provided in places where there is a strong public demand for them, and enrolment of girls is large enough to justify separate schools. However, studies on achievement and personality traits of students of single-sex and coeducational schools give inconsistent results also (Saighal, 1980; Rai, 1984). In Kerala where the literacy rates of males and females are high and where girls and boys have equal opportunities for schooling, due to various reasons, single-sex educational institutions are still popular especially in urban areas.

Considering the above factors, the investigator felt that it is worthwhile to explore whether variations exist in boys and girls in single-sex and coeducational institutions of Kerala. Being a student of Chemistry and Physical Science education; and a teacher of Chemistry, it was decided to confine the study to science performance and factors contributing to Physical Science achievement.

For the selection of variables and for chalking out the design of the investigation, studies related to science education were surveyed. A careful study of (i) the external influences of the science learner from where the learner begins learning, (ii) the characteristic attributes of the learner, (iii) quality of the learning process and the involvement of the learner in the learning process and (iv) the quality and quantity of learning outcomes was made. Besides, the research reports of A.A.U.W. on single-sex instruction were also scanned. It was noticed that besides mental abilities, a learner-centred classroom provide productive environment which in turn promotes meaningful understanding of school subjects (Fraser, 1986; McKea, 1994;

Santhakumari, 1999 and Suchitra, 1999). Also, a desire for learning or intent to learn, that is Achievement Motivation (Simmons, 1968; Jegede, 1994; Fortier, 1995) generalised and course specific attitudes and other affective variables such as self-esteem, adjustment and the like are also considered as determinants of learning and performance. Since only scarce research on the comparative effects of sex-segregated and coeducational schooling is reported from developing countries and research findings of the A.A.U.W. in the U.S.A were reported to be inconclusive and gender inequality in science performance is still a debated question, it is felt the necessity of studying whether classroom learning environment and select affective traits have differential influence on the performance of girls and boys in single-sex and coeducational schools.

1.3 STATEMENT OF THE PROBLEM

The study is entitled as **“CLASSROOM LEARNING ENVIRONMENT AND SELECT AFFECTIVE VARIABLES IN RELATION TO ACHIEVEMENT IN PHYSICAL SCIENCE OF STUDENTS OF SINGLE – SEX AND COEDUCATIONAL SECONDARY SCHOOLS”**.

1.4 DEFINITION OF KEY TERMS

The important terms used in the statement of the problem are defined below:

1.4.1 Classroom Learning Environment

Classroom Learning Environment for science learning is defined as the atmosphere and general environment in the classroom that may help or hinder the learning process. This includes physical and material resources, emotional tone and attitude of teacher, social attitude of peers, rules and regulations (Howes & Howes, 1982).

1.4.2 Affective Variables

The term refers to a class of variables which represent affective or feeling traits. The term is operationalised by measures of *Achievement Motivation, Self-Esteem* and *Attitudes*.

1.4.3 Achievement in Physical Science

Achievement in Physical Science is defined as the tangible accomplishment or proficiency of performance in Physics and Chemistry as measured using a standardised test.

1.4.4 Single – Sex and Coeducational Secondary Schools

The students who are studying in the secondary classes namely Standard VIII, IX and X are called secondary school students. Based on sex enrolment, schools are categorised as *Single-sex* or *Coeducational*. In the coeducational school, boys and girls receive education together in the same classes of the same institution whereas single-sex schools are either all-girls or all-boys schools.

1.5 VARIABLES OF THE STUDY

The variables included for the present investigation are the following:

1.5.1 Independent Variables

For the present investigation, *Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* are treated as independent variables.

1.5.2 Criterion Variables

Achievement in Physics, Achievement in Chemistry and *Achievement in Physical Science* (total) are treated as criterion variables.

1.5.3 Basal Variables

Sex of the students and *Type of schools* based on sex enrolment namely, *Coeducational* schools and *Single-sex* schools (all-girls / all-boys schools) will be treated as basal variables.

1.6 OBJECTIVES

The main objectives of the present study are the following:

- (i) To study the main effect of each of the five select independent variables on *Achievement in Physics* of boys and girls of *Single – Sex* and *Coeducational* secondary schools.
- (ii) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Physics*.
- (iii) To study the main effect of each of the five select independent variables on *Achievement in Chemistry* of boys and girls of *Single – sex* and *Coeducational* secondary schools.
- (iv) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Chemistry*.
- (v) To study the main effect of each of the five select independent variables on *Achievement in Physical Science (total)* of boys and girls of *Single – sex* and *Coeducational* secondary schools.
- (vi) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Physical Science (total)*.
- (vii) To predict High –; Average –; and Low–Achievers in Physics using the variables *Sex* of the subjects, *Type of institutions based on sex enrolment* and five select independent variables.
- (viii) To predict High –; Average –; and Low–Achievers in Chemistry using the variables *Sex* of subjects, *Type of institutions based on sex enrolment* and five select independent variables.
- (ix) To predict High –; Average –; and Low – Achievers in Physical Science using the variables *Sex* of subjects, *Type of institutions based on sex enrolment* and five select independent variables.

1.7 HYPOTHESES

The following hypotheses are proposed to be tested for the present study:

- (i) The main effect of each of the five select independent variables namely, *Classroom Learning Environment; Achievement Motivation; Self-Esteem; Attitude towards Science* and *Attitude towards Academic Work* and *Sex* and *School type* on *Achievement in Physics* of secondary school students will be significant.
- (ii) The interaction effect of each of the five independent variables *Sex* and *School type* on *Achievement in Physics* will be significant.
- (iii) The main effect of each of the five select independent variables namely, *Classroom Learning Environment; Achievement Motivation; Self-Esteem; Attitude towards Science* and *Attitude towards Academic Work* and *Sex* and *School type* on *Achievement in Chemistry* of secondary school students will be significant.
- (iv) The interaction effect of each of the five independent variables, *Sex* and *School type* on *Achievement in Chemistry* will be significant.
- (v) The main effect of five select independent variables namely, *Classroom Learning Environment; Achievement Motivation; Self-Esteem; Attitude towards Science*; and *Attitude towards Academic Work* and *Sex* and *School type* on *Achievement in Physical Science* (total) of secondary school students will be significant.
- (vi) The interaction effect of each of the five independent variables, *Sex* and *School type* on *Achievement in Physical Science* (total) will be significant.
- (vii) High –; Average –; and Low–Achievers in Physics can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work*.

- (viii) High –; Average –; and Low – Achievers in Chemistry can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work.*
- (ix) High –; Average –; and Low – Achievers in Physical Science can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work.*

1.8 PROCEDURE

1.8.1 Sample

The study was conducted on a sample of 946 students studying in class IX of secondary schools in Thiruvanthapuram, Malappuram and Kozhikode districts of Kerala State. The sample of the study was selected using proportionate stratified sampling technique by giving representation to sex, locale, school type, instructional efficiency and type of management of schools.

1.8.2 Tools

The tools used for collecting data regarding the variables are the following:

- i) Scale of Classroom Learning Environment (Usha and Suchitra, 2002)
- ii) Scale of Achievement Motivation (Pillai and Salim Kumar, 1994)
- iii) Self-Esteem Inventory (Battle, 2000)
- iv) Scale of Attitude towards Science (Pillai, K.S., 1980)
- v) Scale of Attitude towards Academic Work (Usha and Suchitra, 2002)
- vi) Test of Achievement in Physical Science (Usha and Suchitra, 2002)

1.8.3 Statistical Techniques Used

The statistical techniques used for the study are the following:

- i) Three-way ANOVA with $3 \times 2 \times 2$ factorial design

- ii) Scheffé Test of Multiple Comparison
- iii) Test of significance of difference between means
- iv) Discriminant Function Analysis

The analysis were specifically designed to throw light on the objective and hypotheses set for the study.

1.9 SCOPE AND LIMITATIONS OF THE STUDY

There is renewed interest for the research on gender differences, single-sex education and single gender / mixed gender grouping in science learning in developed countries. The present study attempts to examine whether variation in *Classroom Learning Environment* and select affective variables of secondary school boys and girls studying in *Single-sex* and *Coeducational* secondary schools affect variation in *Achievement in Physical Science*. An attempt was also made to study the single effect as well as the combined effect of gender and school type along with the select variables on achievement separately for *Achievement in Physics, Chemistry and Physical Science*.

Owing to practical consideration, the following limitations are anticipated for the present investigation:

- (1) The accessible population of the study was confined to students of Standard IX.
- (2) The selection of variables was confined to only five variables: *Classroom Learning Environment* and four affective variables.
- (3) *Achievement in Physical Science* was intended to measure the instructional objectives of cognitive domain only and only objective type test items were included in the test.
- (4) The methodology used for examining the association of the select independent variables and *Achievement in Physical Science* and the possible gender and school type differences, is three-way Factorial ANOVA followed by post hoc comparison.

- (5) No attempt was made to study the component dimensions of the independent variables especially *Classroom Learning Environment*, *Self-Esteem* and *Achievement Motivation*.
- (6) No factor comparison of variables between boys and girls of *Single-sex* and *Coeducational* schools was attempted.
- (7) Sample was confined to three representative revenue districts of Kerala.

1.10 ORGANISATION OF THE REPORT

The report has been presented in five chapters.

- Chapter I:** Introduction, deals with rationale behind the problem, its need and significance, statement of the problem, definition of key terms, variables, objectives and hypotheses, procedure and scope and limitations of the study.
- Chapter II:** deals with a theoretical overview of the variables and review of related studies.
- Chapter III:** gives the design of the investigation namely variables, hypotheses and methodology.
- Chapter IV:** deals with analysis part of the study, conclusions and interpretations.
- Chapter V:** Comprises an overview of the study, major findings, tenability of hypotheses, suggestions for improving educational practices and suggestions for further research.

REVIEW OF RELATED STUDIES

Suchitra K. "Classroom learning environment and select affective variables in relation to achievement in physical science of students of single - sex and coeducational secondary schools " Thesis. Department of Education, University of Calicut, 2004

REVIEW OF RELATED STUDIES

- **Classroom Learning Environment – Theory and Related Studies**
- **Achievement Motivation – Theory and Related Literature**
- **Self-Esteem– Theory and Related Studies**
- **Attitudes – Theory and Related Literature**
- **Attitude towards Science – Related Studies**
- **Attitude towards Academic Work – Related Studies**

CHAPTER II

REVIEW OF RELATED STUDIES

Review of literature has been mainly conducted to get a theoretical overview of the variables selected and to know prior research regarding the association between the select independent variables and achievement in school subjects particularly of single-sex institution and coeducational institutions. Studies concerning gender differences were also surveyed. The reviewed literature has been presented in this chapter by giving a brief theoretical overview of the select independent variables, namely, Classroom Learning Environment, Achievement Motivation, Self-Esteem and Attitudes followed by the reviewed related studies in each section.

2.1.1 Classroom Learning Environment

Introduction

The classroom is the place where students develop their academic understanding and social relationships. Classroom environment, classroom climate, emotional climate in the classroom, learning environment, etc. are different terms used by educational psychologists to describe the psycho-social and educational characteristics of the classroom. It has been noticed that research on Classroom Learning Environment has been going on for more than three decades. Much of the work has emphasised developing instruments and procedures for assessing classroom environment that have a high predictive validity with student achievement and affective outcomes. A few researches used the classroom environment as a criteria for evaluating a given curriculum.

The previous researches on classroom environment were based on Lewin's Field Theory and the related literature. It was Lewin (1936) who recognised first that both the environment and its interaction with the personal characteristics of the individual are potent determinants of human behaviour. He proposed the equation $B = f(P, E)$. Later psychologists working on human

motivation also concentrated on the personal needs and external environmental – press as determinants of behaviour. Class as a group and community having distinct psycho-social characteristics with desired goals to be attained formed the topic of research since nineteen sixties. Early attempts were confined simply to describe classroom on the basis of observations, later with assigning different values to different behaviours such as teacher behaviour, teacher-student interactions and peer interactions [Medley and Mitzel (1963), Flanders (1986)]. This trend broadened in nineteen seventies to examine the relationship between classroom measures and measures of student outcome. Getzel's and Thelen's Model (1960) for the class as social system holds that in school classes, personality needs, role expectations and classroom climate interact to predict group behaviour including learning outcomes. As the classroom environment refers to less tangible aspects of the context of teaching and learning, it is often inferred by asking students to perceive and rate the psychological and social characteristics of their classroom group on questionnaire items. These items are often concerned with the affective and social relations among the class members such as cohesiveness, co-operation, competitiveness, satisfaction, etc., the emphasis given to efficient completion of learning tasks (goal structure, reward structure, task orientation, etc.) and the implicit and explicit systems of rules, discipline and organisation of class.

Fraser and Walberg (1981) indicated that at least three strategies have been utilised for assessing classroom environments: (i) naturalistic enquiry and case studies; (ii) analysis of interactions that takes place in classroom; and (iii) determining student and teacher perceptions of psychological aspects of classrooms. They also listed several advantages for developing paper and pencil techniques. An additional aspect utilised in the development of instruments was the formation of perceived and preferred forms of these instruments.

There are a number of assumptions on which learning environment instruments have been developed which helped in different ways of defining a learning environment. Some of the assumptions as observed by Bowen (1994) include ideas such as: (i) There is a unique way of conceiving the learning environment of a classroom. (ii) People have similar beliefs about teaching and learning that can be found in the learning environment. (iii) Teachers control the classroom learning environment and (iv) The nature of knowledge is not an important part of the classroom learning environment.

Definitions

Many definitions of classroom environment and classroom climate were put forward by different psychologists and each definition reflects the school of psychology that author believes.

Good (1973) defines educational environment as the sum of all physical, social, emotional and mental factors that contribute to the total teaching learning situations.

According to Tagoiri (1968), a class environment include its 'ecology' (the physical and material aspects), its milieu (the social dimensions concerned with the presence of persons and / or group and its 'social system' (the social dimension concerned with belief, systems, values, cognitive structure and meaning).

Thelen (1981) described classroom in terms of the 'way of life in classroom'. The culture or the climate cannot be directly observed, but has to be inferred from the functional interactive situations which take place in classroom between the teacher and the pupils. Classroom climate is described in terms of three constructs – known as ALP components. These components are Authenticity (pupils' involvement); Legitimacy (pupils' purposefulness or satisfaction) and Productivity (pupils' goal attainment).

Howes (1982) defined classroom environment as 'the totality of external surroundings, including conditions, circumstances and events; in

education, often considered for the extent to which such surroundings facilitate or impede learning.

While trying to define learning environment, Bowen (1994) made an assessment of the assumptions underlying the learning environment research and formulated five definitions accordingly. Most accepted among these definitions is the following: "The resulting socially negotiated collaborative or cooperative construction of interacting alternative perceptions of curriculum held by different groups in and outside the classroom".

Measurement of Learning Environment

A number of measuring instruments and techniques by assessing classroom learning environment were developed by various authors in Europe, Australia and America. They include self-report of students, classroom observation schedules and rating scales. Fraser (1998) summarised the more prominent instruments for assessing the classroom environment and classified the scales according to Moos's scheme for classifying human environments. Nine classroom environment scales classified accordingly is presented below:

TABLE 2.1

Overview of Popular Measuring Instruments of Classroom Environment

Author	Name of the Instrument	Level	Items Per Scale	Scales Classified According to Moos's Scheme		
				Relationship Dimensions	Personal Development Dimensions	System Maintenance & Change Dimensions
Fraser, Anderson & Walberg	Learning Environment Inventory (LEI)	Secondary	7	Cohesiveness Friction Favouritism Cliquesness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material Environment Goal Direction Disorganisation Democracy
Fisher & Fraser	Classroom Environment Scale (CES)	"	10	Involvement Affiliation Teacher Support	Task Orientation Competition	Order and Organisation Rule Clarity Teacher Control Innovation
Fraser	Individualised Classroom Environment Questionnaire (ICEQ)	"	10	Personalisation Participation	Independence Investigation	Differentiation
Fisher & Fraser	My Class Inventory (MCI)	Elementary	6-9	Cohesiveness Friction Satisfaction	Difficulty Competitiveness	
Wubbels & Brekelmans	Questionnaire on Teacher Interaction (QTI)	Secondary / Primary	8-10	Helpful / Friendly Understanding Dissatisfied Admonishing		Leadership Student Responsibility and Freedom Uncertain, Strict

Author	Name of the Instrument	Level	Items Per Scale	Scales Classified According to Moos's Scheme		
				Relationship Dimensions	Personal Development Dimensions	System Maintenance & Change Dimensions
Fraser, Fisher & McRobbie	What is Happening In This Classroom (WIHC)	Secondary	8	Student – Cohesiveness Teacher support Involvement	Investigation Task orientation Cooperation	Equity
Fraser & Treagust	College and University Classroom Environment Inventory (CUCEI)	Higher Education	7	Personalisation Involvement Student Cohesiveness Satisfaction	Task Orientation	Innovation Individualisation
Hofstein & Lunetta	Science Laboratory Environment Inventory (SLEI)	Upper Secondary / Higher Education	7	Student Cohesiveness	Open-endedness Integration	Rule Clarity Material Environment
Fraser	Constructivist Learning Environment Survey (CLES)	Secondary	7	Personal – relevance Uncertainty	Critical Voice Shared Control	Student Negotiation

A study by Zhang (2003) attempted to explore modern web-based learning environment and development of a tool for measurement of the same. This new theoretical model of transactional distance helped the investigator in the development of a learning environmental tool with four dimensions, namely, (i) Transactional Distance between Student and Student (TDSS), (ii) Transactional Distance between Student and Teacher (TDST), (iii) Transactional Distance between Student and Content (TDSC) and (iv) Transactional Distance between Student and Interface – online course management system (TDSI).

2.1.2 Related Studies

Association between Student Outcomes and Classroom Learning Environment

The strongest tradition in Classroom Environment research is the investigation of associations between students' cognitive as well as affective learning outcomes and their perceptions of Classroom Learning Environment – Total and different dimensions.

Positive Relations

Pollack (1987) conducted a study on the effect of classroom climate in a gifted programme. The themes relevant to the study were competition, group work, questioning strategies, flexible scheduling and teacher feedback and evaluation. It was found that both forms (between groups and competition with oneself) contributed positively to the development of critical thinking.

Beamon (1990) reported that classroom climate and teacher questioning strategies considered either singly or in combination, have a statistically significant positive influence on level of student cognitive development.

Deng, Bing (1991) identified four classroom climate factors 'academic orientation, 'satisfaction', 'class-tension' and 'cohesiveness'; the first two factors having positive association with Mathematics achievement.

Laly (1991) studied the relationship between classroom learning environment and mathematics achievement on a sample of 600 standard IX students and found that there exists a significant correlation between learning environment and achievement in Mathematics.

McRobbie and Fraser (1993) studied the association between student outcome and psychosocial science environment. Science Laboratory Environment Inventory was used and it was found that the nature of the classroom environment accounted for appreciable proportion of variance in both cognitive and affective outcomes in chemistry beyond those attributable to general ability.

Henderson et al. (1995) investigated association between biology students' perception of the classroom and the laboratory learning environment and its association with biology outcomes. Questionnaire on Teacher Interaction (Q.T.I) and Science Laboratory Environment Inventory (SLEI) were the tools used. It was reported that certain aspects of the learning environment are associated with students' achievement outcomes. These include the integration of practical and theory work, the degree of open-endedness, the teacher's leadership behaviour, and the level of student responsibility and freedom.

Santhakumari (1996) conceptualised and tested two path models using classroom climate, approaches to studying and physics achievement. It was found that total effect, direct effect and indirect effect of 'social factors' and 'educational factors' on achievement in physics, total and comprehension category and synthesis category can be predicted using classroom climate.

Brookhart (1997) studied the effects of the classroom assessment environment on mathematics and science achievement of secondary school students. Data were obtained from the 1987-1991 longitudinal study of American youth. Significant effects of homework and assessment format were found for science achievement.

Suchitra (1999) studied the causal relationships of classroom climate, learning style and achievement in physical science of secondary school students. The first model conceptualised the causal linking of classroom climate with achievement in physical science indirectly through environmental style area and emotional style area. The second model conceptualised the link of two component dimensions of classroom climate, namely physical factor and social factor with achievement in physical science through learning style. Both models were tested by path analysis and found fitting.

The influence of self-concept and learning environment on achievement in physics of higher secondary school students was studied by Lathika (1999). It was reported that the relationship between learning environment and achievement in physics are significant for the total sample and the sub samples (Boys / Girls, Urban / Rural, Government / Private). It was also found that significant sex difference and rural-urban difference exist in the mean learning environment scores.

No Relation / Negative Relation

Some studies were also located with no association between environment and student outcome.

In a study by Padhi (1991) using an Individualised Classroom Environment Questionnaire on a sample of 636 standard IX students, it was found that the correlation between classroom environment and academic achievement is not significant.

Simi (1995) in a study reported that there exist no significant relationship between chemistry classroom climate and scientific attitude for the total sample, boys, girls, rural and urban sample.

Ann (2000) studied the association of classroom environment and academic performance of final grade students of two community colleges. Spearman rho computed between the scores of classroom environment scale

of successful and unsuccessful students reveal that no correlation exists between classroom environment and academic success.

The purpose of the study by Patterson (2001) was to determine whether relationship existed between students' perception of classroom climate and their select track – university or technical study. Moos' Classroom Environment Scale was administered to 151 students in Tennessee. The study found that perceptions of classroom climate were not significantly influenced by curriculum path either university or technical.

Dethlefs (2002) investigated the relationship of constructivist learning environment and student attitudes and achievement in high school mathematics and science. It was reported that no specific dimensions of constructivist learning environment were consistently related to student achievement. However, certain dimensions of constructivist learning environment emerged as significant predictors of student attitude.

Difference between Comparable groups on their Perceptions of Classroom Learning Environment

Classroom Learning Environment instruments were used to investigate differences between comparable groups of students in their perceptions of Classroom Environment.

Trickett et al. (1982) compared the psychosocial environment by comparing groups and classes in 15 schools in the U.S.A using Classroom Environment Scale. Sample consists of 465 students from both single-sex and coeducation schools. Single-sex and co-ed schools were matched within region according to size, sample again matched for content area, subject and boarders – day scholars. Differences between the perception of girls in single-sex and co-ed classes was explored. It was found that in comparison with coeducational independent classrooms, girls perceived single-sex independent classrooms as having greater task orientation, order and organisation, rule clarity, teacher control, involvement, affiliation and competition. Thus, differences between single-sex and coeducational

classrooms tended to be greater in the authority structure in the classroom and qualitative aspects of student – student relationships.

In a study by Pandya (1991) on classroom climate in school under different types of management using a stratified random sample consisting of secondary schools of Bombay, it was found that (i) dimensions of classroom climate of students coming from aided, unaided and central schools do not differ significantly from each other and (ii) students coming from municipal schools differed significantly on the classroom climate score and its dimensions from those coming from other type of schools.

Beenakumari (1993) compared the classroom climate of secondary schools of different types in Kerala. Significant difference in climate were found between (a) coeducational schools and single-sex schools, (b) boys and girls schools, (c) government schools are not significantly different from private schools in 'classroom climate' in social and educational factors. Urban – rural difference is found only in educational factor and not physical and social factors.

Martin (1996) in her study examined the teacher's role in creating a gender-sensitive environment in an all girls physics class and the effects of that environment on girls' achievement, self-concept, and career choices. Findings indicate that teacher's recognition of the girls' need, fulfil the expectations of the girls and the teacher, and create the environment necessary for continued growth and learning.

American Association of University Women (1998) summarised the research findings of four studies in Learning Environment.

Jeffrey Weld considered that gender bias is evident especially in the presentation of science and maths course work. Girls are not called upon to answer questions as much as boys. Boys tend to dominate classroom discussion. Separate-sex and maths classes do not ameliorate this imbalance. An instructional bias exists in science and maths classes that permit gender bias. Further, the role models utilised in science and maths

and depicted in textbooks as well as class speaks and even teachers themselves tend to be masculine. Anne Chapman compiled research from hundreds of studies and asserted that both boys and girls benefit from working collaboratively as opposed to when working alone. Kimura and Bailey asserted that as research has found some differences in the way men and women solve problems, less emphasis may be on competitive speed, more emphasis may be given for co-operative group work and focus on practical, real-life application of mathematics and science may be increased. Alice Keeting reported that coeducational schools encourage a more realistic competition for life roles because the sexes must compete with each other for them.

Wagner (2002) in a study investigated gender differences in students' mathematics achievement and perception of classroom achievement in single-sex mathematics classroom in one coeducational school. Several significant gender effects were found in students' perceptions of the classroom environment.

A study by Chaerul (2002) among senior secondary students in Indonesia found that male students experience a more positive classroom environment than female students. Also, it was reported that regardless of their gender and grade level differences, students expected a more positive classroom climate during learning physics.

Chen, Chang and Chang (2002) while reviewing the studies from 1997 to 2000 regarding students' perceptions of Classroom Climate and Learning in science of students of different gender summarised the findings as (i) Male students are favoured while females are discouraged in science lessons. (ii) Female students prefer participation in contrast with male students, who prefer competition and individualisation. (iii) Gender is a significant variable in students' perception of Classroom Climate. (iv) Female students tended to score higher on their perceptions of Classroom Climate as well as teacher's knowledge and pedagogy. (v) Among the ten researchers,

one investigator found that male students tended to report higher score and interact with teachers much more frequently, than female students.

Chen, Chang and Chang studied whether gender difference exists in the perception of Classroom Climate before and after introducing a teacher developed interdisciplinary curriculum module in Taiwan. They found that gender difference exist in the perceptions of Classroom Climate. Male students scored higher in the subscales 'Teacher Support', 'Student Involvement', 'Investigation', 'Equality', and 'Task Orientation' than females and female students scored higher in 'Student Cohesiveness' and 'Co-operation'.

A Summary of the Studies on Classroom Learning Environment

I. Association between Student Outcomes and Classroom Learning Environment

SI.No.	Author	Variables	Result
Positive Relationship			
1.	Pollack (1987)	Classroom Learning Environment and the dimensions and critical thinking	Positive relationship
2.	Beamon (1990)	Classroom Climate and Cognitive development	Positive influence
3.	Deng (1991)	Classroom Climate and its factors and Mathematics Achievement	Positive association
4.	Laly (1991)	Classroom Learning Environment and Mathematics Achievement	Positive relationship
5.	McRobbie & Fraser (1993)	Psycho-social Science Environment and Student Outcome	do
6.	Henderson et al. (1995)	Classroom and Laboratory Learning Environment and Biology Outcome	do
7.	Santhakumari (1996)	Classroom Climate, Approaches to Studying and Physics Achievement	do
8.	Brookhart (1997)	Classroom Assessment Environment and Mathematics and Science Achievement	do
9.	Suchitra (1999)	Classroom Climate, Learning Style and Achievement in Physical Science	do
10.	Lathika (1999)	Learning Environment, Self-Concept and Achievement in Physics	do
No relationship			
11.	Padhi (1991)	Individualised Classroom Environment and Academic Achievement	No relationship
12.	Simi (1995)	Classroom Climate and Scientific Attitude	do

SI.No.	Author	Variables	Result
13.	Ann (2000)	Classroom Environment and Academic Performance	No relationship
14.	Paterson (2001)	Classroom Climate and Curriculum Path	do
15.	Dethlefs (2002)	Constructivist Learning Environment, Student Attitude and Mathematics and Science Achievement	Only certain dimensions are related to achievement. No specific dimension consistently related.

II. Differences in Comparable Groups in Classroom Learning Environment

SI.No.	Author	Variables	Result
16.	Trickett and others (1982)	Classroom Learning Environment – Boys / Girls, Single-sex / Co-ed School	Gender difference and School type difference exist
17.	Pandya (1991)	Classroom Climate – Different types of schools	No difference exists – Management wise schools. Rural / Urban difference exists.
18.	Beenakumari (1993)	Classroom Climate – Different types of schools	Difference exist in gender and school type
19.	Martin (1996)	Classroom Environment in all girls class and Physics Achievement	do
20.	A.A.U.W (1998) Summaries four studies	Classroom Learning Environment	Gender difference exists and gender bias
21.	Wagner (2002)	Classroom Environment and Mathematics Achievement	Gender affects Classroom Environment
22.	Chaerul (2002)	Classroom Environment	Gender difference exist in perception of Classroom Environment
23.	Chen, Chang and Chang (2002) Summarise ten studies	Classroom Climate and Learning Science	Significant gender difference exists.

2.2.1 Achievement Motivation

Introduction

Theory and research pertaining to achievement motivation has gained much importance in the last five decades. Motivation may be defined as a combination of forces which initiate, direct and sustain behaviour towards a goal. Thus, motivation not only instigates behaviour but also energises and reinforces the ongoing behaviour. Achievement Motivation also referred to as the need for achievement is an important human social motive. The desires to succeed and to excel are called achievement needs. Where and how achievement needs are learned are complex, intriguing and important questions. Achievement Motivation can be understood simply as the tendency to strive for success or the attainment of a desire goal. This definition has many implications: (i) achievement motivation involves an inclination on the part of the individual. Usually, this includes a consideration of the individual's personality and how that personality influences a motivational state given the presence of certain environmental factors. (ii) achievement usually involves a task-oriented behaviour that can be evaluated. (iii) the task-orientation involves some standard of excellence that may be either internally (by the person) or externally (by others) imposed. Achievement Motivation therefore is a powerful determinant of aspiration, effort and persistence when an individual expects that his performance will be evaluated in relation to some standard of excellence. It therefore refers to the behaviour of an individual who strives to accomplish something to do his best.

Theories of Achievement Motivation

McClelland (1961) pioneered research on achievement motivation starting from achievement need of the popular hierarchy of needs put forward by Murray (1938). Largely influenced by Freud's psycho-analytical theory of personality, Murray considered these needs to be primarily unconscious. Since these needs are largely unconscious, he developed a projective technique (Thematic Apperception Test) to measure the needs

directly. McClelland and Atkinson (1981) have adopted the TAT technique to measure the need to achieve. The early work done by these psychologists were later on refined to suggest and formulate a theory on achievement motivation. The theory proposed by Atkinson is known as Expectancy – Value theory which specifies that the strength of achievement motive (or, as it is alternatively labelled, the tendency to achieve) actually aroused in any achievement-oriented situation is determined by the sum of two tendencies with opposite signs: A tendency to approach success (T_S) and a tendency to avoid failure (T_{AF}). The strength of each of these opposing tendencies is determined by three components.

1. The motive to approach success (M_S) or the motive to avoid failure (M_{AF})
2. The expectancy (probability) that an achievement-oriented act will result in success (P_S) or the probability that it will result in failure (P_F).
3. The incentive value of success (I_S) or the incentive value of failure (I_F).

Several modifications were subsequently offered by Atkinson, et al. They concentrated more on intrinsic motivation. Spence and Helmreich suggested that intrinsic achievement motivation may be something more complex than simply striving towards excellence for its own sake. Achievement motivation is conceptualised in terms of three dimensions namely, work orientation, mastery and competitiveness. To measure each of these dimensions, Helmreich and Spence developed a self-reporting instrument called the Work and Family Orientation Questionnaire (WOFO).

Another related theory which helped to understand motivation is Attribution theory. Since 1960, many studies have contributed to understanding why some are highly motivated to achieve and others are not. According to attribution theory (Weiner, 1980), a high achiever will: (i) Approach rather than avoid tasks related to succeeding because success builds pride and confidence. (ii) Persist when the work gets hard rather than giving up because failure is assumed to be caused by a lack of effort.

(iii) Select challenges of moderate difficulty (50% success rate) because the feedback from those tasks tell you more about how well you are doing and
(iv) Work with a lot of energy because the results are believed to be determined by how hard you try. On the contrary, unmotivated person will
(i) Avoid success related chores because he / she tends to doubt his / her ability. (ii) Quit when having difficulty because he / she believes failure is caused by a lack of ability. (iii) Choose easy or very hard tasks to work on because the results will tell him / her very little about how poorly he / she is doing. (iv) Work with little drive or enthusiasm because the outcome isn't thought to be related to effort.

According to socio-cognitive approach of understanding motivation, two basic types of students were identified (Dweck, et al.,1986). The 'learning-oriented' students are those who want to learn and gain competence and consider intelligence as changeable according to the difficulty level of the tasks. The 'image-oriented' students are those who want to look smart and / or avoid looking dumb and consider intelligence as permanently fixed.

In summary, how motivated human being depends on the following: (i) the strength of fairly consistent motives or needs within us (ii) our expectation of what outcomes certain actions will produce, and (iii) how badly at this time we want a certain payoff over all the other wants we have and over the risks we face.

Sex Differences in Achievement Orientations; Educational Attainment and Behaviour

Consistent sex differences were reported when Dweck and Licht (1983) explored achievement related beliefs and behaviours among children. Many earlier investigators have reported girls tend to underestimate their chances for success. In contrast, the expectations of boys are inclined to be overestimated. Girls' expectations are also likely to deteriorate when encountering difficulty or heightened evaluative pressure. Boys are more

likely than girls to choose difficult tasks and girls are more likely to avoid these situations that hold a threat of failure. Dweck also suggests that parents and teachers tend to provide different types of criticism to boys and girls. Girls are more often criticised for their work and capacity and tend to attribute failure to themselves. Boys are more often criticised for their behaviour and situational factors and tend to attribute failure to external situations. Many aspects of women's life have changed in post-industrial twentieth century societies. Now it appears that the structure of men's and women's achievement motives are more similar than they are different. Spence (1983) suggests that when sex differences do emerge, women tend to score slightly higher than men in work orientation, while men seem to be slightly higher in mastery and considerably higher in competitiveness.

2.2.2 Related Studies

Association between Student Outcomes and Achievement Motivation

Positive Relation

Academic achievement in relation to Achievement Motivation was explored in many studies. Some the representative studies are given in the following text:

Zargar (1980) Ghosh (1983) and Sween (1984) reported that there exists positive correlation between academic motivation and achievement. Gandhi (1985) reported that achievement motivation is significantly and positively related to academic achievement of high school boys and girls. But no sex difference was noticed in achievement motivation. Ramasamy (1988) studied correlates of achievement using a stratified sample of class X students of Madurai district of Tamil Nadu. It was reported that academic achievement is positively related to achievement motivation among high – achieving and low – achieving boys and girls and significant difference exists between high and low achievers in achievement motivation. Devanesan (1999) reported that there is significant and positive relationship

between achievement motivation and scholastic achievement of higher secondary mathematics students and science students in Tamil Nadu.

Valsala (1997) found that more than 63 percentage of variance of process outcomes in physics can be attributed to achievement motivation. Relationship between achievement motivation and component dimension of process outcome in physics namely, 'Formulating Hypothesis' is significantly different for boys and girls.

Baldwin (2001) reported that mastering goal score is a significant positive predictor of examination performance, self – regulation and time environment management, components of achievement motivation.

Swapna (2001) found that significant relationship beyond 0.01 level exists between achievement motivation and achievement in chemistry of higher secondary school students. And also achievement motivation significantly discriminates the extreme groups – High – achievers and Low – achievers in chemistry.

A qualitative study by Ahamed (2002) examined the dynamic relationship between students' academic motivation and psycho-social development and their perceptions of their relationship with teachers. It is reported that the development of positive relationship with teachers seem to promote academic motivation although some of the girls in the study suggested vulnerability in their positive relationship with teachers.

Lau (2003) used analytic approach to investigate holistic patterns of cognitive, motivation and affective correlates of science achievement using a sample of 491 X and XI grade high school students. Results of hierarchical regression analysis showed that motivational processes enhance the predictive validity for science test scores and that motivational processes are the strongest predictors of students' commitment to science in the form of choices of science related college courses and careers.

Nelson (2003) investigated the relationship among academic related characteristics of peers, social support provided by peers, achievement motivation and achievement in adolescence. Self-report surveys were administered to 255 adolescents in their class. One of the results was that the achievement related behaviours of peers and the social support provided by peers were related to adolescents' achievement motivation during science class.

The purpose of a comparative / correlational study by Ray (2003) was to examine the role of aptitude and achievement in college students' perceptions of self-regulated learning, motivational beliefs and grade expectations. The results indicated that higher achieving students have higher scores on both self-regulated learning and motivational variables and more accurately predicted their final course grades.

No Relation / Negative Relation

Though many studies in the developed and developing countries reported positive association between academic achievement and achievement motivation, a few studies have been located where achievement motivation has no significant association with achievement. These studies are reported below.

Veeraraghavan (1989) investigated school achievement as related to type of schools, students' achievement motivation and teacher effectiveness. Two important findings are that students' achievement motivation has no relationship with school achievement and that government schools show lowest achievement.

Salimkumar (1994) reported that the main effect of achievement motivation on achievement in biology was found to be significant only for the knowledge category and not for higher objectives or achievement in biology (total score).

A study by Suja (1996) reported that the relationship between science achievement and achievement motivation is not significant for the total sample and boys.

The effects of motivational conditions on the mathematics performance of students on the National Assessment of Educational Progress in Atlanta were investigated by Barker (2003). The results indicated that goal orientation (motivational condition), gender and metacognition did not significantly affect student performance.

Meera (1999) reported that achievement motivation is not related to achievement in English of secondary school students either in the total sample or in the sub samples.

Differences between Comparable Groups in Achievement Motivation

Spence and Helmreich (1980) reported academic achievement motivation of scientists from the studies of Clark (1967); Cole and Cole (1973) and Garfield (1977). The analysis was based on scientific citation index. The results showed that (i) highest citations are being found in the scientists who were high in work mastery and low in competitiveness; (ii) contrary to the implications of the early data from the TAT measure of achievement motivation, analysis of data from WOFO Scale (Work and Family Orientation Questionnaire) suggest that the structure of achievement motivation is similar for both sexes. However, women tending to score higher on work and men higher on mastery and competitiveness.

Canon and Simpson (1985) studied the relationship among Attitude, Motivation and Achievement of Ability grouped, seventh grade life science students. Major findings are: (i) Achievement motivation declines from the beginning to the end of the school year; (ii) Females were more motivated than males in corresponding ability groups; (iii) All groups regardless of ability group (basic, general and advanced) and gender, began the school year more motivated to achieve in life science than at the end;

(iv) Advanced ability grouped females are the most highly motivated of all students during the entire year.

Simpson and Oliver (1985) investigated achievement motivation profiles of male and female science students on a sample of 4000 students grades six through ten. Important findings are: (i) Motivation to achieve in science dropped significantly across each grade with the exception of the only slight drop from grade eight to nine; (ii) Significant difference in the mean scores on achievement and motivation of female and male were found. The mean scores when compared within each grade indicated that female students were significantly higher motivated to achieve in science than males.

Gawande (1988) attempted to analyse the relationship between achievement motivation and scholastic achievement. Major findings are: (i) boys were more achievement motivated than girls and (ii) the correlation coefficient between achievement motivation and scholastic achievement of urban students was at a higher level than of rural students.

A study conducted by Harikrishnan (1992) examined the relationship between academic achievement and achievement motivation. It was found that girls obtained a higher mean achievement than boys and achievement was not related to achievement motivation.

Study of Rani (1992) on a sample of 500 boys and girls yielded the following results: (i) sex difference exists in achievement motivation, girls scoring higher than boys and that (ii) both boys and girls showed significant positive relationship between academic achievement and achievement motivation.

The relationship between the inputs and outputs of the secondary schools in Dominica was investigated by Polydore (2001) and found that significant difference exists between males and females in means of their achievement motivation.

A Summary of the Studies on Achievement Motivation

I. Association between Student Outcomes and Achievement Motivation

SI.No.	Author	Variables	Result
Positive Relationship			
1.	Zargar (1980)	Academic Motivation and Academic Achievement	Positive relationship
2.	Ghosh (1983)	Achievement Motivation and Academic Achievement	do
3.	Sween (1984)	do	do
4.	Gandhi (1985)	do	do
5.	Ramasami (1988)	do	do
6.	Devanesan (1990)	Achievement Motivation and Scholastic Achievement	do
7.	Valsala (1997)	Achievement Motivation and Process Outcomes in Physics	do
8.	Baldwin (2001)	Achievement Motivation and examination performance	Certain dimensions of achievement motivation are significant predictors of examination performance
9.	Swapna (2001)	Achievement Motivation and Chemistry Achievement	Positive relationship
10.	Ahamed (2002)	Academic Motivation & Psychosocial development	do
11.	Lau (2003)	Motivational process and Science Achievement	do
12.	Nelson (2003)	Achievement Motivation and Academic Achievement	do
13.	Ray (2003)	Attitude, Motivation and Achievement	do
No relationship			
14.	Veeraraghavan (1989)	Academic Motivation, Achievement and Teacher Effectiveness	No relationship
15.	Salimkumar (1994)	Achievement Motivation and Achievement in Biology	No relationship for higher objectives and total score
16.	Suja (1996)	Achievement Motivation and Science Achievement	No relationship for total sample and boys

Sl.No.	Author	Variables	Result
17.	Barker (2003)	Goal Orientation, Mathematics Performance and Metacognition	No significant effect
18.	Meera (1999)	Achievement Motivation and Achievement in English	No relationship

II. Differences in Comparable Groups in Achievement Motivation

Sl.No.	Author	Variables	Result
19.	Spence & Helmreich (1980)	Achievement Motivation, gender, intellectual ability	Gender difference in components of Achievement Motivation
20.	Simpson & Oliver (1985)	Achievement Motivation, gender	Gender difference exists in favour of girls
21.	Harikrishnan (1992)	Achievement Motivation and Academic Achievement	Gender difference in favour of girls
22.	Rani (1992)	Achievement Motivation and gender	Gender difference exists in favour of girls
23.	Polydore (2001)	Achievement Motivation and Academic Achievement – gender	No significant gender difference exists.

2.3.1 Self – Esteem

Introduction

Self-Esteem is a term with which almost everyone is familiar, but need not necessarily be easily understood. It was James (1981) who gave the first definition of self-esteem which states that self-esteem equals success divided by pretensions. That is, feelings of self-worth come from the successes an individual achieves tempered by what the person had expected to achieve. According to Mead (1934), the 'self' is something which is not initially there at birth but arises in the process of social development. As children grew up, they become increasingly aware of themselves and of the ways in which other people think of them.

Three terms referring to the 'self' can be distinguished: self-concept, self-image and self-esteem. The self-concept is broader in meaning than self-esteem, but the term overlaps considerably with each other. Self-concept is a global idea of all the things that define who and what a person is. James drew a distinction between two aspects of the self-concept: the 'I' or the self as the subject of experience, and the 'Me' or self as the object of experience. Young children as they grew begin to develop a sense of being separate from other people. Self-concept refers to the sum total of the attributes, abilities, attitudes and values that an individual believes define who he or she is. It includes what people come to know about themselves through experience, reflection and feedback from others. Self-concept therefore is an organised cognitive structure which combines self-esteem and self-image. Self-image is the part of self-concept concerned with the knowledge an individual has about himself or herself. Self-esteem, on the other hand, is the evaluative aspect of the self-concept. It concerns how worthwhile and confident an individual feels about himself or herself including the degree to which he or she possesses self-respect and self-acceptance.

According to Maslow (1965), all people have a need or desire for a stable, firmly based sense of self-regard or self-respect, and they need the esteem from themselves and from others. Maslow classified two categories of esteem needs. The first set of esteem needs includes the desire for strength, for achievement, for adequacy, for mastery, for competence, for self-confidence and for a degree of independence and freedom. A second category of esteem needs involves the desire for prestige, status, recognition, attention, dignity and appreciation.

Theories of Self-Esteem

The antecedents of self-esteem have been identified and the development of self-esteem was theorised by many psychologists. Early psychologists such as Freud, Jung, Adler, James and others realised that an important part of what makes individual think and act the way they do is

determined by the early experiences that create their sense of self and self-esteem. Self-concept and self-esteem play a big role in their interpretation of how and why people perceive and interpret the same event very differently.

Theory of self-concept was elaborated by Rogers (1960), focussing attention upon the perceptual aspects of self-concept and the evaluative elements of self-esteem. Roger (1971) proposed a distinction between the self – as – actually perceived (self-concept) and self – as – ideally desired (ideal self). The discrepancy between the real self, i.e., self-concept and ideal self represents an index of personal psychological adjustment.

Horney reported by Bandura (1980) contended that children who did not receive adequate parental love, acceptance and approval tend to develop a pattern of insatiable needs. She postulated that persons who developed low levels of self-esteem would have inordinate need for approval and affection.

Harter (1982, 87) put forward a cognitive theoretical approach to the development of self-esteem. He considered that self-esteem is increasingly influenced by the opinion of others and children's assessment of their self-competence. Children in the age group 4 – 7 years, self-esteem is assessed in terms of cognitive and physical competence in addition to peer and material acceptance. Self-esteem of children of 8-12 years is assessed in terms of cognitive competence, social competence, physical competence and general self-worth.

Attribution theory recognises the impact of success and failure which have on self-esteem. When a person succeeds or fails, there are three levels of attributions that can be made for explaining the occurrence. Individual must first decide if the event occurred because of something internal or something in the external environment. Second, it must be decided whether the event occurred because of a stable factor (since it happened this time, it will happen again) or a temporary circumstance. Thirdly, it must be

decided whether the event occurred because of something specific or something global. Self-esteem is created through the blending of expectation for success, actual levels of success and the kinds of attributions made for why success or failure occurred.

Coopersmith (1981) found that a person's self-esteem is affected more by relationships with parents (or parent substitutes) and with how these significant persons treated the child during his or her developing years. Religion, ethnic group, social class and traumatic experiences in childhood were relatively weakly related to one's self-esteem. Coopersmith further suggested that high self-esteem requires two things: setting high goals and do something so that there is some success in reaching these goals. Children who like themselves had parents who set high standards, showed respect for the child and showed love; not necessarily overtly.

Deci and Ryan (as referred by Eysenk, 2000) speak of contingent self-esteem as distinguished from true self-esteem. Contingent self-esteem is a conditional self-esteem which is associated with an external orientation such as seeking money, fame and attractiveness. On the other hand, true self-esteem involves a more secure, solid sense of self and self-acceptance. Example: true self-esteem and pride comes when you study for joy, not for just grades; when you do your job to help others, not just getting paid. Also, self-esteem grows in proportion to one's goodness.

Definitions

Self-esteem is an extremely popular construct within psychology, and has been related to virtually every other psychological concept or domain, including personality (e.g. shyness), behavioural (e.g. task performance), cognitive (e.g. attributional bias), and clinical concepts (e.g. anxiety and depression).

Rosenberg (1965) described Self-Esteem as a favourable or unfavourable attitude toward the self.

Webster's New College Dictionary (1995) defines Self-Esteem as "an attitude of acceptance, approval and respect towards oneself, manifested by personal recognition of ones abilities and achievements and an acknowledgement and acceptance of ones limitations".

Self-esteem is a multidimensional concept, as it exists in degrees. Thus, an individual might have high self-esteem in interpersonal relationship, yet lack esteem with regard to mastery of academics. Some of the basic elements of self-esteem are the following:

Trust – which is based on how we are received into the world.

Self – nurture which is learned as to how to be caretakers of oneself.

Autonomy – which comes from mastery, we work through necessary dependencies

Identity – which grows with age. We begin to know who we are and who we are becoming.

Intimacy – develops from identify and need for connection.

Building self-esteem is considered by many psychologists and educators to be so vital to good mental health, physical health and education. Self-esteem is primarily a learned response and therefore with appropriate education, it can be positively modified. Some of the models of teaching put forward by Joyce and Weil (1997) directly address the students' need for self-esteem and self-understanding and for the support and respect of other students. Conceptual systems theory developed by Hunt and associates (1970) describes human behaviour in terms of increasingly complex system for processing information about people, things and events. For optimal growth in the complexity of four levels of conceptual structure or the information processing system (low – ; moderate – ; moderately high – ; and high), the student needs to be exposed to an environment matched to the characteristics of his or her world. The non-directive teaching model of Rogers (1971) focuses on the development of the self and personal awareness of the students.

Among the most popular and well-utilised measures of self-esteem are the Rosenberg Self-Esteem Scale (1965) and Coopersmith Self-Esteem Inventory (1967 /1981) and Culture Free Self-Esteem Inventory (Battle, 2000).

2.3.2 Related Studies

Association between self-Esteem / Self-Concept on Academic Achievement

Studies showing significant association are described in the following text:

Positive Relation

Regarding the association of self-concept / self-esteem and academic achievement, ERIC (2000) summarised the studies of the following researches. Scheirer and Krant (1979), Wylie (1979) and Thomas and Patterson (1985), Covington (1989) had reported that there is considerable evidence that academic achievements are influenced by self-concept. Holly (1987) compiled a summary of several studies and indicated that most of the studies supported the idea that self-esteem is more likely the result rather than the cause of academic achievement. However, it was acknowledged that a certain level of self-esteem is required for a student to achieve academic success and that self-esteem and achievement go hand in hand. Walz and Bleuer (1992) suggested that the factors which are important to school success such as positive feelings about self, inhibiting absenteeism and school retention are affected by successful school self-esteem programmes. Kohn (1994) said that the current self-esteem building programmes are not working effectively.

Mohan (1988) investigated scholastic achievement as related to self-esteem and other select psychological variables on a sample of 300 students of graduate and postgraduate colleges of Jhansi. One of the major findings was that a relationship exists between scholastic achievement and self-esteem. While investigating factors that are responsible for the scholastic performance of class X students, Ramasamy (1988) found that academic

achievement was positively related to self-concept and that significant difference exists between high and low – achievers in self-concept. Jain (1990) tried to find out the relationship between self-concept and academic goals of adolescents girls. It was reported that girls having high self-concept tended to select high academic goals which were positively associated with academic achievement.

The study by Padhi (1991) found that the correlation between academic self-concept and academic achievement in different school subjects are significant.

Burwani (1991) studied the relationship between real / ideal self-concept, academic achievement and mental health. Results of the study revealed that (i) academic achievement was positively associated with perceived intellectual competence and (ii) discrepancies between the real and ideal self-concept affect the academic achievement of science students.

Jacob (1998) while investigating the relationship between select variables with achievement in chemistry of vocational higher secondary school students found that self-concept has a marked and positive relationship with achievement in chemistry – in the total sample and relevant sub samples; and that self-concept is the variable which has the highest contribution to achievement in chemistry.

Reyna and Stella (2000) explored the mathematics – specific self-esteem in Hispanic students. The investigators could identify specific positive indicators of maths-specific self-esteem. It was also reported that better mathematics skills of high school students resulted in higher mathematical self-concept.

Negative Relation / No Relation

Rangappa (1992) investigated the relationship between self-concept, reading ability and achievement in mathematics on a sample of 1000 standard VII students of Bangalore district. Major findings were (i) there was no significant difference in the achievement in mathematics of students having

different levels of self-concept; (ii) there was a significant interaction of self-concept and reading ability on achievement in mathematics.

Dixit (1989) investigated the effect of self-concept on educational achievement of undergraduate students and found that self-concept was not related to educational achievement.

Minikumari (2000) reported that there is no significant relationship between self-concept and achievement in mathematics of secondary school pupils.

Gender Difference in Self-Esteem

Differences in the self-esteem of boys and girls in the educational context and developmental context was of research interest by psycho-educationists. A few studies in this line were also surveyed.

Sills (1985) observed that girls' self-esteem and their development as leaders are strongly influenced by the way boys perceive them or the way the girls think boys perceive them, and this greatly affects their performance in the classroom. Many times girls hide their intelligence and abilities because they think this is the way to be socially accepted and popular with boys. At an all-girls school, however, these temptations to be ignorant are diminished because girls are in the classroom only with female peers.

Self-esteem studies on the effect of school type on girls' esteem suggest that the sources of self-esteem for girls may differ in single-sex and coeducational schools. Multidimensional measures of self-esteem consisting of subcategories (athletic, academic and social esteem) have been used for the studies. Cairns (1990) investigated self-esteem and locus of control (an individual's sense of how environment hinders or facilitates his or her goals) for students in secondary school in Northern Ireland. A multidimensional measure of self-esteem was used and it was concluded that single-sex schools are associated with the benefits of self-esteem. But higher esteem may be confined to cognitive self-concept.

Srivastava (1990) compared deprived and non-deprived boys and girls in terms of their value patterns and self-esteem. Boys and girls were found to differ in self-esteem but sex and self-esteem while interacting among themselves did not affect their value patterns.

Rani (1992) in her study to compare scholastic achievement of advantaged and disadvantaged students found that these two groups differ significantly in self-esteem and that advantaged girls have higher scores on self-esteem.

Joseph (1993) revealed that girls at the single-sex schools were less critical of their own behaviour conduct than girls in the mixed school. The lack of criticism may be a best predictor of global self-worth of girls in the all-girls school. In the coeducational school, physical appearance was the single best predictor of degree of global self-worth.

Smith (1996) in a ten year study of students' self-concept and achievement on one all-boys and one all-girls high school in Australia found that the self-concept of both girls and boys declined initially when they made a transition to coeducation school. But after five years, self-concept increases to a level that which was measured when those students were in single-sex classes.

Chu-Yu-Wei (2000) investigated the relationship between specific self-concept and global self-esteem among adolescents in Taiwan. A multidimensional self-description questionnaire was used for the study. Sample consisted of both boys and girls in four senior high schools. Results indicate that gender and age difference exist in domain specific self-concept but no gender or grade difference were found in negative global esteem or total global esteem.

The role of family and peer involvement and their influence along with self-esteem as predictors of delinquency in adolescents was studied by Coldwell (2000). Important results were: (i) Adolescents' level of family involvement is positively associated with their level of esteem;

(ii) Adolescents' level of self-esteem is negatively correlated with severity of delinquency and (iii) No gender difference was noticed in the above association.

A Summary of Studies on Self-Esteem

I. Association between Student Outcomes and Self-Esteem

Sl.No.	Author	Variables	Result
Positive Relationship			
1.	ERIC summarises studies 1979-1994	Self-Esteem and Academic Achievement	Positive relationship
2.	Mohan (1988)	Self-Esteem and Scholastic Achievement	do
3.	Ramasamy (1988)	Self-Concept and Academic Achievement	do
4.	Jain (1990)	Self-Concept and Academic Goals	do
5.	Padhi (1991)	Academic Self-Concept and Academic Achievement	do
6.	Burwani (1991)	Real / Ideal Self-Concept and Academic Achievement	do
7.	Jacob (1998)	Self-Concept and Achievement in Chemistry	do
8.	Reyna and Stella (2000)	Mathematics-specific Self-Esteem and Mathematics Skill Achievement	do
No relationship			
9.	Rangappa (1992)	Self-Concept and Achievement in Mathematics	No difference in achievement of differing self-concept group
10.	Dixit (1989)	Self-Concept and Educational Achievement	No relationship
11.	Minikumari (2000)	Self-Concept and Achievement in mathematics	do

II. Differences in Comparable Groups in Self-Esteem

SI.No.	Author	Variables	Result
12.	Sills (1985)	Self-Esteem, Gender, School type	Gender difference exists
13.	Cairns (1990)	Self-Esteem, Locus of Control, School type	Difference for girls in Single-sex and Co-ed. Schools

SI.No.	Author	Variables	Result
14	Srivastava (1990)	Self-Esteem, gender, deprivation	Sex difference exist
15.	Rani (1992)	Self-Esteem, Scholastic Achievement	Advantaged girls have high self-esteem than disadvantaged girls
16.	Joseph (1993)	Self-Esteem, gender, School type	Gender and School type difference in global Self-Esteem
17.	Smith (1996)	Self-Concept, gender, School type	Gender and School type interact on Self-Esteem
18.	Ch – Yu – Wei (2000)	Self-Esteem, gender	No gender or grade difference exist
19.	Coldwell (2000)	Self-Esteem, delinquency, gender	No gender difference exists.

2.4.1 Concept of Attitude

Introduction

The concept of attitude is very complex. This term has encompassed a variety of psychological and behavioural dispositions. People can have an 'expectant attitude' (like an examinee waiting in the examination hall for the distribution of question paper), a 'disgruntled attitude' (as when students' request for postponement of date of examination is denied), a 'cooperative attitude' (as when students are engaged in co-operative learning), or an 'authoritarian attitude' (in relation to out-groups and interpersonal relations).

Attitude has been the subject of investigation by social-psychologists for decades because it has been invoked to explain social behaviour. In the words of Eysenk and Arends (1972) attitude refers to a learned predisposition to react consistently in a given manner (either positively or negatively) to certain persons, objects or concepts. As a general rule, positive attitudes are expected to produce favourable behaviours towards the attitude object, while negative attitudes are expected to produce unfavourable behaviours. Another prominent feature of an attitude is its evaluative character, thus it can range from very favourable to very unfavourable on an evaluative continuum. Attitude being an acquired disposition, can be distinguished as of various types because of the role that play different areas of life such as attitude towards religion, schools, school authority or towards any psychological objects. Attitudes also differ in terms of their specificity or generality.

Definitions

Allport (1935) developed attitude as a mental or neural state of readiness organised through experiences upon the individuals' response to all objects and situations with which it is related.

Edwards (1969) defines an attitude as the degree of positive or negative effect associated with some psychologists object.

Nunnally (1978) views attitude as one type of sentiments. He expresses that interests, values and attitudes are the three overlapping and widely investigated types of sentiments. Attitudes are concerned with feelings about particular social objects. Attitudes always concern a particular object or 'target' whereas interest and values concern numerous activities.

Approaches to the development of attitude theory focus on the processes through which attitudes develop and affect our lives. Attitude being a hypothetical construct is not directly observable: its existence must be inferred. Attitude theorists therefore assume that attitudes are acquired through experience and they exert a direct influence on overt responses.

Attitude researchers emphasis more on studying the antecedents of attitude rather than the consequences.

Three broad categories of theory can be identified.

- (i) ***The postural response theory***: This is the theory of neuro-muscular set, characterised by the behaviouristic approach. This theory implies an organic state of readiness accompanied by neuro-muscular adjustments which in turn develops acts of the inter-stimulation of the individuals. An attitude from this standpoint includes not only the stimulus and response but even more so, the preparation for response set up in the neuro-muscular system. Accordingly, an attitude may be defined as preparation for action in certain direction.
- (ii) ***The theory of mental act***: This is based on the 'conscious act' theory of behaviour. The conscious act differs from mechanical act as in neuro-muscular theory of behaviourism in that it makes difference to the individuals experiencing it. A conscious act is perspective or intentional. In this sense, an attitude is an indicator of a future act.
- (iii) ***The general theories***: These theories include the elements 'set' (neural and mental), 'directionality' (approach avoidance tendencies stressed by previous theories) and adding to it, the cognitive and affective elements that give attitudes a greater extent of organisation.

Despite several points of contention are there among the definitions and theories, several common elements are noticeable in the views about the attitudes by different authors. They can be summarised as follows:

- (i) Attitude is a learned disposition.
- (ii) It is a hypothetical construct: an implicit response not directly open to observation but inferred from verbal expression.
- (iii) It is anticipatory and mediating with reference to patterns of overt responses.

- (iv) It is evolved by a variety of stimulus patterns as a result of previous learning.
- (v) Attitude is a cue and 'drive producing'.
- (vi) It is significant in the society as it describes, evaluates, directs and advocates actions.

A fourth category of attitude theory takes the position that attitudes are non-existent. Other theorists argue that attitudes are unobservable. This category of theorists believe them to be social fictions. They should not be given a scientific status of a hypothetical construct.

Structure of Attitude

Attitude may consist of three components:

- (a) Cognitive components described by a person's categorisation, and the relationship between these categories.
- (b) Affective component described by the way a person evaluates the objects which are included in a particular category.
- (c) Behavioural component which reflects the behaviour intentions of the person towards the objects included in a particular category.

Crawley and Kohalla (1994) while reviewing the status of models and methods of attitude research in science education observed the dissatisfaction with the two psychological perspectives namely, behaviourism and phenomenology regarding the theoretical construct of attitude research in science. Increased understanding resulted from renewed recognition that attitude is an unobservable, hypothetical construct that must be inferred from measurable responses to the attitude object. Verbal responses (usually classified as 'attitude') and overt actions (termed 'behaviour') are both observable expressions of an underlying disposition. Recent research to understand the causal link between attitude and behaviour attempted to explain the effects of persuasion, and plan intervention studies designed to promote the development of desirable attitudes and behaviour. Two social

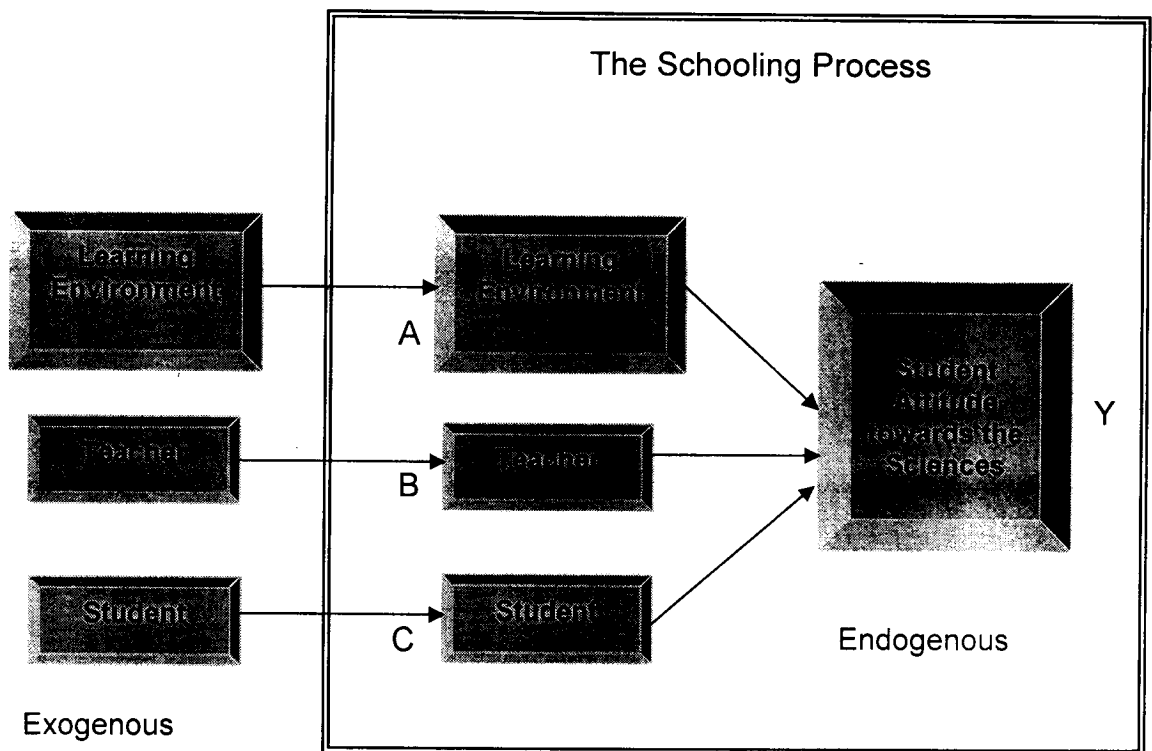
psychological models in this line of research proposed by Fishbein and Ajzen (1975) are the following.

(a) Theory of reasoned action: This theory presents a conceptual framework for linking behaviour to specific antecedent variables such as personal beliefs, attitudes, social support and intentions. Persons form anticipations about the likelihood of specific, personal consequences associated with engaging in a behaviour (behavioural beliefs, b_i), weight each belief by an evaluative reaction toward the specific consequence (outcome evaluations, e_i), and combine each value-action association to form a generalised, personal judgement. This personal judgement is the belief-based antecedent of an individual's attitude toward engaging in a specific behaviour (AB). The theory is summarised in the equation

$A_o = \sum_i b_i e_i$ where A_o is the attitude towards some object, O; b_i is the belief about O, that is, the subjective probability that O is related to attribute 'i'; and 'e_i' is the evaluation of the attribute 'i'.

(b) Theory of planned behaviour. This theory proposed by Ajzen (1985) is an extension of the theory of reasoned action to account for the performance of behaviours that are not completely under the subject's control. It adds a third construct to the model namely 'perceived behavioural control', which has a direct impact on the formation of behaviour intention.

Framework for studying attitude towards the subjects of science is given by the model suggested by Haladyna and Shaughnessy as follows:



$$Y = F(A, B, C)$$

Y = Attitude towards subject matter of science

A = Learning environment variables

B = Teacher variables

C = Student variables

Measurement of Attitudes

Popular instruments for measuring attitudes are: (i) Thurstone's Equal Appearing Interval Scale; (ii) Likert's Summated Rating Scale; and (iii) Osgood's Semantic Differential Scale.

2.4.2 Attitude Related Studies

In academic field, attitudes are of both theoretical and practical importance. It is believed that healthy attitudes help an individual to surpass the limits circumscribed by cognitive abilities. Unhealthy attitudes may be hurdle or a debilitating factor for academic achievement. It prohibits an individual to make the best use of his potentialities and drags him to poor performance in academic realm.

'Attitude towards Science' and 'Attitude towards Academic Work' are the two attitudinal variables selected for the present study. Attitude towards academic subjects and achievement of students have been studied by many investigators. Attitude towards science refers to different aspects of science such as utility of science, intellectual value of science, internalisation, universalism, rationality of science, individualism of science and a belief in progress and meliorism.

2.4.2.1 Studies Related To Attitude towards Science

Association between Attitude towards Science and Science Achievement

Relationship between attitude towards science and science outcomes were surveyed. It was noticed that in many studies, the differential effect of gender, grade and general ability along with attitude towards science on achievement, either singly or in combination were reported. Hence, no separate categorisation was attempted.

The studies surveyed are reported below.

Pillai (1981) reported that there exists only a low correlation between achievement in biology and attitude towards science of high school pupils. But no significant sex difference in mean attitude score exists either in total sample or groups equated for intelligence.

Haladyna and Shaughnessy (1982) made a meta-analysis of 49 studies on attitude towards science. The essence of the research findings revealed that (i) The relation of attitude to achievement has been consistently

of a low order of relationship. (ii) There are small differences in attitude for boys and girls. While boys were found to like science more than girls like science, the difference is consistently small from study to study and from grade to grade.

The study by Cannon and Simpson (1985) regarding the relationship of attitude and achievement in life science of students of three different ability groups (basic, general and advanced) reported the following findings: (i) Attitude towards science at the beginning of the year was more positive than at the end of the year across both gender and ability group. (ii) Males had more positive attitudes than females, regardless of ability group in the beginning, but the difference is not statistically significant at the end of the school year.

In another extensive study on attitude towards science by Simpson and Oliver (1985), the following significant findings were reported: (i) Attitude towards science of adolescent students in the population (N = 3582) steadily declined from grade six to grade eight. The collective attitude towards science of these students was near neutral. (ii) Attitude towards science of all students declined sharply from the beginning to the middle of the year within each grade. (iii) Males exhibited significantly more positive attitude towards science than females. This was true for within each grade.

Sundararajan and Rajasekar (1988) reported that the attitude of higher secondary students towards the study of physics and their achievement in physics are positively related.

Darchingpui (1989) in a study examined the interrelationship of science achievement, attitude towards science and problem solving ability. The study indicated that significant relationship exists between science attitude scores and achievement in science scores.

A study by Kar (1990) to assess the relationship between attitude and achievement in general science found that there was positive

relationship between attitude towards science and achievement and that boys were found to be more favourably disposed towards science than girls.

Rao (1990) attempted to compare scientific attitude and achievement in biology at secondary level. It was found that sex has no influence on scientific attitude and there is a significant and positive association between scientific attitude and biology achievement.

Debaz (1994) revealed his study on metanalysis of the relationship of student characteristics, achievement and attitude towards science that positive relationship were found between attitude towards science and achievement.

Valsala (1997) reported that process outcome in physics of university entrants is significantly related to attitude towards science and the relationship is positive for boys, girls and total sample.

A study by Jacob (1998) revealed that relationship between achievement in chemistry and scientific attitude of vocational higher secondary students are highly significant and positive for the total sample and sub samples.

Shyja (2001) reported that there exists a positive and significant relationship between scientific attitude and achievement in chemistry of higher secondary students.

Differences between Comparable Groups in Attitude towards Science

Sharma (1990) reported that science students in the sample have favourable attitude towards science and there is significant effect of type of school and sex on attitude towards science.

Simon and Oliver (1990) made a summary of major influences of attitude toward science and achievement in science. Major findings were as follows: (i) The combined relationship of attitude towards science, science anxiety and science self-concept on achievement were significant. (ii) When gender differences were studied, males possessed significantly more positive

attitudes towards science and achieved higher in science. But females were significantly more motivated to achieve in science.

Malaviya (1991) reported that the mean scores of scientific attitude test of boys and girls did not differ significantly in the high group and low group but the scores of boys and girls differ significantly in the average group.

Sam (1992) in a study found that the scientific attitude scores of the boys and girls of the average group differ significantly but do not differ in the high group and low group.

A meta-analysis covering the literature of gender differences in student attitude towards science (between 1970 and 1991) was conducted by Weinburgh (1995). Major conclusions are the following: (i) Boys have consistently shown a more positive attitude towards science than girls. (ii) The correlation between attitude towards science and achievement in science are comparable for boys and girls. For both boys and girls, there is a strong positive relationship between attitude towards science and achievement in science, the relationship is stronger for girls.

Chaerule (2002) investigated the differences on students' attitude towards physics during physics classes. The study found that male students do show more positive attitude towards physics than their female counterparts. Also, it was found that female students do not like physics because it is hard, monotonous and boring.

A Summary of Studies on Attitude towards Science

I. Association between Student Outcomes and Attitude towards Science

SI.No.	Author	Variables	Result
Positive Relationship			
1.	Pillai (1981)	Attitude towards Science & Achievement in Biology	Positive but low relation
2.	Haldyna and Shaughnessy (1982) Meta analysis of 49 studies	Attitude towards Science, Achievement, gender, grade	Positive but low relation
3.	Canon & Simpson (1985)	Attitude towards Science and Achievement in Science	Positive but low relation. Interaction of gender and grade significant
4.	Simpson & Oliver (1985)	Attitude towards Science, gender	Attitude towards Science decline within each grade
5.	Sundararajan & Rajasekar (1988)	Attitude towards Physics and Achievement in Physics	Positive relationship
6.	Darchingpui (1989)	Attitude towards Science, Science Achievement and Problem solving ability	Positive relationship
7.	Kar (1990)	Attitude towards Science & Achievement	do
8.	Rao (1990)	Scientific Attitude and Achievement in Biology	do
9.	Debaz (1994)	Attitude towards Science, Achievement, student characteristics	do
10.	Valsala (1997)	Attitude towards Science, Process Outcomes in Physics	do
11.	Jacob (1998)	Scientific attitude, Achievement in Chemistry	do
12.	Shyja (2001)	Scientific Attitude, Achievement in Chemistry	do

II. Differences in Comparable Groups in Attitude towards Science

Sl.No.	Author	Variables	Result
13.	Sharma (1990)	Attitude towards Science, Sex and School type	Sex and School type have significant effects on Attitude towards Science
14.	Simpson & Oliver (1990)	Attitude towards Science, Achievement in Science, gender	No gender difference
15.	Malaviya (1991)	Scientific Attitude, gender	Gender difference exists in average group. No difference in high and low group.
16.	Sam (1992)	Scientific attitude	do
17.	Weinburgh (1995) Summarises studies from 1970 to 1991	Attitude towards Science, gender	Gender difference in Attitude towards Science and no gender difference in relationship between Attitude towards Science and achievement
18.	Chaerule (2002)	Attitude towards Physics	Gender difference exists.

2.4.2.2 Studies Related to Attitude towards Academic Work/ Education

Association between attitude towards academic work and achievement in school subject were surveyed. Studies showing positive relationship between academic achievement and attitude towards academic work are given below:

Abraham (1973) reported that the (i) Mean scores of attitude towards academic work of normal achievers are significantly greater than the mean scores of under – achievers of the unselected sample and equated groups. (ii) Mean scores of over – achievers are significantly greater than normal – achievers for the unselected sample and equated groups.

Nair (1984) conducted a study using a sample of 1200 Standard IX secondary school students of Ernakulam revenue district and reported that attitude towards academic work differ significantly between over – ; normal – ; and under – achievers.

In a study conducted by Baby (1987) the association of variables attitude towards education and achievement in Malayalam was found to be significant for all the three intelligence groups and to all the subgroups based on sex and locale.

Sreemanunni (1987) studied the relationship of attitude towards education and achievement in Malayalam of socially advantaged and disadvantaged secondary school pupils and found significant relation between attitude towards education and achievement in Malayalam of socially advantaged and disadvantaged secondary school pupils.

Attitude towards academic work and scientific attitude were included to study the influence of certain personality variables on process outcomes in physics of university entrants by Poulose (1988). The sample was 450 pre-degree students of Kerala University. The results reported is that both attitude towards academic work and scientific attitude exerted significant influence on process outcomes in physics.

Raj (1991) carried out a study on some attitude variables discriminating between over – ; normal – ; and under – achievers in maths at secondary school level and found that the mean difference of the variable attitude towards education is significant between over, normal and under achievers in mathematics.

The study of Lethadeviamma (1995) reported the following results: (i) The coefficient of correlation between attitude towards academic work and achievement in Malayalam of Standard IX students are positive and significant but very low which is true for the total sample and sub samples. (ii) But high and low – achievers in Malayalam significantly differ in their attitude scores.

Anitha (1996) reported that relationship between achievement in science and attitude towards academic work is significant at 0.01 level for the total sample as well as for four sub samples.

Jayasree (2002) in a study using attitude towards academic work as one of the independent variables and achievement in Malayalam as dependent variable found that (i) There is significant relation between attitude towards academic work and achievement in Malayalam for the total sample and sub samples. (ii) High – achievers and low – achievers in Malayalam significantly differ in their mean attitude scores.

Mumthas's (2001) study using attitude towards academic work as one of the predictor variables revealed the following: (i) Attitude towards academic work have significant effect on achievement in mathematics. Groups of high, average and low achievers in maths differ significantly in the mean scores of attitude towards academic work. (ii) Attitude towards academic work has significant correlation with achievement in mathematics.

Yesudasi (2002) compared two extreme groups of process achievers in science in a sample of 1030 students of Standard IX. It was found that attitude towards academic work, achievement motivation and scientific attitude discriminates between the contrasted groups namely high and low achievers in process outcomes in science.

No Relation / Negative Relation

Some studies indicating no significant association between attitude towards academic work and achievement in school subjects are as follows:

The study by Lisamma (1967) reported the following: (i) relation between attitude of pre-degree students towards academic work and their achievement are not significant. (ii) There is no significant sex difference in the mean scores of attitude towards academic work. (iii) High – achievers and low –achievers do not differ significantly in mean attitude towards academic work score. Similar results were reported by Lalithamma (1967). Two major

findings are: (i) There is only low correlation between attitude towards academic work scores and achievement scores of students of high school stage. (ii) There is no significant difference between boys and girls in means scores of attitude towards academic work of boys and girls.

Study carried out by Gopinathan (1981) found that attitude towards academic work has no influence on achievement in Malayalam.

Rahiman (1981) while conducting a study of certain personality variables which discriminates between high and low achievers in secondary school social studies reported that attitude towards academic work has no significant role in social studies achievement.

A comparative study of the relation of some psychological variables with academic achievement of institutionalised, juvenile delinquents and normal children conducted by Nambiar (1990) found that there is no significant relation between attitude towards education and academic achievement in the case of both juvenile delinquents and normal children.

Leving (1993) studied about the parental behaviour supporting school work and students' attitude towards school work. It was found that for both Chinese and Americans, school attainment value and school achievement predicted attitude towards school work but not perception of parental behaviours supporting school work.

A Summary of Studies on Attitude towards Academic Work

I. Association between Student Outcomes and Attitude towards Academic Work

Sl.No.	Author	Variables	Result
Positive Relationship			
1.	Abraham (1973)	Attitude towards Academic Work and Achievement in English	Positive relationship
2.	Nair (1984)	Attitude towards Academic Work and Academic Achievement	do
3.	Baby (1987)	Attitude towards Academic Work	do
4.	Sreemanunni (1987)	Attitude towards Education and Achievement in Malayalam	do
5.	Poulose (1988)	Attitude towards Work and Process Outcomes in Physics	do
6.	Raj (1991)	Attitude towards Education and Mathematics Achievement	do
7.	Lethadeviamma (1995)	Attitude towards Academic Work and Achievement in Malayalam	Very low relationship
8.	Anitha (1996)	Attitude towards Science, Attitude towards Academic Work and Achievement in Science	Positive
9.	Jayasree (2002)	Attitude towards Academic Work and Achievement in Malayalam	do
10.	Mumtas (2001)	Attitude towards Academic Work and Achievement in Mathematics	do
11.	Yesudasi (2002)	Attitude towards Academic Work and Process Outcomes in Science	Discriminates high and low achievers in Process Outcomes
No Relationship			
12.	Lisamma (1967)	Attitude towards Academic Work and Academic Achievement	No significant relation relationship

SI.No.	Author	Variables	Result
13.	Lalithamma (1967)	Attitude towards Academic Work and Academic Achievement	No significant relationship / No sex difference
14.	Gopinathan (1981)	Attitude towards Academic Work and Achievement in Malayalam	No relationship
15.	Rahiman (1981)	Attitude towards Academic Work and Achievement in Social Studies	No relationship
16.	Nambiar (1990)	Attitude towards Education, Academic Achievement, delinquency	do
17.	Leving (1993)	Attitude towards School Work, Parental behaviour and School Attainment	do

CONCLUSION

An extensive review of the available studies enabled the investigator to arrive at the following conclusions:

- (i) Most of the studies on classroom environment indicate that classroom environment is associated positively with academic achievement. However, a few recent studies reveal that classroom environment or certain dimensions, therefore do not relate consistent with achievement.
- (ii) Studies regarding the influence of achievement motivation on achievement of students mostly suggest a positive relationship though some studies of no relationship were also noticed.
- (iii) Inconclusive results were obtained regarding the influence of self-esteem / self-concept on academic achievement; some studies show positive relationship and a few others indicate no relationship.
- (iv) Almost all the studies indicate a positive relationship (but low) of attitude towards science / scientific attitude on academic achievement.
- (v) Attitude towards academic work / towards school is seen positively associated with achievement in various school subjects in most of the

studies surveyed; a few exceptions of no relationship were also located.

- (vi) Regarding differences between comparable groups in the select variables of the study, it is noticed that the results are inconclusive especially in the studies of gender differences. Consistent gender differences and gender bias were reported mostly in the studies of classroom learning environment.
- (vii) The survey of studies show that gender equality in education and assessment of single-sex schooling and coeducational schooling were not investigated adequately in underdeveloped and developing countries. Not many studies were located in India.

The present study is therefore taken to fill the gap.

VARIABLES, HYPOTHESES AND METHODOLOGY

Suchitra K. “Classroom learning environment and select affective variables in relation to achievement in physical science of students of single - sex and coeducational secondary schools ” Thesis. Department of Education, University of Calicut, 2004

VARIABLES, HYPOTHESES AND METHODOLOGY

- **Selection of Variables**
- **Objectives and Hypotheses**
- **Methodology**

CHAPTER III

VARIABLES, HYPOTHESES AND METHODOLOGY

This chapter deals with the design of the study which has been described under the following heads:

- 3.1 SELECTION OF VARIABLES
- 3.2 OBJECTIVES AND HYPOTHESES
- 3.3 METHODOLOGY

3.1 SELECTION OF VARIABLES

The main aim of the investigation was to explore whether Classroom Learning Environment and select affective traits have differential influence on the performance of boys and girls in single-sex and coeducational schools.

A thorough review of studies has been made for collecting the various factors that cause differences among boys and girls in academic achievement and to ascertain whether gender inequalities exist in the social as well as educational context. From among the different variables, the major variables were identified and classified. They are presented below:

(i) Cognitive Variables

This category includes variables belonging to the cognitive domain such as intelligence, metacognition, aptitude, cognitive style and the like.

(ii) Affective Variables

This category includes affective variables like attitudes, adjustment, achievement motivation, self-concept, interest, anxiety, etc.

(iii) Social – Familial and Other Environmental Variables

This part refers to parental education, profession and income, parental aspiration, locale, facilities available at home, classroom environment and the like.

(iv) Instructional Methods

This group includes the variables like teaching and instructional methods and techniques, evaluation procedure, instructional effectiveness, use of audiovisual materials, size of the class, use of reading materials and co-curricular activities.

(v) Study Habit and Approaches to Studying

This category includes the variables like study habits, learning styles, learning preferences, methods of work, use of reference material, note-taking behaviour and regularity in studies.

3.1.1 Criteria Used for the Selection of Variables

After identifying the important factors, the investigator made a careful selection of the variables for the present study considering the following aspects:

- i) Variables should be strongly related to Achievement in Science in general and Achievement in Physical Science in particular.
- ii) Studies which reveal existence of group differences manifested by sex, language, ethnicity, educational environment and socio-economic group membership.
- iii) Standardised tests for the variables should be available or tests could be developed within a reasonable time.
- iv) Data for the variables could be collected through group measurement.
- v) Variables for which exploratory studies are not adequate enough to draw conclusion especially in the Indian context.

Considering the above factors, the following variables were selected for the study:

(i) Independent Variables

For the present investigation, *Classroom Learning Environment*, *Self-Esteem*, *Achievement Motivation*, *Attitude towards Science*, and *Attitude towards Academic Work* are treated as independent variables.

(ii) Criterion Variables

Achievement in Physics, Achievement in Chemistry, and Achievement in Physical Science (Total) are treated as criterion variables.

(iii) Basal Variables

Sex of the students and *Type of schools* based on sex enrolment namely Coeducation schools and Single-sex schools (all-girls, all-boys schools) are treated as basal variables.

3.2 OBJECTIVES AND HYPOTHESES

A detailed review of related studies and personal experience of the investigator as a teacher of Chemistry enabled to select and formulate the objectives and hypotheses of the present study.

3.2.1 Objectives

- (i) To study the main effect of each of the five select independent variables on *Achievement in Physics* of boys and girls of *Single – Sex* and *Coeducational* secondary schools.
- (ii) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Physics*.
- (iii) To study the main effect of each of the five select independent variables on *Achievement in Chemistry* of boys and girls of *Single – sex* and *Coeducational* secondary schools.
- (iv) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Chemistry*.
- (v) To study the main effect of each of the five select independent variables on *Achievement in Physical Science (total)* of boys and girls of *Single – sex* and *Coeducational* secondary schools.
- (vi) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Physical Science (total)*.

- (vii) To predict High –; Average –; and Low–Achievers in Physics using the variables Sex of the subjects, Type of institutions based on sex enrolment and five select independent variables.
- (viii) To predict High –; Average –; and Low–Achievers in Chemistry using the variables Sex of subjects, Type of institutions based on sex enrolment and five select independent variables.
- (ix) To predict High –; Average –; and Low – Achievers in Physical Science using the variables Sex of subjects, Type of institutions based on sex enrolment and five select independent variables.

3.2.2 Hypotheses

The following hypotheses are proposed to be tested for the present study:

- (i) The main effect of each of the five select independent variables namely, *Classroom Learning Environment*; *Achievement Motivation*; *Self-Esteem*; *Attitude towards Science* and *Attitude towards Academic Work* and Sex and *School type* on *Achievement in Physics* of secondary school students will be significant.
- (ii) The interaction effect of each of the five independent variables Sex and *School type* on *Achievement in Physics* will be significant.
- (iii) The main effect of each of the five select independent variables namely, *Classroom Learning Environment*; *Achievement Motivation*; *Self-Esteem*; *Attitude towards Science* and *Attitude towards Academic Work* and Sex and *School type* on *Achievement in Chemistry* of secondary school students will be significant.
- (iv) The interaction effect of each of the five independent variables, Sex and *School type* on *Achievement in Chemistry* will be significant.
- (v) The main effect of five select independent variables namely, *Classroom Learning Environment*; *Achievement Motivation*; *Self-Esteem*; *Attitude towards Science*; and *Attitude towards Academic*

Work and Sex and School type on Achievement in Physical Science (total) of secondary school students will be significant.

- (vi) The interaction effect of each of the five independent variables, *Sex and School type on Achievement in Physical Science* (total) will be significant.
- (vii) High –; Average –; and Low–Achievers in Physics can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work.*
- (viii) High –; Average –; and Low – Achievers in Chemistry can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work.*
- (ix) High –; Average –; and Low – Achievers in Physical Science can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work.*

3.3 METHODOLOGY

The methodology of the present study has been described under the following heads:

3.3.1 Sample for the Study

3.3.2 Tools Used for the Study

3.3.3 Data Collection Procedure

3.3.4 Scoring and Consolidation of Data

3.3.5 Procedure of Analysis of Data

3.3.1 Sample for the Study

The important aspects of the sample selection for the study are given below:

3.3.1.1 Population of the Study

Students of secondary schools of Kerala are the target population for the present investigation.

3.3.1.2 Size of the Sample

Regarding the size of the sample Krech and Crutchfield (1968) pointed out that a sample of 500 would yield reasonably good results which would keep the error less than five per cent. But in order to get sufficient number of cases for the subgroups for the different types of analysis, the sample size was fixed as 1000.

3.3.1.3 Sampling Technique

Proportionate stratified sampling technique which has been widely recommended by Indian Social Science researchers was used for the selection of sample for the present study. This technique is applicable when the population is composed of subgroups or strata of different size, so that a representative sample must contain individuals drawn from each category or stratum in accordance with the size of the group. Stratification helps to avoid bias and ensures greater representation.

3.3.1.4 Rationale for the Various Strata Considered

The most representative of the secondary school pupils could be obtained by considering the following aspects:

- i) Sex of pupils
- ii) Rural/Urban schools
- iii) Single sex / Coeducational schools
- iv) Instructional efficiency of schools
- v) Type of Management (Aided / Government schools).

The above mentioned aspects were considered to ensure adequate representation for the different strata. The decision regarding the

proportionate representation for categories was made based on the statistics published by Director of Public Instruction, Government of Kerala. For classifying the schools, the estimated ratios (roughly taken) were as follows:

Boys : Girls	-	1 : 1
Rural : Urban	-	2 : 1
Government : Private	-	2 : 3
Single-sex : Coed. schools	-	1 : 2

The schools were classified into three categories based on instructional efficiency, viz., Above-Average, Average and Below-Average schools using the consecutive pass percentage in three S.S.L.C. examinations. Schools getting pass percentage 60 and above were considered as Above Average, schools getting pass percentage in the range of 30 to 60 as Average schools and those getting pass percentage below 30 were considered as Below Average schools.

Based on the ratios fixed as above, the tentative break-up of the sample was roughly estimated as shown below:

Boys	- 500	Girls	- 500
Rural	- 600	Urban	- 400
Government school	- 350	Private Aided school	- 650
Single Sex school	- 350	Coeducational school	- 650

Instructional efficiency

Level A – 250	level B – 500	Level C - 250
(Above average)	(Average)	(Below Average)

The literacy rate of the State of Kerala is very high and the number of school going children in different parts of the State are almost same. Considering these aspects and for the economy of time and effort, for the collection of data Thiruvananthapuram, Malappuram and Kozhikode districts were selected for the study. Assuming that the strength of pupils in standard IX will be approximately between 40 and 50, it was decided to select

two class divisions of standard IX from each school. Therefore, it was decided to select ten schools for the collection of needed data.

3.3.2 Tools Used for the Study

The selection of appropriate instruments or devices of proved validity and reliability is the first step in the collection of needed data for an investigation. Where standardised tests for the educational level in question were available, they were selected for use in the present investigation. But where such tests were not readily available, the investigator developed them herself.

For collecting the needed data to test the nine hypotheses formulated, the following tools were used:

The variables of the present study and the tools used for collecting data regarding the variables are listed below:

Independent Variables

i) Classroom Learning Environment

The Independent variable, *Classroom Learning Environment* was measured by using the Scale of Classroom Learning Environment developed by the investigator.

ii) Achievement Motivation

The Independent variable, *Achievement Motivation* was measured by using the Scale of Achievement Motivation developed by Pillai and Salim Kumar (1994).

iii) Self-Esteem

A Culture Free Self-Esteem Inventory developed by Battle (2000) was adopted by the investigator to measure *Self-Esteem* of the sample.

iv) Attitude towards Science

The Independent variable, *Attitude towards Science* was measured by using Scale of Attitude towards Science developed by Pillai (1980). The validity and reliability were re-established by Valsala (1997).

v) **Attitude towards Academic Work**

The Independent variable, *Attitude towards Academic Work* was measured by using Scale of Attitude towards Academic Work developed by the investigator.

Criterion Variable

The Criterion variables, *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science* were measured by using Test of Achievement in Physical Science developed by the investigator.

A brief description of the various tools used for obtaining the needed data is presented below:

3.3.2.1 Scale of Classroom Learning Environment

Major steps in the development of the Scale of Classroom Learning Environment are listed below:

- i) Formulation of conceptual background
- ii) Development of items
- iii) Content validity check by experts
- iv) Development of draft instrument
- v) Collection of data from students
- vi) Analysis of items and subscale
- vii) Refinement of the instrument.

Identification of Dimensions and Item Writing

The first two steps of the development of the scale were covered in this section. An overview of the related literature by Fraser (1986), Richardson-Kochler (1987), Arends (1989), Bowen (1994) and Orion (1997) helped the investigator to get a theoretical idea of the concept and measurement of Classroom Learning Environment.

Students and teachers spend majority of their time in the social setting of the classroom. In this social setting, students interact with each other, with the teachers and handle various academic materials. A classroom group may be thought of as a developing system with its own structure,

organisation and norms. Research on classroom has uncovered important relationship between leader and member behaviours and their influence on student learning. The processes and structures teacher choose to build in classroom are very important factors influencing how a class develops and the norms it establishes for social and productive academic learning.

For identifying the salient dimensions of the scale, productive learning environment has been conceptualised as characterised by

- (i) An overall climate where the students feel positive about themselves, their peers, and the classroom as a group;
- (ii) Structures and processes where students' needs are satisfied and where students persist with academic task and work in cooperative ways with the teachers and other students; and
- (iii) A setting where students have acquired the necessary group and interpersonal skills to accomplish the academic and group demands of the classroom (Arends, 1989).

From earlier studies on some popular instruments of Classroom Learning Environment and from a theoretical overview of the construct, three major factors which affect the learning environment were identified to be included in the present scale. A brief description of the three factors is given below

(i) Physical and Material Factor

This factor indicates the surroundings in which the students are working such as availability of adequate learning resources (books, equipments, etc.), furniture, space and lighting. Allocation and management of time and space along with the resources decide the quality of learning environment.

(ii) Educational factor

Classroom task structure, goal structure, reward structure, student motivation, interest and speed in the learning task, motivation, routine, communication skill, etc. form the subcomponents of this factor.

(iii) Psycho-social factor

This factor comprises of the extent of group cohesiveness, democracy, friction, favouritism, group development, self-dependence, rules, peer influence and organisation.

An initial pool of eighty items were prepared. The third step warrants content validity check by experts. Hence, the 80 items pooled were subjected to scrutiny by experts in the field of psychology and education. The scale was further pilot tested with 50 secondary school students. The responses of the students enabled the investigator to ascertain further item appropriateness, language precision and clarity of the items. After editing the items in the light of expert opinion and the scrutiny of the responses of the pilot testing, 75 items were selected and were written in the form of statements on a three-point scale. Both positive and negative statements were included in the draft scale.

Two illustrative items are presented below:

Positive item : Limitation of classroom space is compensated by adoption of suitable teaching technique.

Always – Sometimes – Never

Negative item: Students do not get opportunity to raise doubts or express their ideas in the class.

Always – Sometimes – Never

The item validity of the 75 statements selected was further ascertained by field testing. For this purpose, the scale was administered to a representative sample of 100 students of standard IX from two schools selected at random from Thiruvananthapuram district. Items were analysed by estimating coefficient of correlation of individual item scores with the total score using Product Moment Coefficient of Correlation. The item-wise correlation coefficient found out is presented in Table 3.1.

TABLE 3.1
Scale of Classroom Learning Environment –
Item-wise Correlation Coefficient

SI.No.	r	SI.No.	r	SI.No.	r
1.	0.21	26.	0.53	51.	0.13
2.	0.24	27.	0.20	52.	0.53
3.	0.30	28.	0.29	53.	0.35
4.	0.195	29.	-0.09*	54.	0.09*
5.	0.20	30.	0.08*	55.	0.31
6.	0.36	31.	0.36	56.	0.20
7.	0.43	32.	0.31	57.	0.27
8.	0.31	33.	0.33	58.	0.20
9.	0.195	34.	0.31	59.	0.33
10.	0.20	35.	0.41	60.	0.20
11.	0.27	36.	0.48	61.	-0.20*
12.	0.20	37.	0.42	62.	0.39
13.	0.27	38.	0.48	63.	-0.14*
14.	0.28	39.	0.40	64.	0.56
15.	0.44	40.	0.44	65.	0.35
16.	0.57	41.	0.28	66.	0.34
17.	0.48	42.	0.28	67.	0.41
18.	0.41	43.	0.49	68.	0.44
19.	0.45	44.	0.34	69.	0.59
20.	0.009*	45.	0.18*	70.	0.40
21.	0.20	46.	0.21	71.	0.32
22.	0.47	47.	0.34	72.	0.29
23.	-0.10*	48.	0.20	73.	0.23
24.	0.61	49.	0.47	74.	0.49
25.	0.57	50.	0.03*	75.	0.26

Note: * indicates items not included in the final scale

Sixty six items in the scale were found to be significant beyond 0.05 level. The best sixty six items including both positive and negative items were selected and the final scale was prepared with instructions to respond. Of the 66 items, 12 items belong to the Physical and Material factor, 32 items to the Educational factor and 22 items to the Psycho-Social factor. Response sheet and scoring scheme were also prepared. Sum of the obtained score for individual items indicate Classroom Learning Environment perceived by the subjects. The draft scale, final scale and its approximate English translation are presented as Appendix I A, I B and I C respectively and response sheet as I D. The final scale was then subjected to test of validity and reliability.

Validity of the Test

The present test was constructed in such a way that it covered various factors which influence Classroom Learning Environment. Each item in the test was prepared in accordance with the different subcomponents of each factor. The investigator had consulted experts in educational psychology to make judgements regarding the adequacy of items. Thus, content validity and construct validity were ensured for the test.

The test was validated using scores obtained on the Scale of Classroom Climate developed by Pillai and Santhakumari (1996). The coefficient of correlation 'r' was found to be 0.69 (N = 50).

Reliability of the Test

Reliability of the Scale of Classroom Learning Environment was estimated using two techniques, namely, internal consistency and test-retest method.

- (i) The internal consistency of the test items was calculated using Cronbach's reliability coefficient alpha using the formula

$$\alpha = \frac{K}{K-1} \left(1 - \frac{\text{Var}(i)}{\text{Var}(x)} \right)$$

Where K = No. of items in the test

Var (i) = Sum of variance of the different item score distribution

Var (x) = Variance of the distribution of test score.

Cronbach's reliability coefficient alpha estimated for the factors of Classroom Learning Environment for a representative sample of 40 secondary school students selected at random are presented in Table 3.2.

TABLE 3.2

Cronbach's Reliability Coefficient Alpha for the Factors of Classroom Learning Environment

Factor	Alpha Coefficient
Classroom Learning Environment – Physical and Material factor	0.843
Classroom Learning Environment – Educational factor	0.884
Classroom Learning Environment – Psycho-Social factor	0.851

- ii) Reliability of the test was also estimated by test-retest method. The reliability coefficient calculated was found to be 0.81, the interval between test and retest being two weeks for a sample of 40.

The values of validity coefficient and reliability coefficient reveal that the scale developed is a reasonably dependable tool for measuring Classroom Learning Environment of secondary schools as perceived by the pupils.

3.3.2.2 Scale of Achievement Motivation

Achievement Motivation of the students was measured using the Scale of Achievement Motivation developed by Pillai and Salimkumar (1993). This multifactorial scale is a self-reporting instrument in Malayalam modelled after Cassidy-Lynn Achievement Motivation Questionnaire. Fifty items were grouped under seven factors namely 'Work ethic' (8 items), 'Acquisitiveness'

(6 items), 'Dominance' (10 items), 'Pursuit of Excellence' (6 items), 'Competitiveness' (6 items), 'Status aspiration' (10 items) and 'Mastery' (4 items). A brief description of each factor is given below:

(i) **Work ethic:** It incorporates the desire to study hard and is based on the reinforcement in the performance itself. As a motivational attribute, it influences attitudes, values and behaviour.

(ii) **Pursuit of Excellence:** It is defined as competition with a standard of excellence. It is the reward obtained by making the best performance in studies.

(iii) **Status aspiration:** It incorporates the desire to be a dominant member or a leader among other students. It is reinforcement in climbing the social status hierarchy.

(iv) **Competitiveness:** It is the satisfaction obtained while competing with others.

(v) **Acquisitiveness:** This is motivation based on the reinforcing properties of position or possession attained by the individuals.

(vi) **Mastery:** It is the satisfaction obtained when succeeding in the study of different matters.

(vii) **Dominance:** It includes the desire to lead or to take initiative or to become a dominant member of the group.

Sum of the scores for individual items indicate Achievement Motivation of the subjects. The respondent has to respond in a three point scale namely, 'Yes', 'Undecided', or 'No'. For positive statements, scores, 2, 1, 0 were given and for negative items the scoring order is reversed, that is, 0, 1, 2. The scale was validated against Kerala Scale of Achievement Motivation (1975). The validity coefficient was found to be 0.68 (N = 80). Reliability of the scale was found out by estimating the internal consistency of test items by estimating Cronbach's Alpha Coefficient. The obtained Alpha coefficient for Work ethic, Pursuit of excellence, Status aspiration, Mastery,

Competitiveness, Acquisitiveness and Dominance are 0.68, 0.84, 0.59, 0.62, 0.64 and 0.67 respectively.

A copy of the Scale of Achievement Motivation is presented as Appendix II A and its response sheet as Appendix II B.

3.3.2.3 Self-Esteem Inventory

Self-Esteem of the sample was measured using Culture Free Self-Esteem Inventory CFSE-3 developed by Battle (2000). This Self-esteem Inventory is a multidimensional self reporting inventory. The concept of self-esteem is based on the premise that self-esteem is an attitude towards oneself based on one's recognition of abilities and limitations. This attitude is considered to begin as a global, largely positive or negative feeling in early to middle childhood. During adolescence, self-esteem becomes increasingly differentiated to include academic, general, parental/home, social and personal self-esteem. Though the earlier theorists like Rosenberg (1965) and Coopersmith (1967) viewed self-esteem as an overall sense of self-respect, which is global in nature, the modern theorists use multidimensional models to describe self-esteem.

The subscales of Culture Free Self-Esteem Inventory are the following:

(i) Academic Self-Esteem

This subscale measures self-esteem in academic and intellectual situations. Ten items in the subscale ask about the student's perception of his or her abilities, attitudes and values as they relate to school, academic skills and intelligence.

Example: Do you enjoy learning?

(ii) General Self-Esteem

General self-esteem measures an individual's overall perceptions about himself or herself as a person. The individual's perceptions of self-worth such as his or her emotional states, physical characteristics, successfulness and self-acceptance are elicited through eleven items.

Example: Do you feel you are as important as most people?

(iii) Parental / Home Self-Esteem

This subscale consisting of twelve items measures self-esteem within the family unit. The items ask about the individual's perception of his or her status at home including abilities, attitudes, interests and values as they relate to the quality of interactions within the home and family unit.

Example: Do you trust your family?

(iv) Social Self-Esteem

Social self-esteem measures self-esteem in social situations and interpersonal relationship with peers. Twelve items included in this subscale elicit the individual's perception of his or her abilities, attitudes, interests and values as they relate to the quality of interactions with peers outside the family unit.

Example: Are you popular with other people of your age?

(v) Personal Self-Esteem

This subscale measures the individual's most intimate perceptions of anxiety and self-worth.

Example: Are you easily depressed?

The CFSE Inventory-3 consists of 10 items under Academic subscale; 11 items belong to General subscale; 12 items under Parental / Home subscale; 14 items under Personal subscale and 12 items under Social subscale. Besides, 8 items were also included to yield the Defensiveness score. This is not a measure of self-esteem, but it is lie scale. Both positive and negative items are included in the inventory.

In order to adopt this popular Self-Esteem Inventory to Kerala conditions, the investigator decided to establish the important psychometric properties of the inventory. A brief description of the procedure of determining validity and reliability of the inventory is presented below.

The 67 items belonging to five subscales including the 8 items of the lie scale are translated to Malayalam in consultation with experts. The

items were presented at random in the inventory. The inventory was printed with proper instructions to respond. The subjects have to respond to each items either as 'Yes' or 'No'. To ascertain the item validity, the inventory was administered to a representative sample of 320 students of standard IX in Thiruvananthapuram and Kozhikkode districts. The sample consisted of both boys and girls of single – sex and coeducational schools from rural and urban area. Scoring procedure is 1 score for checking 'Yes' response for a positive item and zero score for 'No' response. The scoring scheme is reversed for negative items. The response sheets of subjects whose Defensive score reach or exceed four out of eight (which is the cut off score) were not considered for further analysis. Finally, the scores of 300 subjects were considered for item analysis. The discriminating power of items were estimated using the item – total score Pearson Correlation index. Defensive items (Item No. 5, 10, 18, 23, 29, 36, 48, 62) were not considered for item analysis. The item-wise correlation coefficient found out was presented in Table 3.3.

TABLE 3.3

Self-Esteem Inventory – Item-wise Correlation Coefficient

Item.No.	r	Item.No.	r	Item.No.	r
1.	0.28	25.	0.35	49.	0.34
2.	0.35	26.	0.34	50.	0.32
3.	0.21	27.	0.38	51.	0.53
4.	0.31	28.	0.46	52.	0.37
6.	0.19	30.	0.36	53.	0.19
7.	0.19	31.	0.38	54.	0.38
8.	0.26	32.	0.16	55.	0.37
9.	0.18	33.	0.23	56.	0.33
11.	0.14	34.	0.31	57.	0.19
12.	0.13	35.	0.45	58.	0.30
13.	0.19	37.	0.39	59.	0.18
14.	0.38	38.	0.30	60.	0.40
15.	0.38	39.	0.21	61.	0.19
16.	0.21	41.	0.31	63.	0.49
17.	0.13	42.	0.36	64.	0.34
19.	0.14	43.	0.16	65.	0.22
20.	0.18	44.	0.38	66.	0.17
21.	0.43	45.	0.37	67.	0.36
22.	0.39	46.	0.46		
24.	0.39	47.	0.39		

The correlation coefficients of all the items were found to be well beyond the accepted value of significance at 0.05 level. ($> .113$). The total score of the five subscales were considered as the Self-Esteem score of the subjects for the present study.

The Self-Esteem Inventory was then subjected to test of validity and reliability.

Validity

Content and construct validity of the inventory were well established by the author in a series of studies. Criterion related validity of the inventory was found out by the investigator. Total score of the Self-Esteem Inventory was correlated with the score of Self-Esteem Inventory developed by Raj and Thomas (1985) for a sample of 60 students drawn from two secondary schools of Thiruvananthapuram district. The validity coefficient is found to be 0.49.

Reliability

To determine the degree of homogeneity among items within the inventory, the internal consistency reliability of the test items was calculated using Cronbach's alpha coefficient for a sample of 100 secondary school students and they are presented in Table 3.4.

TABLE 3.4

Coefficient Alpha for Self-Esteem Inventory

Subscale	Alpha Coefficient
Academic	0.68
General	0.70
Parental / Home	0.69
Social	0.72
Personal	0.68

Further, test-retest reliability also was estimated by administering the Self-Esteem Inventory after a gap of three weeks on a

sample of 60 students of standard IX. The test-retest reliability coefficient (r) was found to be 0.81.

The obtained validity and reliability indices of the inventory revealed that the Self-Esteem Inventory is a reasonably valid and reliable instrument for measuring Self-Esteem of secondary school students of Kerala. A copy of the Self-Esteem Inventory in English and its approximate Malayalam translation is presented as Appendix III A and II B and response sheet as Appendix III C.

3.3.2.4 Scale of Attitude Towards Science

This scale is a Likert type scale developed and standardised by Pillai (1981). It consists of 40 items indicating different degrees of favourableness or unfavourableness towards science. The statements covered different aspects of attitude towards science such as utility of science, intellectual value of science, internationalism, universalism, rationality of science, individualism of science and a belief in progress and meliorism.

A subject has to respond to each statement by choosing any one of the five alternatives, Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) or Strongly Disagree (SD). Scoring procedure for the positive statement was 5, 4, 3, 2, 1 and for negative statements 1, 2, 3, 4, 5.

Two illustrative items of the scale are given below:

Positive item: *Without science, the progress of humanity would have been slow.*

Negative item: *Science is beneficial only to the rich.*

The validity of the original scale was determined using two external criteria – school marks and teacher rating. The validity coefficient reported using teacher rating as external criteria is 0.53. The validity coefficient using school marks as external criteria is reported to be 0.49. Reliability of the test determined by test-retest method was reported to be 0.762. The scale has been used widely by later investigators. The scale of

Attitude towards Science was revised and the validity and reliability were re-established (Valsala, 1996). The validity coefficient was found to be 0.57 and split-half reliability coefficient was reported to be 0.64 for a sample of 30 Pre-Degree science students selected at random. A copy of the Scale of Attitude towards Science and response sheet is presented as Appendix IV A and IV B.

3.3.2.5 Scale of Attitude towards Academic Work

Scale of Attitude towards Academic Work was developed by the investigator in consultation with her supervising teacher. It was decided to construct attitude scale of Likert type. For pooling the statements, analysis of literature related to (i) Attitude Scale Construction (Edward, 1969), (ii) Methodology of teaching school subjects (Anderson and Koutnik, 1972), (iii) Research Reports and Articles on teaching and learning was done. Besides, informal discussions with select students were also made. This enabled the investigator to identify the dimensions to be included in the attitude scale. The dimensions are:

- (i) Enjoyment in the classroom learning
- (ii) Interest in taking up outdoor activities
- (iii) Balance between academic learning and co-curricular activities
- (iv) Avoidance of distraction (satisfaction)
- (v) Reactions to procedure of disciplining the class.

After deciding the dimensions, items were written in the form of statements. For pooling items, the Scale of Attitude towards Academic Work by Abraham and Nair (1974) was also reviewed. For developing the scale, the eight steps suggested by Anderson (1981) for the development of a satisfactory Likert scale were followed. Statements were written that are either favourable or unfavourable with respect to the attitude towards academic work.

While writing the statements, the investigator has tried to (a) avoid statements that are factual or capable of being interpreted as factual; (b) avoid statements that refer to the past; (c) avoid statements that

are likely to be endorsed by almost everyone or by almost none; (d) to keep the language of the statements simple, clear and direct; (e) avoid statements containing universals such as 'all', 'always', 'none', 'never'; (f) not to use words such as 'only', 'just', 'merely', etc. and (g) to avoid the use of double negatives.

Twenty students of standard IX and X were called in to examine the statements and were asked to classify it either as favourable, unfavourable or neither. Any statement not classified as favourable or unfavourable by majority of students (who were considered as judges) was eliminated.

The investigator pooled fifty statements at first. After consulting with experts including teacher educators and teachers of higher secondary school, some items were modified and the number of items were reduced to forty five. The respondent has to respond to each statement by choosing any of the three alternatives 'Agree', 'Undecided', or 'Disagree'. Extreme agreement or disagreement was omitted. The scoring procedure is 5, 3, 1 for a positive statement and 1, 3, 5 for a negative statement.

Illustrative statements

Positive statement

It is better to study as per a pre-fixed schedule

Negative statement

I do my studies in order to avoid punishment

The draft scale consisting of 45 statements with appropriate directions for responding were prepared. This scale was administered to a representative sample of 120 students drawn from 2 class divisions of standard IX. In order to ascertain the item validity, the correlation between the responses made to each statement and the total score was computed (N = 100) as suggested by Anderson. Items which are significant beyond

0.05 level were selected to be included in the final scale. The item wise correlation coefficient is presented in Table 3.5.

TABLE 3.5

Item Analysis Data of Draft Scale of Attitude towards Academic Work

Item.No.	r	Item.No.	r	Item.No.	r
1.	0.15	16.	0.42*	31.	0.19*
2.	0.24*	17.	0.47*	32.	0.35*
3.	0.47*	18.	0.51*	33.	-0.28
4.	0.31*	19.	0.33*	34.	0.52*
5.	0.41*	20.	0.37*	35.	0.10
6.	0.27*	21.	-0.01	36.	0.42*
7.	-0.07	22.	0.23*	37.	0.23*
8.	0.18	23.	0.18	38.	0.15
9.	0.47*	24.	0.35*	39.	0.24*
10.	0.17	25.	0.51*	40.	0.22*
11.	0.47*	26.	0.43*	41.	0.27*
12.	0.09	27.	0.36*	42.	0.23*
13.	0.08	28.	0.17	43.	0.49*
14.	0.06	29.	0.62*	44.	0.19*
15.	0.23*	30.	0.13	45.	0.03

*Note: * item selected for final scale*

A final scale consisting of 30 items with appropriate direction for responding and scoring scheme were prepared. The scale consists of both positive and negative items. The Attitude Scale in the draft form and final form together with approximate English translation and response sheet is presented as Appendix V A, V B, V C and V D. The final scale thus prepared was tested for validity and reliability.

Validity of the Attitude Scale

The validity of the Scale of Attitude towards Academic Work was assessed using teacher ratings as external criterion. For this, a sample of 30 pupils consisting of 20 boys and 10 girls were selected. The science teachers teaching physics and chemistry were asked to observe the pupils for a period of one month in order to understand their attitude towards academic work and then rate them on a five point scale based on their overall attitude towards academic work (very poor, below average, average, above average and very good). The average scores assigned by two teachers were taken as external criterion. The scores on the test were correlated with teacher ratings. The correlation coefficient was found to be 0.48. The validity coefficient suggests that the scale is a reasonably valid measure of secondary school pupils, attitude towards academic work.

Reliability of the Attitude Scale

The reliability of the final scale was assessed using test-retest method. The reliability coefficient was found to be 0.78, the interval between the first test and the retest being two weeks for a sample of 50.

2.3.2.6 Test of Achievement in Physical Science

The criterion variable, Achievement in Physical Science, was measured by using a standardised Achievement Test in Physical Science developed by the investigator in consultation with her supervising teacher. The procedure for preparing the test was based on scientific procedure suggested by Ebel (1972). The design adopted for the development of the test is described below:

Planning the Test

Objective and content of the secondary school syllabus in physics and chemistry were carefully studied. It was decided that the content of the achievement test includes the basic concepts of physics and chemistry which the students study in standard VIII and IX. It was decided to prepare a test of about 80 items which include equal number of items from physics and

chemistry. Only objective type items of multiple choice category were included in the test.

(a) Weightage to Objectives

The different educational objectives included are Knowledge, Comprehension and Higher Objectives. Higher objectives include Application, Analysis, Synthesis and Evaluation. The weightage given to the objectives are presented below.

Sl.No.	Objectives	Percentage
1.	Knowledge	30
2.	Comprehension	45
3.	Higher Objectives	25
	Total	100

(b) Weightage to Content

A thorough analysis of the prescribed syllabus of physics and chemistry in standard IX was made to find out basic concepts covered in this syllabus. An adequate number of items had to be proportionately distributed over the area of content. The weightage given to different topics are presented below:

Sl.No.	Topics	Percentage
1.	Forces	15
2.	Motion	10
3.	Heat	10
4.	Electricity & Magnetism	9
5.	Light	4
6.	Sound	3
7.	Atoms, Molecules & Chemical arithmetic	22
8.	Periodic table	6
9.	Chemical reactions (physical/chemical change, redox reaction)	21
	Total	100

A two-way grid specifying weightage to objectives and weightage to content was prepared as a blueprint for the test of Achievement in Physical Science. The blueprint is given in Table 3.6.

TABLE 3.6

Blueprint of Test of Achievement in Physical Science

Sl. No.	Content	Objectives			Total
		Knowledge	Comprehension	Higher Objectives	
1.	Forces	2	7	3	12
2.	Motion	-	7	1	8
3.	Heat	1	4	3	8
4.	Electricity & Magnetism	6	-	1	7
5.	Light	1	1	1	3
6.	Sound		1	1	2
7.	Atoms, Molecules and Chemical arithmetic	7	7	4	18
8.	Chemical Reactions	3	7	7	17
9.	Periodic Table	5	-	-	5
	Total	25	34	21	80

Note: Each item carries one mark

Item Writing

In order to get enough number of items of proved psychometric properties in the final test, 110 multiple choice items with four distractors were pooled initially based on the design of the test. Textbooks, reference books, question banks and standardised tools developed by the investigator and her supervising teacher for other purpose were referred for pooling the items. The items were subjected to scrutiny by experts. Finally, 100 items were included in the draft test. A pilot study (N = 10) was conducted to note for ambiguous items and items with improper language style. Items were further edited accordingly. Scoring key was also prepared. Thus, the final draft test

with Part A comprising of physics items and Part B comprising of chemistry items was prepared with necessary instructions for field testing.

The final draft test administered to a representative sample of 380 students studying in standard IX of selected schools of Thiruvananthapuram district. All the response sheets were scored (one score for correct answer and no score for incorrect answer).

Item Analysis

Item analysis was done using the method suggested by Ebel in 1972. After rejecting 10 answer sheets at random, 370 answer sheets were used for item analysis. The answer sheets were arranged in the descending order of their total scores. The top 100 (27 per cent) and bottom 100 answer sheets were separated which form the upper group (U) and lower group (L). The number of correct responses for each item of the upper and lower group were recorded separately. The difficulty level and discriminating index were calculated using the formula

$$D_i = \frac{U + L}{2N} \quad \text{and} \quad D_p = \frac{U - L}{N} \quad \text{respectively}$$

where

- U = number of right responses in upper group
- L = number of right responses in lower group.
- N = size of the sample.

The details of item analysis are presented in Table 3.7.

TABLE 3.7
Data and Results of the Item Analysis of
Achievement Test in Physical Science

Item No.	Difficulty Index (DI)	Discriminating Power (DP)	Item Selected / Rejected S/R	Item No.	Difficulty Index (DI)	Discriminating Power (DP)	Item Selected / Rejected S/R
1.	0.81	0.25	S	26	0.37	0.17	R
2.	0.48	0.35	S	27.	0.56	0.48	S
3.	0.13	0.09	R	28.	0.41	0.23	S
4.	0.61	0.30	S	29.	0.57	0.42	S
5.	0.66	0.34	S	30.	0.58	0.64	S
6.	0.66	0.40	S	31.	0.49	0.27	S
7.	0.28	0.05	R	32.	0.80	0.20	R
8.	0.38	0.43	S	33.	0.76	0.20	R
9.	0.65	0.45	S	34.	0.75	0.29	S
10.	0.59	0.29	S	35.	0.48	0.29	S
11.	0.40	0.16	R	36.	0.47	0.65	S
12.	0.62	0.19	R	37.	0.72	0.35	S
13.	0.62	0.51	S	38.	0.35	0.38	S
14.	0.57	0.26	S	39.	0.72	0.40	S
15.	0.75	0.25	S	40.	0.57	0.35	S
16.	0.58	0.29	S	41.	0.60	0.52	S
17.	0.31	0.20	R	42.	0.49	0.47	S
18.	0.56	0.40	S	43.	0.48	0.41	S
19.	0.50	0.62	S	44.	0.43	0.52	S
20.	0.41	0.23	S	45.	0.34	0.26	S
21.	0.69	0.32	S	46.	0.73	0.40	S
22.	0.49	0.25	S	47.	0.56	0.26	S
23.	0.41	0.11	R	48.	0.81	0.21	R
24.	0.36	0.38	S	49.	0.34	0.28	S
25.	0.42	0.42	S	50.	0.39	0.25	S

Item No.	Difficulty Index (DI)	Discriminating Power (DP)	Item Selected / Rejected S/R	Item No.	Difficulty Index (DI)	Discriminating Power (DP)	Item Selected / Rejected S/R
51.	0.68	0.43	S	76.	0.50	0.53	S
52.	0.69	0.60	S	77.	0.30	0.36	S
53.	0.74	0.29	S	78.	0.51	0.45	S
54.	0.75	0.19	R	79.	0.39	0.33	S
55.	0.69	0.34	S	80.	0.75	0.25	S
56.	0.62	0.45	S	81.	0.20	0.04	R
57.	0.59	0.34	S	82.	0.61	0.64	S
58.	0.58	0.43	S	83.	0.48	0.29	S
59.	0.81	0.20	R	84.	0.47	0.65	S
60.	0.53	0.43	S	85.	0.43	0.51	S
61.	0.69	0.44	S	86.	0.38	0.32	S
62.	0.48	0.29	S	87.	0.38	0.33	S
63.	0.57	0.71	S	88.	0.36	0.12	R
64.	0.49	0.39	S	89.	0.44	0.47	S
65.	0.22	0.20	R	90.	0.44	0.39	S
66.	0.38	0.17	R	91.	0.34	0.32	S
67.	0.63	0.54	S	92.	0.41	0.40	S
68.	0.60	0.29	S	93.	0.24	0.28	R
69.	0.75	0.233	S	94.	0.42	0.21	S
70.	0.33	0.32	S	95.	0.41	0.21	S
71.	0.33	0.33	S	96.	0.46	0.57	S
72.	0.48	0.35	S	97.	0.79	0.21	R
73.	0.34	0.34	S	98.	0.34	0.32	S
74.	0.60	0.69	S	99.	0.28	0.09	R
75.	0.76	0.19	R	100	0.48	0.27	S

Items with difficulty level between 0.3 and 0.6 and discriminating power above 0.3 were readily selected. A few items with discrimination power around 0.25 and above were also selected to comply with the Blueprint for the final test. Thus, 40 items in physics and 40 items in chemistry were selected for inclusion in the final test. The draft test of Achievement in Physical Science is presented as Appendix VI A, the final test and its approximate English translation as Appendix VI B and VI C. Response sheet and scoring key of the same are presented as Appendix VI D and VI E.

Validity of the Test

Content and construct validity of the test was ensured by preparing the test following the scientific procedure of construction of an achievement test. Concurrent validity of the achievement test was estimated by correlating the scores of the test with average marks obtained in the two terminal examinations in physics and chemistry using Pearson's 'r'. The validity coefficient was found to be 0.611 (N = 50).

Reliability of the Test

Reliability of the test was found out by split-half method using odd-even technique. From the reliability of the half test, reliability of the whole test was estimated using Spearman-Brown formula

$$r_{11} = \frac{2 r_{1/2}^{1/2}}{1 + r_{1/2}^{1/2}}$$

The reliability coefficient of the half-test was 0.871 and the whole test was 0.931.

The psychometric properties of the test suggest that the test is an adequate instrument for measuring the variable Achievement in Physical Science of students of standard IX.

The decile norms of the Scale of Classroom Learning Environment, Self-Esteem Inventory, Scale of Attitude towards Academic Work, Test of Achievement in Physical Sciences (Achievement in Physics,

Chemistry and Total) were worked out using the scores of the final sample and are presented in Table 3.8.

TABLE 3.8

Norms for the Scale of Classroom Learning Environment, Self-Esteem Inventory, Attitude towards Academic Work, Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science (Total)

Percentiles	Classroom learning Environment	Self-Esteem	Attitude towards Academic Work	Achievement in Physics	Achievement in Chemistry	Achievement in Physical Science
P ₁₀	67	29	100	12	10	23
P ₂₀	75	33	108	14	12	27
P ₃₀	81	35	114	16	14	31
P ₄₀	85	38	118	18	16	34
P ₅₀	89	40	122	20	17	37
P ₆₀	94	42	126	21	19	39
P ₇₀	98	44	128	23	21	44
P ₈₀	102	46	132	25	23	48
P ₉₀	108	49	138	28	26	53
P ₁₀₀	128	59	195	36	36	71

3.3.3 Data Collection Procedure

Test booklets and response sheets were prepared. Then the investigator contacted the Heads of the selected schools the Head of the Department of Education, University of Calicut. A time schedule was made for testing. Two consecutive days were allotted for each school.

In administering the tools, the conditions prescribed in the tests were strictly followed. In each class, a brief description regarding the tools was given. Then necessary oral instructions were given as to how to mark the responses in the response sheet provided. Scale of Classroom Learning Environment, Self-Esteem Inventory and Attitude towards Academic Work

were administered on the first day. On the next day, Scale of Achievement Motivation, Attitude towards Science and Achievement Test in Physical Science were administered. The data collection was done during the month of January, 2003.

3.3.4 Scoring and Consolidation of Data

Scoring was done according to the direction given in the tools. Scale of Classroom Learning Environment was scored separately for its components namely, Physical and Material factor, Educational factor and Psycho-Social factor. Sum of the three component score yield the score on Classroom Learning Environment. Scale of Achievement Motivation was also scored separately for its components. The sum of the eight component scores yielded the score on Achievement Motivation of each subject.

Self-Esteem Inventory was scored separately for its components. The component scores were then added which yielded the global Self-Esteem score of the subject. Scale of Attitude towards Science and Scale of Attitude towards Academic Work were also scored. Test of Achievement in Physical Science were scored separately to yield scores on Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science (total).

Thus, the scores of five independent variables and three criterion variables were obtained. Since the tests were conducted on two consecutive days, data regarding some cases who had not taken all the tests, had to be rejected. Finally, 946 cases that were complete in all respects were chosen for final analysis.

The scores of these 946 students for different tests were tabulated on a consolidated data sheet. Each student was given a specific serial number and against this number data concerned with him/her was entered in the same line. The consolidated data were subjected to different analysis using appropriate statistical techniques. Break up of the final sample is presented in Table 3.9.

TABLE 3.9
Break Up of the Final Sample

Sl. No.	Name of School	Rural / Urban	Govt. / Private	Instructional Efficiency	School Type	No. of Students		
						Boys	Girls	Total
1.	St. Joseph's H.S.S., Trivandrum	U	Private	A	Single Sex	94	-	94
2.	Govt. Girls H.S.S., Pattom	U	Govt.	A	Single Sex	-	88	88
3.	R.K.D. N.S.S. H.S.S., Sasthamangalam	U	Private	C	Coeducational	48	8	56
4.	Concordia Lutheran H.S.S.	U	Private	B	Coeducational	17	39	56
5.	H.S.S. for Girls, Venganoor	R	Private	B	Single Sex	-	69	69
6.	H.S.S. for Boys, Venganoor	R	Private	B	Single Sex	74	-	74
7.	Govt. H.S.S., Karakulam	R	Govt.	B	Coeducational	35	23	58
8.	G.M.H.S.S., C.U. Campus	R	Govt.	A	Coeducational	60	56	116
9.	S.P.B.S., Ramanattukara	R	Private	B	Coeducational	44	59	103
10.	G.V.H.S.S., Cheruvannur	R	Govt.	C	Coeducational	36	34	70
11.	Govt. Ganapath V.H.S.S., Feorke	R	Govt.	C	Coeducational	43	39	82
12.	R.K. Mission, H.S.S., Kozhikode	U	Private	B	Coeducational	34	46	80
						485	461	946

A – Instructional efficiency above average; B-average; C-below average.

3.3.5 Procedures for Analysis of Data

Procedure used for analysis of data is described under the following heads:

3.3.5.1 Classification Technique

(i) Classification based on Classroom Learning Environment

The total sample ($N = 946$) was divided into three groups on the basis of their perception of classroom learning environment as Favourable Learning Environment Group (FL), Moderately Favourable Learning Environment Group (MFL) and Less Favourable Learning Environment Group (LFL). Assuming Classroom Learning Environment scores following a normal distribution, the conventional procedure of using σ distance for dividing the total sample was used. Subjects who score $M + \frac{1}{2} \sigma$ and above were considered as Favourable Learning Environment group and subjects who score $M - \frac{1}{2} \sigma$ and below were considered as Less Favourable Learning Environment group. Subjects whose score fall between $M + \frac{1}{2} \sigma$ and $M - \frac{1}{2} \sigma$ were considered as Moderately Favourable Learning Environment group.

In the present study, mean (M) for Classroom Learning Environment was found to be 88.31 with a standard deviation (σ) 16.39. Therefore, students who score 97 and above were considered as Favourable Learning Environment group. Students who score 80 and below were considered as Less Favourable Environment group and those who score between 80 and 97 were treated as Moderately Favourable Learning Environment group.

(ii) Classification based on Achievement Motivation

The total sample was divided into three nearly identical groups based on Achievement Motivation as High – Achievement Motivation group (H – AM), Average – Achievement Motivation group (A – AM) and Low Achievement Motivation group (L – AM). The procedure described above in section 3.3.5.1 considering mean as the cut-off point was used for the classification. The mean Achievement Motivation was found to be 71.74 and

standard deviation 12.00. Those students whose Achievement Motivation score 78 (rounded value of $M + \frac{1}{2} \sigma$) and above were treated as High – Achievement Motivation group and students whose score were less than 65 (rounded value of $M - \frac{1}{2} \sigma$) were treated as Low – Achievement Motivation group. The remaining subjects were grouped as Average – Achievement Motivation group.

(iii) Classification based on Self - Esteem

The procedure described as in section 3.3.5.1 was used for categorising total sample into three nearly identical groups based on Self – Esteem. The mean Self-Esteem score was found to be 39.35 with a standard deviation of 7.94. Subjects who score 43 and above ($M + \frac{1}{2} \sigma$) were considered as High – Self – Esteem group (H – SE). Subjects who score 35 and below ($M - \frac{1}{2} \sigma$) were considered as Low – Self – Esteem group (L – SE). Students who score between 35 and 43 were treated as Average – Self – Esteem (A – SE) group.

(iv) Classification based on Attitude towards Science

The procedure described above was used for categorising total sample into three nearly identical groups based on Attitude towards Science. Mean Attitude towards Science score was found to be 137.40 with a standard deviation of 16.09. Subjects who score 145 and above ($M + \frac{1}{2} \sigma$) were considered as Favourable – Attitude towards Science group (F – ATS). Subjects who score 128 and below ($M - \frac{1}{2} \sigma$) were considered as Less Favourable – Attitude towards Science group (L – ATS). Students who score between 128 and 145 were grouped as Moderately Favourable – Attitude towards Science group (M – ATS).

(v) Classification based on Attitude towards Academic Work

The total sample was divided into three nearly identical groups based on Attitude towards Academic Work. The mean Attitude towards Academic Work was found to be 119.67 with a standard deviation of 15.55. Those students whose Attitude towards Academic Work score 127 ($M + \frac{1}{2} \sigma$)

and above were treated as Favourable – Attitude towards Academic Work group (F – ATA) and students whose score were less than 111 ($M - \frac{1}{2} \sigma$) were treated as Less – Favourable Attitude towards Academic Work group (L – ATA). The remaining subjects were grouped as Moderately – Favourable Attitude towards Academic Work group (M – ATA).

The number of students categorised into three nearly identical groups based on 'Classroom Learning Environment', 'Achievement Motivation', 'Self – Esteem', 'Attitude towards Science' and 'Attitude towards Academic Work as presented below:

Variable	Group	Number
Classroom Learning Environment	Favourable (FL)	311
	Moderately Favourable (MFL)	364
	Less – Favourable	271
Achievement Motivation	High (H – AM)	317
	Average (A – AM)	365
	Low (L – AM)	264
Self – Esteem	High (H – SE)	312
	Average (A – SE)	348
	Low (L – SE)	286
Attitude towards Science	Favourable (F – ATS)	294
	Moderately – Favourable (M – ATS)	367
	Less – Favourable (L – ATS)	285
Attitude towards Academic Work	Favourable (F – ATA)	309
	Moderately – Favourable (M – ATA)	389
	Less – Favourable (L – ATA)	248

3.3.5.2 Statistical Techniques

(I) Preliminary Analysis

For the preliminary analysis of the test scores, the important statistical constants such as Mean, Median, Mode and Standard deviation of

the select variables were computed separately for the total sample, boys and girls, coeducational and single – sex students. Relevant group differences in the select variables were examined by two-tailed test of significance of difference between means.

(ii) Three – Way Analysis of Variance

The main effect and interaction effect of each of the select independent variables, *Sex* and *School Type* on *Achievement in Physics* were studied employing the Three – Way Analysis of Variance with $3 \times 2 \times 2$ factorial design. The similar factorial design was adopted for studying the main effect and interaction effect of the select variables on 'Achievement in Chemistry' and 'Achievement in Physical Science' (total).

Each of the subjects in the sample was identified as belonging to either of the 12 combination groups mentioned below:

(a) Groups based on Classroom Learning Environment

1. Boys of Coeducational schools with Favourable – Classroom Learning Environment
2. Girls of Coeducational schools with Favourable – Classroom Learning Environment
3. Boys of Single – Sex schools with Favourable Classroom – Learning Environment
4. Girls of Single – Sex schools with Favourable Classroom – Learning Environment
5. Boys of Coeducational schools with Moderately Favourable Classroom Learning Environment
6. Girls of Coeducational schools with Moderately Favourable Classroom Learning Environment
7. Boys of Single – Sex schools with Moderately Favourable Classroom Learning Environment
8. Girls of Single – Sex schools with Moderately Favourable Classroom Learning Environment

9. Boys of Coeducational schools with Less – Favourable Classroom Learning Environment
10. Girls of Coeducational schools with Less – Favourable Classroom Learning Environment
11. Boys of Single – Sex schools with Less – Favourable Classroom Learning Environment
12. Girls of Single – Sex schools with Less – Favourable Classroom Learning Environment

(b) Groups based on Achievement Motivation

1. Boys of Coeducational schools with High – Achievement Motivation
2. Girls of Coeducational schools with High – Achievement Motivation
3. Boys of Single – Sex schools with High – Achievement Motivation
4. Girls of Single – Sex schools with High – Achievement Motivation
5. Boys of Coeducational schools with Average – Achievement Motivation
6. Girls of Coeducational schools with Average – Achievement Motivation
7. Boys of Single - Sex schools with Average – Achievement Motivation
8. Girls of Single - Sex schools with Average – Achievement Motivation
9. Boys of Coeducational schools with Low – Achievement Motivation
10. Girls of Coeducational schools with Low – Achievement Motivation
11. Boys of Single - Sex schools with Low – Achievement Motivation
12. Girls of Single - Sex schools with Low – Achievement Motivation

(c) Groups based on Self - Esteem

1. Boys of Coeducational schools with High – Self – Esteem
2. Girls of Coeducational schools with High – Self – Esteem
3. Boys of Single – Sex schools with High – Self – Esteem
4. Girls of Single – Sex schools with High – Self – Esteem
5. Boys of Coeducational schools with Average – Self – Esteem
6. Girls of Coeducational schools with Average – Self – Esteem
7. Boys of Single - Sex schools with Average – Self – Esteem
8. Girls of Single - Sex schools with Average – Self – Esteem

9. Boys of Coeducational schools with Low – Self – Esteem
10. Girls of Coeducational schools with Low – Self – Esteem
11. Boys of Single - Sex schools with Low – Self – Esteem
12. Girls of Single - Sex schools with Low – Self – Esteem

(d) Groups based on Attitude towards Science

1. Boys of Coeducational schools with Favourable – Attitude towards Science
2. Girls of Coeducational schools with Favourable – Attitude towards Science
3. Boys of Single - Sex schools with Favourable – Attitude towards Science
4. Girls of Single - Sex schools with Favourable – Attitude towards Science
5. Boys of Coeducational schools with Moderately Favourable Attitude towards Science
6. Girls of Coeducational schools with Moderately Favourable Attitude towards Science
7. Boys of Single - Sex schools with Moderately Favourable Attitude towards Science
8. Girls of Single - Sex schools with Moderately Favourable Attitude towards Science
9. Boys of Coeducational schools with Less – Favourable Attitude towards Science
10. Girls of Coeducational schools with Less – Favourable Attitude towards Science
11. Boys of Single - Sex schools with Less – Favourable Attitude towards Science
12. Girls of Single - Sex schools with Less – Favourable Attitude towards Science

(e) Groups based on Attitude towards Academic Work

1. Boys of Coeducational schools with Favourable – Attitude towards Academic Work
2. Girls of Coeducational schools with Favourable – Attitude towards Academic Work

3. Boys of Single - Sex schools with Favourable – Attitude towards Academic Work
4. Girls of Single - Sex schools with Favourable – Attitude towards Academic Work
5. Boys of Coeducational schools with Moderately Favourable Attitude towards Science
6. Girls of Coeducational schools with Moderately Favourable Attitude towards Academic Work
7. Boys of Single - Sex schools with Moderately Favourable Attitude towards Academic Work
8. Girls of Single - Sex schools with Moderately Favourable – Attitude towards Academic Work
9. Boys of Coeducational schools with Less – Favourable Attitude towards Academic Work
10. Girls of Coeducational schools with Less – Favourable Attitude towards Academic work
11. Boys of Single - Sex schools with Less – Favourable Attitude towards Academic Work
12. Girls of Single - Sex schools with Less – Favourable Attitude towards Academic Work

(iii) Test of Significance of Difference between Means for Large Independent Sample

Analysis of Variance where significant F values were obtained, further analysis as a comparison between nearly comparable groups categorised on the basis of independent variables selected in Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science (total) were attempted. For this purpose, t-test for difference between means for large independent sample was estimated.

The results of the critical ratios computed were interpreted using two-tailed test of significance for appropriate degrees of freedom.

(iv) Scheffé Test for Multiple Comparison

Scheffé Test for Multiple Comparison (Ferguson, 1976) was applied to compare the relevant category of the independent variables (when more than two categories are made) in relation to the mean scores of Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science (total).

(v) Discriminant Analysis

Discriminant Analysis is a technique used to predict category membership. In the present study, this technique was used to predict High – Achievers; Average – Achievers and Low – Achievers in Physics, Chemistry and Achievement in Physical Science separately using the predictor variables, Classroom Learning Environment, Achievement Motivation, Self – Esteem, Attitude towards Science, Attitude towards Academic Work, Sex of subjects and School type based on sex enrolment.

To discriminate the population groups, discriminant function analysis by direct method (Tacqu, 1997) was used, which involves the following three steps.

- Step 1: Prior classification of sample into defined groups which are proposed to be discriminated.
- Step 2: Analysis of means of the many discriminating characteristics which results in two functions (in case of three groups situation) which are linear combinations of selected variables in the form of $D = B_0 + B_1X_1 + B_2 X_2 + \dots B_rX_r$ where B's are the linear coefficients estimated from the data $X_1 X_2 \dots X_r$ are the predictor variables used in the study.
- Step 3: Testing the effectiveness of the discriminant functions to discriminate groups and estimation of canonical coefficients for the classification of new cases into three groups.

The analysis of the data and the interpretation of results are presented in chapter IV.

ANALYSIS

Suchitra K. "Classroom learning environment and select affective variables in relation to achievement in physical science of students of single - sex and coeducational secondary schools " Thesis. Department of Education, University of Calicut, 2004

ANALYSIS

- **Preliminary Analysis**
- **Investigation of Main Effect and Interaction Effect**
- **Investigation of Group Differences**
- **Prediction of High -; Average - ; and Low -
Achievers in Physical Science**
- **Conclusions and Interpretations**

CHAPTER IV

ANALYSIS

Analysis of the data of the present study is described in this chapter. This has been described under the following main heads:

4.1 PRELIMINARY ANALYSIS

4.2 INVESTIGATION OF MAIN EFFECT AND INTERACTION EFFECT OF EACH OF THE SELECT INDEPENDENT VARIABLES ON ACHIEVEMENT IN PHYSICS, CHEMISTRY AND PHYSICAL SCIENCE (TOTAL) IN RELATION TO SEX AND SCHOOL TYPE

4.3 INVESTIGATION OF GROUP DIFFERENCE IN ACHIEVEMENT IN PHYSICAL SCIENCE

4.4 PREDICTION OF HIGH -, AVERAGE -, AND LOW-ACHIEVERS IN PHYSICAL SCIENCE USING THE SELECT INDEPENDENT VARIABLES, SEX AND SCHOOL TYPE AND THE EFFECTIVENESS OF THE PREDICTORS

4.5 CONCLUSIONS AND INTERPRETATIONS

4.1 PRELIMINARY ANALYSIS OF TEST SCORES

A preliminary analysis of the scores of the independent variables and the criterion variables selected for the present investigation were studied to know the basic properties of the test scores for the total sample and relevant sub samples. This analysis was taken up to get an appropriate set of summary statistics which may provide a quick impression of the main features of the data which in turn may provide some guidance as to how the analysis and interpretation should proceed.

The score distributions of the independent variables namely, *Classroom Learning Environment*, *Achievement Motivation*, *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work*; the criterion variables *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science (total)* were studied for the nature of their distribution. For this, the important statistical indices namely mean, median, mode, standard deviation, skewness and kurtosis of the scores were calculated for the total sample, boys and girls and are presented in Table 4.1, 4.2 and 4.3 respectively.

TABLE 4.1
Important Statistical Constants for the Score Distribution of the Independent and
Criterion Variables for the Total Sample (N = 946)

Sl.No.	Variables	Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
1.	Classroom Learning Environment	88.31	89.00	101.00	16.39	-0.13	0.43
2.	Achievement Motivation	71.74	73.00	76.00	12.00	-0.32	0.52
3.	Self-Esteem	39.35	40.00	41.00	7.94	-0.25	-0.07
4.	Attitude towards Science	137.40	137.00	137.00	16.09	0.07	0.48
5.	Attitude towards Academic Work	119.67	122.00	130.00	15.55	-0.45	1.77
6.	Achievement in Physics	19.73	20.00	20.00	6.05	-0.13	-0.61
7.	Achievement in Chemistry	17.73	17.00	17.00	6.07	0.36	-0.38
8.	Achievement in Physical Science	37.47	37.00	39.00	11.15	0.13	-0.59

TABLE 4.2
Important Statistical Constants for the Score Distribution of the Independent and
Criterion Variables for Boys (N = 485)

SI.No.	Variables	Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
1.	Classroom Learning Environment	85.86	87.00	89.00	17.38	-0.20	0.29
2.	Achievement Motivation	72.88	75.00	82.00	11.97	-0.53	0.24
3.	Self-Esteem	39.81	40.00	43.00	7.52	-0.08	-0.25
4.	Attitude towards Science	135.58	136.00	137.00	15.26	-0.08	-0.31
5.	Attitude towards Academic Work	117.86	119.00	126.00	16.39	-0.21	0.87
6.	Achievement in Physics	20.32	20.00	20.00	5.80	0.16	-0.42
7.	Achievement in Chemistry	17.67	18.00	17.00	5.75	-0.17	-0.37
8.	Achievement in Physical Science	37.99	38.00	39.00	10.54	0.00	-0.51

TABLE 4.3
Important Statistical Constants for the Score Distribution of the Independent and
Criterion Variables for Girls (N = 461)

Sl.No.	Variables	Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
1.	Classroom Learning Environment	90.88	92.00	101.00	14.88	-0.23	0.38
2.	Achievement Motivation	70.53	72.00	77.00	11.93	-0.37	0.79
3.	Self-Esteem	38.87	39.00	41.00	8.34	-0.05	-0.02
4.	Attitude towards Science	139.31	139.00	144.00	16.73	0.06	1.27
5.	Attitude towards Academic Work	121.58	124.00	130.00	14.40	-0.50	3.63
6.	Achievement in Physics	19.12	19.00	15.00	6.25	0.06	-0.68
7.	Achievement in Chemistry	17.80	17.00	16.00	6.40	0.37	-0.45
8.	Achievement in Physical Science	36.93	36.00	29.00	11.75	0.24	-0.64

The statistical constants presented in Tables 4.1, 4.2 and 4.3 indicate that the values are close approximations to the values expected for normal distribution. The values of skewness and kurtosis for the distribution also show that the distribution fairly approximate to what is expected for normal curves. The near normal distribution obtained suggests that the sample chosen for the study can be considered as a fairly representative of the population.

4.2 INVESTIGATION OF THE MAIN EFFECT AND INTERACTION EFFECT OF EACH OF THE FIVE SELECT INDEPENDENT VARIABLES ON ACHIEVEMENT IN PHYSICAL SCIENCE IN RELATION TO SEX AND SCHOOL TYPE

This part of the analysis was taken up with a view to investigate whether variation in Achievement in Physical Science (Physics, Chemistry and total separately) depend on variation in each of the five select independent variables when combined with the sex of the subjects and *school type* based on sex enrolment. The five independent variables selected for the study are *Classroom Learning Environment*, *Achievement Motivation*, *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work*. Three-way Analysis of Variance was computed to study the single effect and cross over effect of each of the five select independent variables in *Achievement in Physical Science in relation to sex and school type*. Separate ANOVA was done for *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science (total)*.

The analysis of data was done using $3 \times 3 \times 2$ factorial design of three-way analysis of variance. As described in Chapter 3, the total sample (N = 946) was first classified into two on the basis of *school type* based on Sex (subjects of single-sex schools and coeducational schools) and then on the basis of Sex (boys and girls). Further, the sample was categorised into three on the basis of *Classroom Learning Environment*, *Achievement*

Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work separately as High –; Average –; and Low– group. The entire computation process was carried out using the computer facility with the help of the software, Statistical Package for Social Science (SPSS for Windows, 1999). Accordingly, three ANOVA was undertaken to study the main effect and interaction effect of *Classroom Learning Environment*, one of the five independent variables, on *Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science (total)* separately in relation to sex and school type. Similarly, three ANOVA each was undertaken to study the main effect and interaction effect of *Achievement Motivation* by sex by school type; *Self-Esteem* by sex by school type; *Attitude towards Science* by sex by school type; and *Attitude towards Academic Work* by sex and by school type on *Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science (total)*. Factorial ANOVA was used to test for group mean differences, as there are more than two independent variables for the study.

The results of the three-way ANOVA and the interpretation of results are discussed in this section. The main effect and interaction effect of each of the five select independent variables, sex and school type on *Achievement in Physics* for the total sample is presented first. The same pattern was used to discuss the results of the three-way ANOVA of the select independent variables on *Achievement in Chemistry and Achievement in Physical Science (total)*.

4.2.1 Investigation of the Main Effect of Each of the Select Five Independent Variables, Sex and School Type on Achievement in Physics for The Total Sample

The main effect and interaction effect of each of the select independent variables by sex by school type based on sex enrolment on *Achievement in Physics* for the total sample is discussed in the following section. For this purpose five separate ANOVA were computed.

4.2.1.1 Main Effect and Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Physics

The main effect and interaction effect of Classroom Learning Environment, sex and school type on Achievement in Physics were studied for the total sample. The sum of squares along with their degrees of freedom, variance estimates and the F-values were calculated. The summary of the three-way ANOVA is presented in Table 4.4.

TABLE 4.4
Summary of Three-way ANOVA of Achievement in Physics by Classroom Learning Environment by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Classroom Learning Environment	1.43	2	0.71	0.02	NS
Sex	679.47	1	679.47	19.69	0.01
School type	251.38	1	251.38	7.28	0.01
Classroom Learning Environment × Sex	94.20	2	47.10	1.36	NS
Classroom Learning Environment × School type	226.43	2	113.22	3.28	0.05
Sex × School type	819.92	1	819.92	23.76	0.01
Classroom Learning Environment × Sex × School type	167.04	2	83.52	2.42	NS
Within cells	32231.57	934	34.51		
Total	34581.34	945	36.59		

Main Effect

The main effect of *Classroom Learning Environment*, *Sex* and *School Type* on *Achievement in Physics* were examined. As per Table 4.4, the F-values are 0.02, 19.69 and 7.28 respectively. In the case of *Classroom Learning Environment*, the obtained F-value is less than the table value set at 0.05 level of significance for the corresponding degrees of freedom 2, 945 (< 3.01). This result reveals that the scores on *Achievement in Physics* is independent of the scores of *Classroom Learning Environment*. But for the single effect of *Sex* and *School Type* on *Achievement in Physics*, the obtained F-values are greater than the tabled value set at 0.01 level of significance for degrees of freedom 1, 950 (> 6.69). These results indicate that the scores of *Achievement in Physics* differ significantly with *Sex* of the subjects and the *School Type* based on sex enrolment.

First order interaction effect

The obtained F-values for the first order interaction effect of (i) *Classroom Learning Environment* by *Sex*; (ii) *Classroom Learning Environment* by *School type*; and (iii) *Sex* by *School type* on *Achievement in Physics* are 1.36, 3.28 and 23.76 respectively. Of these, the F-values of *Classroom Learning Environment* \times *School type* is greater than the tabled value (3.01) at 0.05 level of significance and the F-value of *Sex* \times *School type* is greater than the tabled value (6.69) at 0.01 level of significance for the corresponding degree of freedom 2, 934 and 1, 934. The result suggests that scores of *Achievement in Physics* is influenced by the combined effect of *Classroom Learning Environment* and *School type* based on sex enrolment and by that of *Sex* and *School type*. But the scores of *Achievement in Physics* is not seen influenced by the combined effect of *Classroom Learning Environment* and *Sex*.

Second order Interaction Effect

The result of the Three-way ANOVA of *Achievement in Physics* by *Classroom Learning Environment* by *Sex* by *School type* shows that F-

value 2.42 is not significant even at 0.05 level of significance for degrees of freedom 2, 945, F being less than 3.00.

4.2.1.2 Main Effect and Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Physics

The results obtained for the Three-way ANOVA of Achievement in Physics by Achievement Motivation by Sex by School Type (N = 946) is summarised in Table 4.5.

TABLE 4.5
Summary of Three-way ANOVA of Achievement in Physics by
Achievement Motivation by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Achievement Motivation	47.61	2	23.80	0.69	NS
Sex	865.37	1	865.37	25.20	0.01
School type	264.02	1	264.02	7.69	0.01
Achievement Motivation × Sex	21.83	2	10.92	0.32	NS
Achievement Motivation × School type	170.56	2	85.28	2.48	NS
Sex × School type	1315.24	1	1315.24	38.30	0.01
Achievement Motivation × Sex × School type	381.13	2	190.56	5.55	0.01
Within cells	32076.84	934	34.34		
Total	34581.34	945	36.59		

Main Effect

As per Table 4.5, the values obtained for the main effect of *Achievement Motivation* on *Achievement in Physics* is 0.69 which is not significant even at 0.05 level ($p > 4.63$ for df 2, 945). This result shows that *Achievement in Physics* does not differ significantly with changes in the score of *Achievement Motivation*.

The obtained F-value for the main effect of *Sex* on *Achievement in Physics* and *School type* on *Achievement in Physics* are 25.20 and 7.69 respectively. These values are well beyond the tabled value set at 0.01 level of significance. This result indicates that scores on *Achievement in Physics* depend on *Sex* of subjects and the *School type* based on sex enrolment.

First order interaction effect

It is found that F-value obtained for the interaction of *Achievement Motivation* and *Sex* and that of *Achievement Motivation* and *School type* on *Achievement in Physics* are 0.32 and 2.48 respectively. These values are not significant even at 0.05 level indicating that *Achievement in Physics* of the sample is not influenced by the combined effect of *Achievement Motivation* and *Sex*; or *Achievement Motivation* and *School type*.

On the other hand, F-value obtained for the interaction of *Sex* and *School type* on *Achievement in Physics* ($F = 38.30$ for df 1, 946) is significant beyond 0.01 level. The result suggests that the scores of *Achievement in Physics* is influenced by the joint effect of *Sex* of the subjects and *School type*.

Second order interaction effect

The results for the second order interaction effect of *Achievement Motivation* by *Sex* by *School type* on *Achievement in Physics* as per Table 4.5 reveal that F-value obtained is 5.55 for df 2, 944 is significant at 0.01 level. This result shows that the scores of *Achievement in Physics* of the sample depend on the combined effect of *Achievement Motivation*, *Sex* of

subjects, and *School type*. i.e., *Sex* × *School type* interaction are not same for the different levels of *Achievement Motivation*.

4.2.1.3 Main Effect and Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Physics

The results of the three-way ANOVA to study the single effect and interaction effect of *Self-Esteem*, *Sex* and *School type* on *Achievement in Physics* are summarised in Table 4.6.

TABLE 4.6
Summary of Three-way ANOVA of Achievement in Physics by Self-Esteem by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Self-Esteem	869.70	2	434.85	12.83	0.01
Sex	669.84	1	669.84	19.76	0.01
School type	282.48	1	282.48	8.33	0.01
Self-Esteem × Sex	25.46	2	12.73	0.38	NS
Self-Esteem × School type	164.82	2	82.41	2.43	NS
Sex × School type	964.12	1	964.12	28.44	0.01
Self-Esteem × Sex × School type	0.08	2	0.04	0.00	NS
Within cells	31664.78	934	33.90		
Total	34581.34	945	36.59		

Main Effect

The obtained F-values as per Table 4.6 for the single effect of *Self-Esteem*, *Sex*, *School type* on *Achievement in Physics* are 12.83, 19.76 and 8.33 respectively. All the obtained F-values are well beyond the tabled values set at 0.01 level of significance ($p > 6.66$ for df 1, 945 and $p > 4.63$ for

df 2, 944 respectively). This result shows that scores of *Achievement in Physics* differ with differences in *Self-Esteem* of the subjects, *Sex* of the subjects and *School type*.

First order interaction effect

According to Table 4.6, F-values obtained for the interaction effect of *Self-Esteem* by *Sex*; and interaction effect of *Self-Esteem* by *School type* on *Achievement in Physics* are 0.38 and 2.43 respectively. These values are not significant even at 0.05 level of significance indicating that the scores of *Achievement in Physics* is not influenced by either the combined effect of *Self-Esteem* and *Sex* or the combined effect of *Self-Esteem* and *School type*.

The obtained F-value for the interaction effect of *Sex* and *School type* on *Achievement in Physics* is 28.44. As the F-value is greater than the tabled value at 0.01 level of significance, the result suggests that *Achievement in Physics* is influenced by the combined effect of *Sex* and *School type*.

Second order interaction effect

Three-way ANOVA of second order interaction effect of *Self-Esteem* by *Sex* by *School type* shows that the obtained F-value is not significant even at 0.05 level of significance.

4.2.1.4 Main Effect and Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physics

The results of the three-way ANOVA undertaken to find out the main effect and interaction effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement in Physics* are presented in Table 4.7.

TABLE 4.7
Summary of Three-way ANOVA of Achievement in Physics by
Attitude towards Science by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Attitude towards Science	5406.98	2	2703.49	94.96	0.01
Sex	1274.07	1	1274.07	44.75	0.01
School type	327.50	1	327.50	11.50	0.01
Attitude towards Science × Sex	54.63	2	27.31	0.96	NS
Attitude towards science × School type	3.42	2	1.71	0.06	NS
Sex × School type	853.02	1	853.02	29.96	0.01
Attitude towards Science × Sex × School type	207.62	2	103.81	3.65	0.05
Within cells	26589.40	934	28.47		
Total	34581.34	945	36.59		

Main Effect

The F-values obtained for the main effect of *Attitude towards Science*; *Sex*; and *School type* on *Achievement in Physics* are 94.96, 44.75 and 11.50 respectively. The obtained F-values are well beyond the tabled value set at 0.01 level of significance. The results therefore suggest that *Achievement in Physics* can be considered to be varying with the scores of *Attitude towards Science*, *Sex* of the subjects and *School type* for the total sample.

First order interaction effect

It can be seen from Table 4.7 that the obtained F-values for the first order interaction effect of *Attitude towards Science* and *Sex*, *Attitude*

towards Science and *School type* are 0.96 and 0.06 respectively. These values are not significant even at 0.05 level for df 2, 944 suggesting that *Achievement in Physics* is not influenced by the joint effect of *Attitude towards Science* and *Sex* or *Attitude towards Science* and *School type*. On the other hand, it is seen from Table 4.7 that the interaction effect of *Sex* and *School type* on *Achievement in Physics* is significant at 0.01 level, the obtained F-value being 29.96. This result indicates that *Achievement in Physics* is influenced by the combined effect of *Sex* and *School type*.

Second order interaction effect

When the second order interaction effect of *Attitude towards Science* by *Sex* by *School type* on *Achievement in Physics* was studied, the obtained F-value 3.65 was found significant at 0.05 level ($p > 3.00$ for df 2, 944). The result suggests that *Achievement in Physics* is influenced by the joint effect of *Attitude towards Science*, *Sex* and *School type*. i.e., *Sex* × *School type* interaction are not same for the different levels of *Attitude towards Science*.

4.2.1.5 Main Effect and Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physics

The data regarding the main effect and interaction effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Physics* is presented in Table 4.8.

TABLE 4.8
Summary of Three-way ANOVA of Achievement in Physics by Attitude towards Academic Work by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Attitude towards Academic Work	1894.65	2	947.33	28.81	0.01
Sex	1011.83	1	1011.83	30.77	0.01
School type	486.50	1	486.50	14.79	0.01
Attitude towards Academic Work × Sex	7.21	2	3.61	0.11	NS
Attitude towards Academic Work × School type	12.99	2	6.50	0.20	NS
Sex × School type	804.76	1	804.76	24.47	0.01
Attitude towards Academic Work × Sex × School type	58.07	2	29.03	0.88	NS
Within cells	30715.06	934	32.89		
Total	34581.34	945	36.59		

Main Effect

The single effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Physics* were studied separately. The obtained F-values were found to be 28.81, 30.77, and 14.79 respectively. All the obtained F-values are well beyond the tabled values set at 0.01 level of significance at appropriate degrees of freedom. This result reveals that scores of *Achievement in Physics* of the total sample are dependent on the

scores of *Attitude towards Academic Work*, *Sex* of the subjects and *School type* on *Sex enrolment*.

First order interaction effect

It is seen from Table 4.8 that the F-value obtained for the first order interaction of *Sex* and *School type* on *Achievement in Physics* is 24.47 which is significant at 0.01 level of significance. This shows that scores of *Achievement in Physics* is influenced by the combined effect of *Sex* and *School type*. On the other hand, the F-values obtained for the interaction effect of *Attitude towards Academic Work* and *Sex* and *Attitude towards Academic Work* and *School type* (0.11 and 0.20) are not significant even at 0.05 level of significance. The result suggests that *Achievement in Physics* is not influenced by the combined effect of *Attitude towards Academic Work* and *Sex* and *Attitude towards Academic Work* and *School type*.

Second order interaction effect

Three-way ANOVA of second order interaction effect of *Attitude towards Academic Work* by *Sex* by *School type* shows that the obtained F-value is not significant even at 0.05 level of significance.

4.2.2 Investigation of the Main Effect of Each of the Select Five Independent Variables, Sex and School Type on Achievement in Chemistry for the Total Sample

Three-way ANOVA was undertaken to study the main effect and interaction effect of each of the select independent variables by *Sex* by *School type* based on sex enrolment on *Achievement in Chemistry*. Five separate ANOVA were computed for this purpose.

4.2.2.1 Main Effect and Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Chemistry

The results of the three-way ANOVA to study the single effect and interaction effect of *Classroom Learning Environment*, *Sex* and *School type* on *Achievement in Chemistry* are summarised in Table 4.9.

TABLE 4.9
Summary of Three-way ANOVA of Achievement in Chemistry by
Classroom Learning Environment by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Classroom Learning Environment	21.49	2	10.74	0.32	NS
Sex	120.44	1	120.44	3.54	NS
School type	797.72	1	797.72	23.47	0.01
Classroom Learning Environment × Sex	62.76	2	31.38	0.92	NS
Classroom Learning Environment × School type	102.64	2	51.32	1.51	NS
Sex × School type	1375.48	1	1375.48	40.48	0.01
Classroom Learning Environment × Sex × School type	64.44	2	32.22	0.95	NS
Within cells	31739.26	934	33.98		
Total	34808.87	945	36.83		

Main effect

The obtained F-values as per Table 4.9 for the single effect of *Classroom Learning Environment*, *Sex* and *School type* on *Achievement in Chemistry* are 0.32, 3.54 and 23.47 respectively. The first two F-values are not significant even at 0.05 level of significance. This result shows that scores of *Achievement in Chemistry* do not differ with differences in *Classroom Learning Environment* or *Sex* of the subjects. On the other hand, the third F-

value is significant at 0.01 level of significance. This result reveals that Achievement in Chemistry depends on School type based on Sex enrolment.

First order interaction effect

It is found that F-values obtained for the interaction of *Classroom Learning Environment* and *Sex* and that of *Classroom Learning Environment* and *School type* on *Achievement in Chemistry* are 0.92 and 1.51 respectively. These values are not significant even at 0.05 level of significance indicating that *Achievement in Chemistry* of the sample is not influenced by the combined effect of *Classroom Learning Environment* and *Sex*; or *Classroom Learning Environment* and *School type*. On the other hand, it can be seen that *Sex* × *School type* interaction effect on *Achievement in Chemistry* is found to be significant.

Second order interaction effect

The result of the three-way ANOVA of *Achievement in Chemistry* by *Classroom Learning Environment* by *Sex* by *School type* shows that F-value 0.95 is not significant even at 0.05 level of significance for degrees of freedom 2, 944, F being less than 3.00.

4.2.2.2 Main Effect and Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Chemistry

The results of the three-way ANOVA undertaken to find out the main effect and interaction effect of *Achievement Motivation*, *Sex* and *School type* on *Achievement in Chemistry* are presented in Table 4.10.

TABLE 4.10
Summary of Three-way ANOVA of Achievement in Chemistry by
Achievement Motivation by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Achievement Motivation	16.13	2	8.06	0.24	NS
Sex	109.50	1	109.50	3.21	NS
School type	904.36	1	904.36	26.49	0.01
Achievement Motivation × Sex	58.66	2	29.33	0.86	NS
Achievement Motivation × School type	119.50	2	59.75	1.75	NS
Sex × School type	1678.45	1	1678.45	49.16	0.01
Achievement Motivation × Sex × School type	89.15	2	44.57	1.31	NS
Within cells	31891.78	934	34.15		
Total	34808.87	945	36.83		

Main effect

As per Table 4.10, the F-value for the main effect of School type on Achievement in Chemistry is 26.49. This value is well beyond the tabled value set at 0.01 level of significance. This result indicates that scores on Achievement in Chemistry depend on the School type which is based on Sex enrolment.

The obtained F-values for the main effect of Achievement Motivation on Achievement in Chemistry and Sex on Achievement in Chemistry are 0.24 and 3.21 respectively. These values are not significant even at 0.05 level of significance. This result shows that Achievement in Chemistry does not differ significantly with the changes in the score of Achievement Motivation and Sex of the subjects/

First order interaction effect

It can be seen from Table 4.10 that the obtained F-values for the first order interaction effect of Achievement Motivation and Sex, Achievement Motivation and School type are 0.86 and 1.75 respectively. These values are not significant even at 0.05 level of significance suggesting that Achievement in Chemistry is not influenced by the joint effect of Achievement Motivation and Sex or Achievement Motivation and School type. On the other hand, it can be seen from Table 4.10 that the interaction effect of Sex and School type on Achievement in Chemistry is significant at 0.01 level, the obtained F-value being 49.16. This result indicates that Achievement in Chemistry is influenced by the combined effect of Sex and School type.

Second order interaction effect

Three-way ANOVA of second order interaction effect of *Achievement Motivation by Sex by school type* shows that the obtained F-value is not significant even at 0.05 level of significance.

4.2.2.3 Main Effect and Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Chemistry

The data regarding the main effect and interaction effect of *Self-Esteem, Sex, and School type on Achievement in Chemistry* is presented in Table 4.11.

TABLE 4.11
Summary of Three-way ANOVA of Achievement in Chemistry by
Self-Esteem by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Self-Esteem	806.75	2	403.37	12.10	0.01
Sex	84.10	1	84.10	2.52	NS
School type	893.95	1	893.95	26.82	0.01
Self-Esteem × Sex	48.24	2	24.12	0.72	NS
Self-Esteem × School type	54.27	2	27.14	0.81	NS
Sex × School type	1572.16	1	1572.16	47.16	0.01
Self-Esteem × Sex × School type	33.70	2	16.85	0.51	NS
Within cells	31136.93	934	33.34		
Total	34808.87	945	36.83		

Main effect

The obtained F-values for the main effect of *Self-Esteem* on *Achievement in Chemistry* and *School type* on *Achievement in Chemistry* are 12.10 and 26.82 respectively. These values are significant at 0.01 level of significance. This result indicates that the scores of *Achievement in Chemistry* differ significantly with *Self-Esteem* of the subjects and *School type*. But for the single effect of *Sex* on *Achievement in Chemistry*, the obtained F-value is not significant even at 0.05 level of significance. This

shows that the scores of *Achievement in Chemistry* is independent of Sex of the subjects.

First order interaction effect

It is seen from Table 4.11 that the F-value obtained for the first order interaction of Sex and School type on *Achievement in Chemistry* is 47.16 which is significant at 0.01 level of significance. This shows that scores of *Achievement in Chemistry* is influenced by the combined effect of Sex and School type. On the other hand, the F-values obtained for the interaction effect of *Self-Esteem* and Sex and *Self-Esteem* and School type (0.72 and 0.81 respectively) are not significant even at 0.05 level of significance. The result suggests that *Achievement in Chemistry* is not influenced by the combined effect of *Self-Esteem* and Sex and *Self-Esteem* and School type.

Second order interaction effect

Three-way ANOVA of second order interaction effect of *Self-Esteem* by Sex by School type shows that the obtained F-value is not significant even at 0.05 level of significance.

4.2.2.4 Main Effect and Interaction Effect of Attitude towards science, Sex and School type on Achievement in Chemistry

The main effect and interaction effect of *Attitude towards Science*, Sex and School type on *Achievement in Chemistry* were studied for the total sample. The summary of the three-way ANOVA is presented in Table 4.12.

TABLE 4.12
Summary of Three-way ANOVA of Achievement in Chemistry by
Attitude towards Science by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Attitude towards Science	3801.78	2	1900.89	64.75	0.01
Sex	357.87	1	357.87	12.19	0.01
School type	782.01	1	782.01	26.64	0.01
Attitude towards Science × Sex	170.74	2	85.37	2.91	NS
Attitude towards Science × School type	81.12	2	40.56	1.38	NS
Sex × School type	1364.20	1	1364.20	46.47	0.01
Attitude towards Science × Sex × School type	184.05	2	92.02	3.13	0.05
Within cells	27421.58	934	29.36		
Total	34808.87	945	36.83		

Main effect

The main effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement in Chemistry* were examined. As per Table 4.12, the F-values are 64.75, 12.19 and 26.64 respectively. All these values are significant at 0.01 level of significance. This result shows that scores of *Achievement in Chemistry* differ with differences in the *Attitude towards Science* of the subjects, *Sex* of the subjects and *School type*.

First order interaction effect

The obtained F-values for the first order interaction of *Attitude towards Science* by *Sex*; *Attitude towards Science* by *School type*; and *Sex* by *School type* on *Achievement in Chemistry* are 2.91, 1.38 and 46.47 respectively. Of these, the F-value of *Sex* × *School type* is greater than the tabled value set at 0.01 level of significance. This result suggests that scores of *Achievement in Chemistry* is influenced by the combined effect of *Sex* and *School type*. The scores of *Achievement in Chemistry* is not seen influenced by the combined effect of *Attitude towards Science* by *Sex* or *Attitude towards Science* by *School type* since the obtained F-values are not significant even at 0.05 level of significance.

Second order interaction effect

The result of the three-way ANOVA of *Achievement in Chemistry* by *Attitude towards Science* by *Sex* by *School type* shows that F-value 3.13 is significant at 0.5 level of significance. The result suggests that *Achievement in Chemistry* is influenced by the joint effect of *Attitude towards science*, *Sex* and *School type*.

4.2.2.5 Main Effect and Interaction Effect of Attitude towards Academic Work, Sex and School Type

The results obtained for the three-way ANOVA of *Achievement in Chemistry* by *Attitude towards Academic Work* by *Sex* by *School type* (N = 946) is summarised in Table 4.13.

TABLE 4.13
Summary of Three-way ANOVA of Achievement in Chemistry by
Attitude towards Academic Work by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Attitude towards Academic Work	1121.37	2	560.69	17.08	0.01
Sex	289.50	1	289.50	8.82	0.01
School type	1006.91	1	1006.91	30.67	0.01
Attitude towards Academic Work × Sex	134.76	2	67.38	2.05	NS
Attitude towards Academic Work × School type	38.77	2	19.39	0.59	NS
Sex × School type	1529.48	1	1529.48	46.58	0.01
Attitude towards Academic Work × Sex × School type	5.89	2	2.94	0.09	NS
Within cells	30667.61	934	32.83		
Total	34808.87	945	36.83		

Main effect

The obtained F-values as per Table 4.13 for the single effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Chemistry* are 17.08, 8.82 and 30.67 respectively. All the obtained F-values are well beyond the tabled values set at 0.01 level of significance. This result shows that scores of *Achievement in Chemistry* differ with differences in *Attitude towards Academic Work* of the subjects, *Sex* and *School type*.

First order interaction effect

It is found that F-values obtained for the interaction of *Attitude towards Academic Work* and *Sex* and that of *Attitude towards Academic Work*

and *School type* on *Achievement in Chemistry* are 2.05 and 0.59 respectively. These values are not significant even at 0.05 level indicating that *Achievement in Chemistry* of the sample is not influenced by the combined effect of *Attitude towards Academic Work* and *Sex*; or *Attitude towards Academic Work* and *School type*.

On the other hand, F-value obtained for the interaction of *Sex* and *School type* on *Achievement in Chemistry* ($F = 46.58$ for $df 1, 945$) is significant beyond 0.01 level. The result suggests that the scores of *Achievement in Chemistry* is influenced by the joint effect of *Sex* of the subjects and *School type*.

Second order interaction effect

The results for the second order interaction effect of *Attitude towards Academic Work* by *Sex* by *School type* on *Achievement in Chemistry* as per Table 4.13 reveal that F-value obtained is not significant at 0.01 level. This result shows that the scores of *Achievement in Chemistry* of the sample is independent of the combined effect of *Attitude towards Academic Work*, *Sex* and *School type*.

4.2.3 Investigation of the Main Effect of Each of the Select Five Independent Variables, Sex and School Type on Achievement in Physical Science for the Total Sample

The main effect and interaction effect of each of the select independent variables by *Sex* by *School type* based on sex enrolment on *Achievement in Physical Science* (total) for the total sample is discussed in the following section. For this purpose five separate ANOVA were computed.

4.2.3.1 Main Effect and Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Physical Science

The data regarding the main effect and interaction effect of *Classroom Learning Environment*, *Sex* and *School type* on *Achievement in Physical Science* is presented in Table 4.14.

TABLE 4.14
Summary of Three-way ANOVA of Achievement in Physical Science by Classroom Learning Environment by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Classroom Learning Environment	18.93	2	9.46	0.08	NS
Sex	1362.82	1	1362.82	11.86	0.01
School type	1955.72	1	1955.72	17.01	0.01
Classroom Learning Environment × Sex	294.84	2	147.42	1.28	NS
Classroom Learning Environment × School type	575.14	2	287.57	2.50	NS
Sex × School type	4335.74	1	4335.74	37.72	0.01
Classroom Learning Environment × Sex × School type	416.07	2	208.04	1.81	NS
Within cells	107369.19	934	114.96		
Total	117469.79	945	124.31		←

Main effect

The main effect of *Classroom Learning Environment*, *Sex* and *School type* on *Achievement in Physical Science* were examined. As per Table 4.14, the F-values are 0.08, 11.86 and 17.01 respectively. In the case of *Classroom Learning Environment*, the obtained F-value is less than the tabled value set at 0.05 level of significance. This shows that the scores on *Achievement in Physical Science* is independent of the scores of *Classroom Learning Environment*. But for the single effect of *Sex* and *School type* on

Achievement in Physical Science, the obtained F-values are greater than the tabled value set at 0.01 level of significance. This result indicates that the scores of *Achievement in Physical Science* differ significantly with Sex of the subjects and *School type*.

First order interaction effect

The obtained F-values for the first order interaction effect of *Classroom Learning Environment* by Sex; *Classroom Learning Environment* by *School type* and Sex by *School type* on *Achievement in Physical Science* are 1.28, 2.50 and 37.72 respectively. Of these, the F-value of Sex \times *School type* is greater than the tabled value (37.72) set at 0.01 level of significance. This result shows that scores of *Achievement in Physical Science* is influenced by the combined effect of Sex and *School type*. But the scores on *Achievement in Physical Science* is not seen influenced by the combined effect of *Classroom Learning Environment* \times Sex or *Classroom Learning Environment* \times *School type*.

Second order interaction effect

The result of the three-way ANOVA of *Achievement in Physical Science* by *Classroom Learning Environment* by Sex by *School type* shows that F-value 1.81 is not significant even at 0.05 level of significance.

4.2.3.2 Main Effect and Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Physical Science

The results of the three-way ANOVA to study the single effect and interaction effect of *Achievement Motivation*, Sex and *School type* on *Achievement in Physical Science* are summarised in Table 4.15.

TABLE 4.15
Summary of Three-way ANOVA of Achievement in Physical Science by
Achievement Motivation by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Achievement Motivation	11.88	2	5.94	0.05	NS
Sex	1578.99	1	1578.99	13.70	0.01
School type	2159.09	1	2159.09	18.74	0.01
Achievement Motivation × Sex	106.44	2	53.22	0.46	NS
Achievement Motivation × School type	526.45	2	263.22	2.28	NS
Sex × School type	5987.63	1	5987.63	51.96	0.01
Achievement Motivation × Sex × School type	676.81	2	338.40	2.94	NS
Within cells	107621.37	934	115.23		
Total	117469.79	945	124.31		

Main effect

The obtained F-value as per Table 4.15 for the single effect of *Achievement Motivation* on *Achievement in Physics* is 0.05 which is not significant even at 0.05 level of significance. But the obtained F-values for the single effect of *Sex*, *School type* on *Achievement in Physical Science* are 13.70 and 18.74 respectively. These two values are well beyond the tabled values set at 0.01 level of significance. This result shows that scores of

Achievement in Physical Science differ with differences in Sex of the subjects and *School type*.

First order interaction effect

According to Table 4.15, F-values obtained for the interaction effect of *Achievement Motivation* by Sex; and the interaction effect of *Achievement Motivation* by *School type* on *Achievement in Physical Science* are 0.46 and 2.28 respectively. These values are not significant even at 0.05 level of significance indicating that the scores of *Achievement in Physical Science* is not influenced by either the combined effect of *Achievement Motivation* and Sex or the combined effect of *Achievement Motivation* and *School type*.

The obtained F-value for the interaction effect of Sex and *School type* on *Achievement in Physical Science* is 51.96. As this F-value is greater than the tabled value at 0.01 level of significance, the result suggests that *Achievement in Physical Science* is influenced by the combined effect of Sex and *School type*.

Second order interaction effect

Three-way ANOVA of second order interaction effect of *Achievement Motivation* by Sex by *School type* shows that the obtained F-value is not significant even at 0.05 level of significance.

4.2.3.3 Main Effect and Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Physical Science

The results obtained for the three-way ANOVA of *Achievement in Physical Science* by *Self-Esteem* by Sex by *School type* (N = 946) is summarised in Table 4.16.

TABLE 4.16
Summary of Three-way ANOVA of Achievement in Physical Science by Self-Esteem by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Self-Esteem	3336.87	2	1668.44	14.83	0.01
Sex	1217.22	1	1217.22	10.82	0.01
School type	2196.75	1	2196.75	19.53	0.01
Self-Esteem × Sex	69.11	2	34.55	0.31	NS
Self-Esteem × School type	402.18	2	201.09	1.79	NS
Sex × School type	5021.72	1	5021.72	44.65	0.01
Self-Esteem × Sex × School type	33.31	2	16.66	0.15	NS
Within cells	105045.90	934	112.47		
Total	117469.79	945	124.31		

Main effect

The obtained F-values for the main effect of *Self-Esteem*, *Sex* and *School type* on *Achievement in Physical Science* are 14.83, 10.82 and 19.53 respectively. These values are well beyond the tabled value set at 0.01 level of significance. This result indicates that scores on *Achievement in Physical Science* depends on the *Self-Esteem* of the subjects, *Sex* and *School type*.

First order interaction effect

It is found that F-values obtained for the interaction of *Self-Esteem* and *Sex* and that of *Self-Esteem* and *School type* on *Achievement in Physical Science* are 0.31 and 1.79 respectively. These values are not significant even at 0.05 level of significance indicating that *Achievement in Physical Science* is not influenced by the combined effect of *Self-Esteem* and *Sex* or *Self-Esteem* and *School type*.

On the other hand, F-value obtained for the interaction of *Sex* and *School type* on *Achievement in Physical Science* is significant beyond - 0.05 level. The result suggests that the scores of *Achievement in Physical Science* is influenced by the joint effect of *Sex* of the subjects and *School type*.

Second order interaction effect

No significant second order interaction, i.e., *Achievement in Physical Science* by *Self-Esteem* by *Sex* by *School type* was found to exist since the obtained F-value (0.15) is far below the tabled value set at 0.05 level of significance.

4.2.3.4 Main Effect and Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physical Science

The data regarding the main effect and interaction effect of Attitude towards Science, Sex and School type on Achievement in Physical Science is presented in Table 4.17.

TABLE 4.17
Summary of Three-way ANOVA of Achievement in Physical Science by
Attitude towards Science by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Attitude towards Science	18179.35	2	9089.68	96.69	0.01
Sex	2959.35	1	2959.35	31.48	0.01
School type	2141.20	1	2141.20	22.78	0.01
Attitude towards Science × Sex	323.08	2	161.54	1.72	NS
Attitude towards Science × School type	111.97	2	55.98	0.60	NS
Sex × School type	4402.76	1	4402.76	46.83	0.01
Attitude towards Science × Sex × School type	744.39	2	372.19	3.96	.05
Within cells	87801.73	934	94.01		
Total	117469.79	945	124.31		

Main effect

The single effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement in Physical Science* were studied separately. The obtained F-values were found to be 96.69, 31.48 and 22.78 respectively. All the obtained F-values are well beyond the tabled values set at 0.01 level of significance at appropriate degrees of freedom. This result reveals that scores of *Achievement in Physical Science* for the total sample are dependent

on the scores of *Attitude towards Science*, *Sex* of the subjects and *School type* on sex enrolment.

First order interaction effect

It is seen from Table 4.17 that the F-value obtained for the first order interaction of *Sex* and *School type* on *Achievement in Physical Science* is 46.83 which is significant at 0.01 level of significance. This shows that scores of *Achievement in Physical Science* is influenced by the combined effect of *Sex* and *School type*. On the other hand, the F-values obtained for the interaction effect of *Attitude towards Science* and *Sex*; and *Attitude towards Science* and *School type* (1.72 and 0.60) are not significant even at 0.05 level of significance. The result suggests that *Achievement in Physical Science* is not influenced by the combined effect of *Attitude towards Science* and *Sex* and *Attitude towards Science* and *School type*.

Second order interaction effect

When the second order interaction effect of *Attitude towards Science* by *Sex* by *School type* on *Achievement in Physical Science* was studied, the obtained F-value 3.96 was found significant at 0.05 level. The result suggest that *Achievement in Physical Science* is influenced by the joint effect of *Attitude towards Science*, *Sex* and *School type*, i.e., *Sex* × *School type* interaction are not same for the different levels of *Attitude towards Science*.

4.2.3.5 Main Effect and Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physical Science

The results of the three-way ANOVA undertaken to find out the main effect and interaction effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Physical Science* are presented in Table 4.18.

TABLE 4.18
Summary of Three-way ANOVA of Achievement in Physical Science by
Attitude towards Academic Work by Sex by School Type (N = 946)

Source of Variation	Sum of Squares (S.S)	Degrees of Freedom (df)	Mean Square of Variance	F-Value	Level of Significance
Attitude towards Academic Work	5885.32	2	2942.66	26.83	0.01
Sex	2361.38	1	2361.38	21.53	0.01
School type	2918.00	1	2918.00	26.60	0.01
Attitude towards Academic Work × Sex	145.83	2	72.92	0.66	NS
Attitude towards Academic Work × School type	11.14	2	5.57	0.05	NS
Sex × School type	4584.24	1	4584.24	41.79	0.01
Attitude towards Academic Work × Sex × School type	60.25	2	30.12	0.27	NS
Within cells	102454.32	934	109.69		
Total	117469.79	945	124.31		

Main effect

The F-values obtained for the main effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Physical Science* are 26.83, 21.53 and 26.60 respectively. The obtained F-values are well beyond the tabled values set at 0.01 level of significance. The results suggest that *Achievement in Physical Science* can be considered to be varying with the

scores of *Attitude towards Academic Work*, *Sex* of the subjects and *School type*.

First order interaction effect

It is seen from Table 4.18 that the interaction effect of *Sex* and *School type* on *Achievement in Physical Science* is significant at 0.01 level, the obtained F-value being 41.79. This result shows that *Achievement in Physical Science* is influenced by the combined effect of *Sex* and *School type*. But the F-values obtained for the first order interaction of *Attitude towards Academic Work* and *Sex* and *School type* are 0.66 and 0.05 respectively. These values are not significant even at 0.05 level of significance. This result suggests that *Achievement in Physical Science* is not influenced by the joint effect of *Attitude towards Academic Work* and *Sex* and *Attitude towards Academic Work* and *School type*.

Second order interaction effect

When the second order interaction effect of *Attitude towards Academic Work* by *Sex* by *School type* on *Achievement in Physical Science* was studied, the obtained F value (0.27) was found to be not significant even at 0.05 level of significance. The result suggests that *Achievement in Physical Science* is not influenced by the joint effect of *Attitude towards Academic Work*, *Sex* and *School type*.

4.2.4 Discussion of Three-Way ANOVA

Three-way ANOVA was undertaken to examine the main effect and interaction effect of Classroom Learning Environment, *Sex* and *School type* in *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science* for total sample (N = 946) separately. Similar procedure was followed to study the effect of *Achievement Motivation*, *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work* separately in combination with *Sex* and *School type* on *Achievement in Physical Science* (Physics, Chemistry and Total). Results of the three-way ANOVA are discussed in the following text.

4.2.4.1 Summary of Three-way ANOVA of Achievement in Physical Science (Physics, Chemistry and Total) by Classroom Learning Environment by Sex by School Type

Summary of the three $3 \times 2 \times 2$ factorial ANOVA is presented in Table 4.19.

TABLE 4.19
Summary of Three-way ANOVA of Achievement in Physical Science (Physics, Chemistry and Total) by Classroom Learning Environment by Sex by School Type (N = 946)

Independent Variables	Degrees of Freedom	Dependent Variables		
		Achievement in Physics F-Value	Achievement in Chemistry F-value	Achievement in Physical Science F-value
Classroom Learning Environment (CLE)	2	0.02	0.32	0.08
Sex	1	19.69**	3.54	11.86**
School type	1	7.28**	23.47**	17.01**
CLE × Sex	2	1.36	0.92	1.28
CLE × School type	2	3.28*	1.51	2.50
Sex × School type	1	23.76**	40.48**	37.72**
CLE × Sex × School type	2	2.42	0.95	1.81

CLE - Classroom Learning Environment

** - Significant at 0.01 level

* - Significant at 0.05 level

Out of the three F-values obtained for the study of the main effect of Classroom Learning Environment on Achievement in Physics,

Achievement in Chemistry and *Achievement in Physical Science*, none of the F-values was found to be significant.

The main effect of *Sex* on *Achievement in Physics* and *Physical Science* (total) was found significant at 0.01 level, but for *Achievement in Chemistry*, it was not significant.

All the F-values obtained for the main effect of *School type* on *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science* are found to be significant at 0.01 level.

Regarding the first order interaction, all the three F-values obtained for *Sex* by *School type* interaction on *Achievement in Physics*, *Chemistry* and *Physical Science* (total) are found to be significant (beyond 0.01 level). *Classroom Learning Environment* by *School type* interaction is significant on *Achievement in Physics* only. *Classroom Learning Environment* by *Sex* by *Achievement in Physical Science* is not seen significant for any of the three ANOVA computed.

Second order interaction (*Classroom Learning Environment* by *Sex* by *School type*) on *Achievement in Physical Science* (Physics, Chemistry and Total) are also not significant.

4.2.4.2 Summary of the Three-way ANOVA of Achievement in Physical Science (Physics, Chemistry and Total) by Achievement Motivation by Sex by School Type

The results of the three $3 \times 2 \times 2$ factorial ANOVA computed were summarised and presented in Table 4.20.

TABLE 4.20
Summary of Three-way ANOVA of Achievement in Physical Science
(Physics, Chemistry and Total) by Achievement
Motivation by Sex by School Type (N = 946)

Independent Variables	Degrees of Freedom	Dependent Variables		
		Achievement in Physics F-Value	Achievement in Chemistry F-value	Achievement in Physical Science F-value
Achievement Motivation (AM)	2	0.69	0.24	0.05
Sex	1	25.20**	3.21	13.70**
School type	1	7.69**	26.49**	18.74**
AM × Sex	2	0.32	0.86	0.46
AM × School type	2	2.48	1.75	2.28
Sex × School type	1	38.30**	49.16**	51.96**
AM × Sex × School type	2	5.55**	1.31	2.94

AM - Achievement Motivation

** - Significant at 0.01 level

* - Significant at 0.05 level

It can be noticed from Table 4.20 that the main effect of *Achievement Motivation* on *Achievement in Physical Science* (Physics, Chemistry and Total) are not significant since all the three F-values obtained are far below the accepted level for significance (below 3.85 for df 2/944). Single effect of *Sex* on *Achievement in Physics* and *Physical Science* are found to be significant at 0.01 level. On the other hand, the main effect of *School type* on *Achievement in Physical Science* (Physics, Chemistry, Total) are found to be significant in all the three F-values computed.

Table 4.20 also reveals that while *Sex by School type by Achievement in Physics* is significant in all the three factorial ANOVA computed ($F < 6.69$ for $df\ 1/1000$). None of the other two first order interactions (either *Achievement Motivation × Sex* or *Achievement Motivation × School type*) are significant.

While *Achievement Motivation × Sex × School type* interaction on *Achievement in Physics* is found to be significant ($F < 4.63$ for $df\ 2/944$), the other two second order interactions (for Chemistry and total) are not significant.

4.2.4.3 Summary of Three-way ANOVA of Achievement in Physical Science (Physics, Chemistry and Total) by Self-Esteem by Sex by School Type

Results of the $3 \times 2 \times 2$ factorial ANOVA computed to study the effect of Self-Esteem, Sex and School type on Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science are summarised and presented in Table 4.21.

TABLE 4.21

Summary of Three-way ANOVA of Achievement in Physical Science
(Physics, Chemistry and Total) by Self-Esteem by Sex by School Type

(N = 946)

Independent Variables	Degrees of Freedom	Dependent Variables		
		Achievement in Physics F-Value	Achievement in Chemistry F-value	Achievement in Physical Science F-value
Self-Esteem (SE)	2	12.83**	12.10**	14.83**
Sex	1	19.76**	2.52	10.82**
School type	1	8.33**	26.82**	19.53**
SE × Sex	2	0.38	0.72	0.31
SE × School type	2	2.43	0.81	1.79
Sex × School type	1	28.44**	47.16**	44.65**
SE × Sex × School type	2	0.00	0.51	0.15

SE - Self-Esteem

** - Significant at 0.01 level

* - Significant at 0.05 level

It can be noticed from Table 4.21 that the main effect of *Self-Esteem* and *School type* on *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science* are significant well beyond 0.01 level for appropriate degrees of freedom. The main effect of *Sex* on *Achievement* is found to be significant in two out of the three ANOVA computed.

While *Sex* by *School type* interaction on *Achievement* is significant in all the three ANOVA computed, none of the other two first order interaction (*Self-Esteem* by *Sex* and *Self-Esteem* by *School type*) on *Achievement* is significant.

Similarly, second order interaction (*Self-Esteem* × *Sex* × *School type*) on *Achievement* is not significant in any of the three ANOVA computed.

4.2.4.4 Summary of Three-way ANOVA of Achievement in Physical science (Physics, Chemistry and Total) by Attitude towards Science by Sex by School Type

Three $3 \times 2 \times 2$ factorial ANOVA was computed to study the single effect and joint effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement in Physics, Chemistry and Physical Science*. The summary of the results are presented in Table 4.22.

TABLE 4.22
Summary of Three-way ANOVA of Achievement in Physical Science
(Physics, Chemistry and Total) by Attitude towards
Science by Sex by School Type (N = 946)

Independent Variables	Degrees of Freedom	Dependent Variables		
		Achievement in Physics F-Value	Achievement in Chemistry F-value	Achievement in Physical Science F-value
Attitude towards Science (ATS)	2	94.96**	64.75**	96.69**
Sex	1	44.75**	12.19**	31.48**
School type	1	11.50**	26.64**	22.78**
ATS × Sex	2	0.96	2.91	1.72
ATS × School type	2	0.06	1.38	0.60
Sex × School type	1	29.96**	46.47**	46.83**
ATS × Sex × School type	2	3.65*	3.13*	3.96*

ATS - Attitude towards Science

** - Significant at 0.01 level

* - Significant at 0.05 level

As per Table 4.22, it can be noticed that all the nine F-values computed to study the single effect of *Attitude towards Science*, *Sex* and *School type* (three each for each independent variable) on *Achievement in Physical Science* are significant beyond 0.01 level.

Regarding the first order interaction, only *Sex by School type* interaction on *Achievement* is significant. All the three F-values are significant beyond 0.01 level.

Second order interaction of *Attitude towards Science by Sex by School type* on *Achievement in Physical Science* is found to be significant; the three F-values are significant at 0.05 level.

4.2.4.5 Summary of Three-way ANOVA of Achievement in Physical Science (Physics, Chemistry and Total) by Attitude towards Academic Work by Sex by School Type

Summary of the $3 \times 2 \times 2$ ANOVA of Attitude towards Academic Work by Sex by School type on Achievement in Physical Science is presented in Table 4.23.

TABLE 4.23
Summary of Three-way ANOVA of Achievement in Physical Science
(Physics, Chemistry and Total) by Attitude towards
Academic Work by Sex by School Type (N = 946)

Independent Variables	Degrees of Freedom	Dependent Variables		
		Achievement in Physics F-Value	Achievement in Chemistry F-value	Achievement in Physical Science F-value
Attitude towards Academic Work (ATS)	2	28.81**	17.08**	26.83**
Sex	1	30.77**	8.82**	21.53**
School type	1	14.79**	30.67**	26.60**
ATA × Sex	2	0.11	2.05	0.66
ATA × School type	2	0.20	0.59	0.05
Sex × School type	1	24.47**	46.58**	41.79**
ATA × Sex × School type	2	0.88	0.09	0.27

ATA - Attitude towards Academic Work

** - Significant at 0.01 level

All the nine F-values obtained to study the main effect of *Attitude towards Academic Work*, *Sex* and *School type* (three each for each independent variable) are found to be significant ($p < .01$ level).

First order interaction of *Sex × School type* on *Achievement in Physics*, *Chemistry* and *Physical Science* are significant; all the obtained F-values are significant beyond 0.01 level. The other two first order interactions (*Attitude towards Academic Work × Sex* or *Attitude towards Academic Work × School type*) are not significant. Similarly, the second order interaction of *Attitude towards Academic Work × Sex × School type* is also not

found to be significant as the F-values obtained are far below the accepted level for significance at 0.05 level.

Comments

When the summary of the results of fifteen three-way ANOVA as per Tables 4.19, 4.20, 4.21, 4.22 and 4.23 was studied, the following findings were noticed:

- (i) Variables which show significant main effect on *Achievement in Physical Science*, *Achievement in Physics* and *Achievement in Chemistry* are listed below:

Self-Esteem

Attitude towards Science

Attitude towards Academic Work

School type

F-values for the study of main effect of Sex on *Achievement in Physical Science* were found to be significant for thirteen out of fifteen ANOVA computed.

- (ii) No significant main effect on *Achievement in Physical Science* was noticed in the case of the following variables:

Classroom Learning Environment

Achievement Motivation

- (iii) First order interactions of the following variables on *Achievement in Physical Science* were found to be significant.

Sex \times School type - All 15 F-values are significant

Classroom Learning Environment - One F-value is significant

\times School type

- (iv) None of the other first order interaction are significant.
- (v) Second order interactions of the following variables were found to be significant.

Attitude towards Science × *Sex* × *School type* on *Achievement in Physics*, on *Achievement in Chemistry* and *Achievement in Physical Science* are found to be significant at 0.05 level.

Achievement Motivation × *Sex* × *School type* on *Achievement in Physics* is significant beyond 0.01 level.

(vi) Other second order interactions are not significant even at 0.05 level.

4.2.5 Graphical Representation of Interactions

The graphs of the interaction effects provide a pictorial representation of the interactions of the different variables. They highlight the depth of the combined effect of the independent variables on the dependent / criterion variable. They are presented under the following heads:

4.2.5.1 Graphical Representation of Interaction Effect of Each of the Independent Variables, *Sex* and *School Type* on *Achievement in Physics* for the Total Sample

4.2.5.2 Graphical Representation of the Interaction Effect of Each of the Independent Variables, *Sex* and *School Type* on *Achievement in Chemistry* for the Total Sample

4.2.5.3 Graphical Representation of the Interaction Effect of Each of the Independent Variables, *Sex* and *School Type* on *Achievement in Physical Science* for the Total Sample

4.2.5.1.1 Graphical Representation of Interaction Effect of Classroom Learning Environment, *Sex* and *School Type* on *Achievement in Physics* for the Total Sample

Significant first order interaction was noticed for two out of the three first order interactions computed in the three-way ANOVA of *Achievement in Physics* by *Classroom Learning Environment* by *Sex* by *School type* while interaction of *Classroom Learning Environment* by *School type* on *Achievement in Physics* is significant at 0.05 level, the interaction of *Sex* by *School type* on *Achievement in Physics* is significant at 0.01 level. But

no significant second order interaction was noticed. Therefore, the investigator made an attempt to study the nature of the relations of the variables graphically since graph is considered to be one of the most powerful tools of analysis.

For the purpose of graphical representation of the interaction, the mean scores of the dependent variables *Achievement in Physics* of the subjects were plotted as the ordinate of the graph and three groups of subjects categorised on the basis of *Classroom Learning Environment* were marked in abscissa. Mean Achievement scores of boys and girls categorised on the basis of School type was marked separately in Figure 4-1.

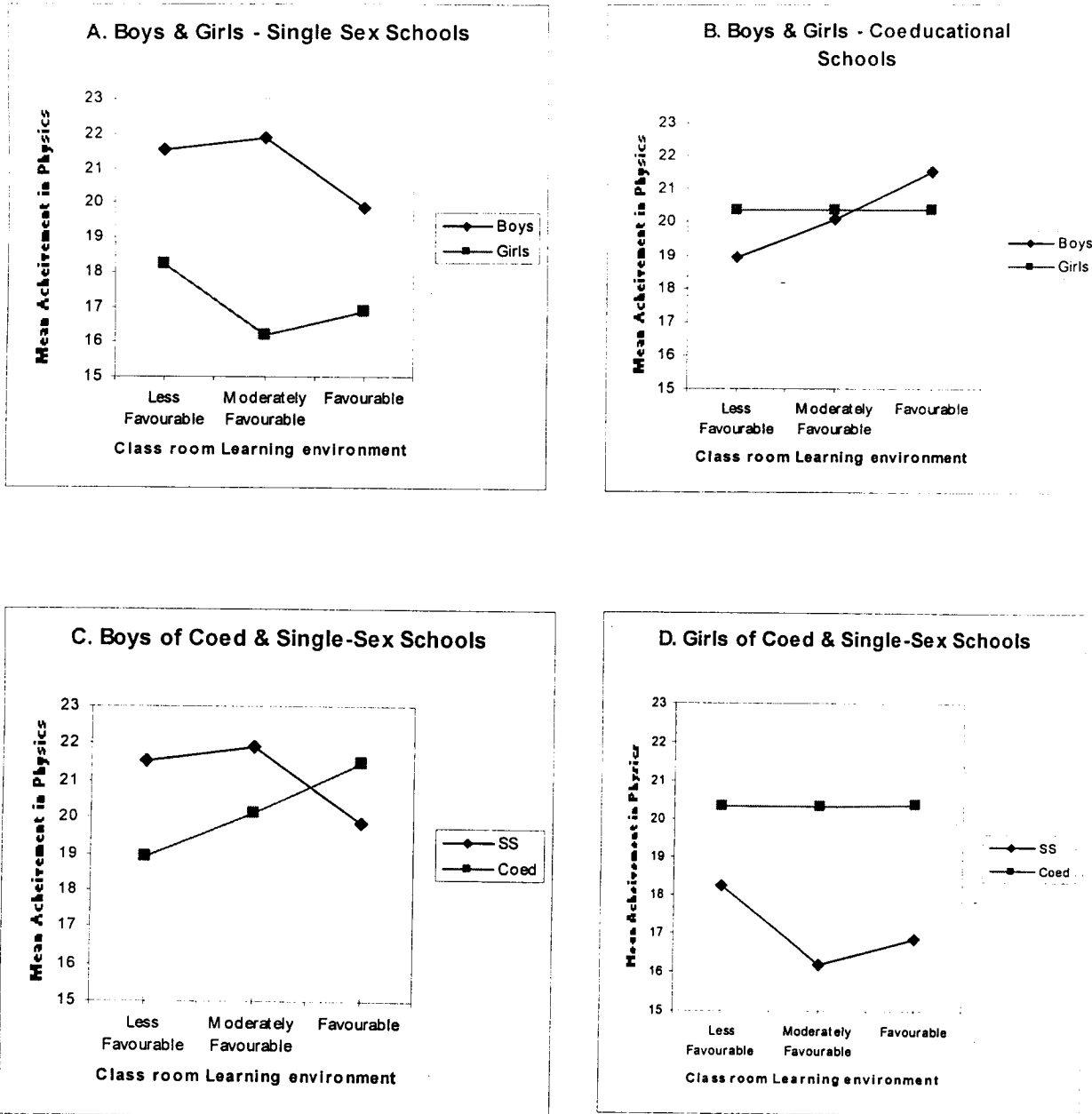


FIGURE - 4-1

Interaction Effect of Classroom Learning Environment,
Sex and School Type on Achievement in Physics

The pattern of relationship among the variables *Classroom Learning Environment Sex* and *School type* were examined separately. An examination of the graphical representation of the relationship of the qualitative variable *Achievement in Physics* by the qualitative variable *Classroom Learning Environment* of boys and girls of *Coeducational* and *Single-sex* schools reveal that the separation between the lines are not horizontal especially in Figure 4-1 A, C, and D.

It can be noticed from Figure 4.1 A that Mean *Achievement in Physics* scores of boys and girls of three levels of *Classroom Learning Environment* are consistently different in '*Single-sex schools*'; boys consistently having higher means; but the means of boys and girls of *Coeducational* schools are almost uniform vide Figure 4-1 B. This indicates that the trend of sex difference in *Achievement in Physics* is not similar in *single-sex schools* and *coeducational schools*.

While the difference in mean *Achievement in Physics* scores of boys and *Coeducational* and *Single-sex* schools in *Less Favourable Classroom Learning Environment* is marked, the difference are seen in reverse direction for *Favourable Classroom Learning Environment*. That is, an antagonistic interaction which is illustrated in Figure 4-1 C. By contrast, the girls of three levels of *Classroom Learning Environment* in *Coeducation* schools are almost same as indicated by almost a straight line (Figure 4-1 D); but girls of three levels of *Classroom Learning Environment* perform differently in *Single-sex schools*; the performance being better in *Coeducational Schools* in all the three levels of *Classroom Learning Environment*.

4.2.5.1.2. Graphical Representation of Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Physics for the Total Sample

In the three-way ANOVA computed, besides significant main effect of *Sex* and *School type* on *Achievement in Physics*, first order interaction effect of *Sex* and *School type* on *Achievement* were also noticed.

Further, second order interaction of *Achievement in Physics* by *Achievement Motivation* by *Sex* by *School type* was also found to be significant beyond 0.01 level. Graph showing a plot of the means of *Achievement in Physics* so as to demonstrate the relationship between Achievement scores and *Achievement Motivation* of boys and girls in *Coeducational schools* versus *Single-sex schools* is presented in Figure 4-2.

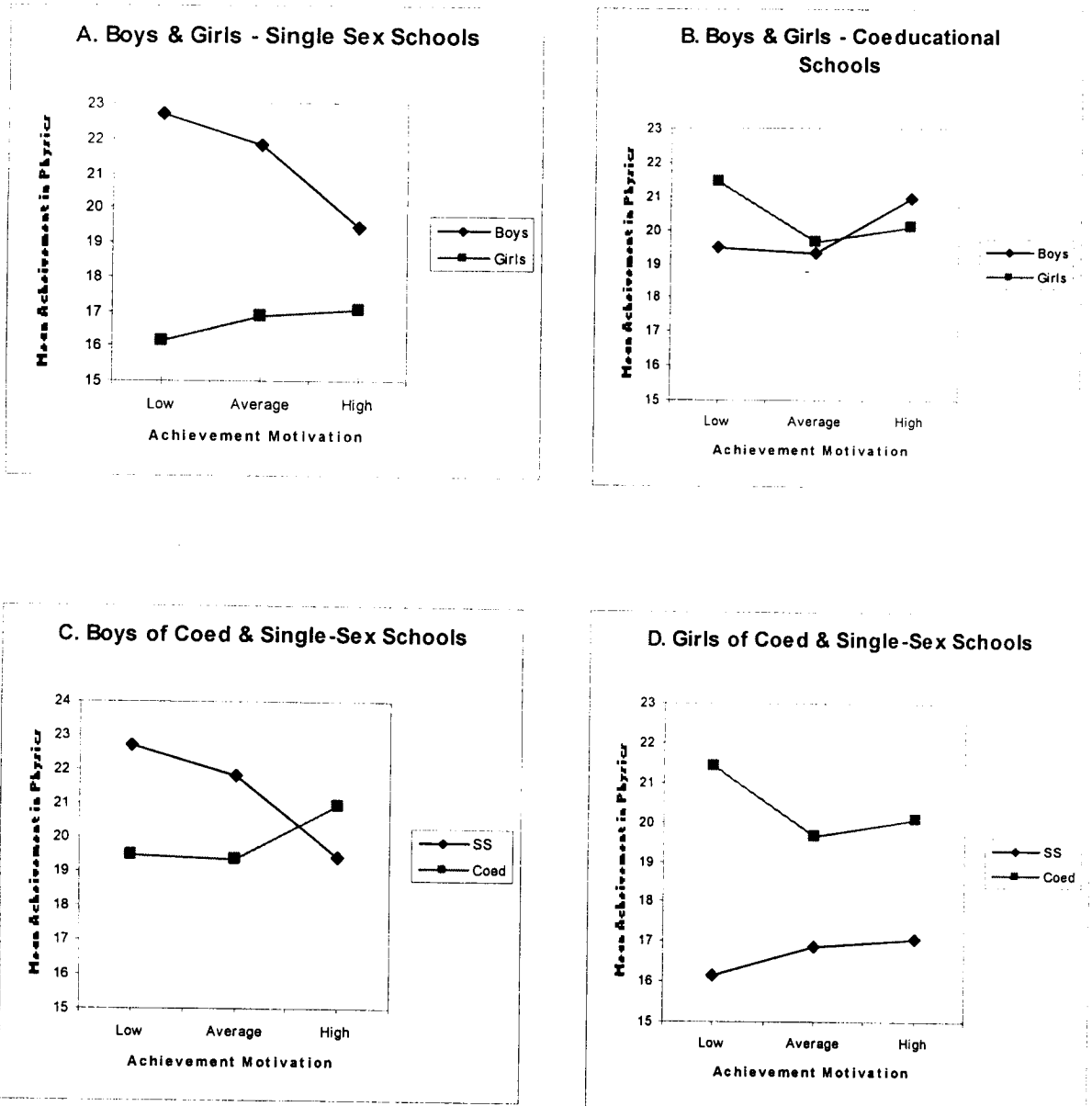


FIGURE - 4-2

Interaction Effect of Achievement Motivation, Sex and School Type
on Achievement in Physics

It can be noted that Sex difference in *Achievement in Physics* become narrower for students of High – Achievement Motivation group than for students of Low – Achievement Motivation and Average – Achievement Motivation group in *Single-sex* schools. Figure 4-2 A shows this interaction termed as Ceiling effect Interaction (McBurney, 2002). On the other hand, Sex difference is consistently narrow or almost nil for all the three levels of *Achievement Motivation* in *Coeducational* schools.

Regarding the performance of boys in *Coeducational* and *Single-sex* schools, it will be noted that the differences based on School type are in the opposite direction for the High – Achievement Motivation Group, i.e., an antagonistic interaction is noticed here also (vide Figure 4-2. C). On the other hand, the performance of girls in *Coeducational* and *Single-Sex* schools reveal that the difference became narrower in Average – ; and High – Achievement Motivation group. Whether or not boys are superior to girls in mean *Achievement in Physics* depends upon whether they are from *Coeducational* schools or *Single-sex* schools. The graph further indicates that the Sex by School type interaction is not the same for the different levels of *Achievement Motivation* of the sample, hence F-being significant in the three-way interaction.

4.2.5.1.3. Graphical Representation of Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Physics for the Total Sample

Even though significant main effect was noticed for all the three variables namely *Self-Esteem*, *Sex* and *School type* on *Achievement in Physics*, significant first order interaction was noticed only for Sex by School type. Second order interaction was also found not to be significant. Here also, an attempt was made to study the result of the interaction graphically. The pattern of relationship was plotted separately for boys and girls of *Single-Sex* schools and *Coeducational* schools of the total sample. The graphical relationship of *Achievement in Physics* by *Self-Esteem* by Sex by School type is presented in Figure 4-3.

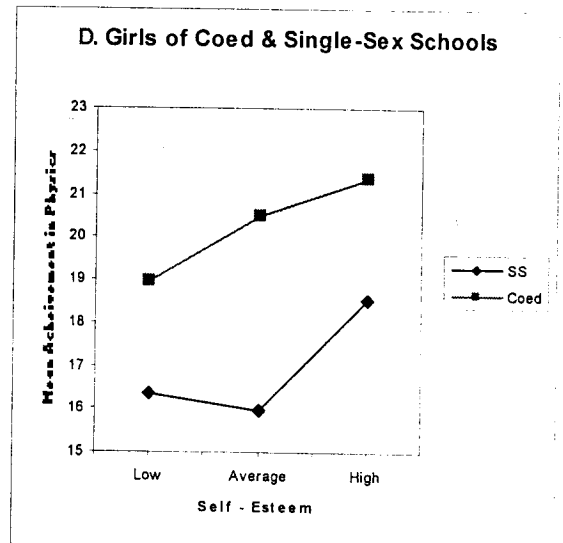
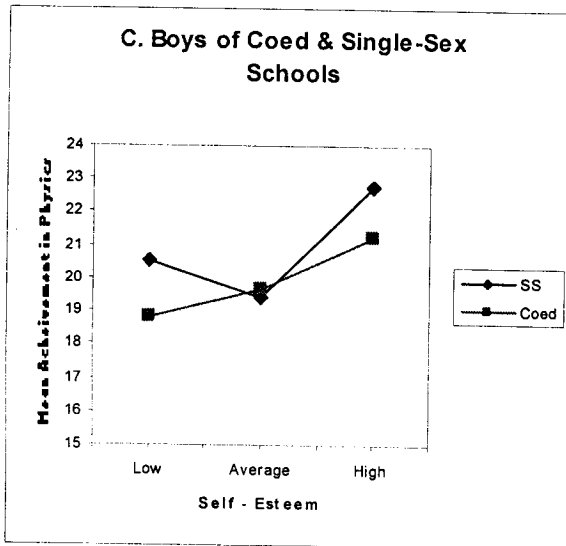
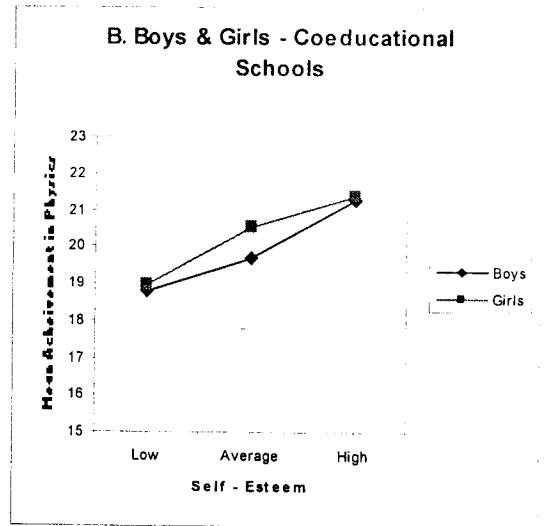
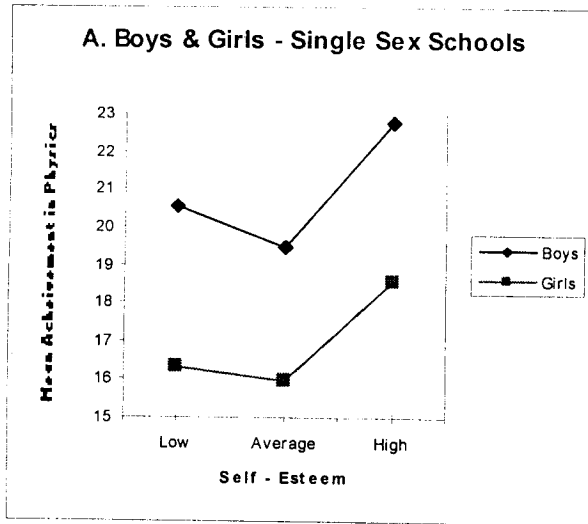


FIGURE - 4-3

Interaction Effect of Self Esteem, Sex and School Type on
Achievement in Physics

The pattern of relationship of *Achievement in Physics* and *Self-Esteem* of boys and girls was examined separately for the sample of *Single-sex* schools and *Coeducational* schools. By examining the pattern of relationship, it is possible to determine whether the means of *Achievement in Physics* owe their divergence to *Sex* difference, the differences in *School type* or to both at three levels of *Self-Esteem*.

The graphs given in Figure 4-3 A and 4-3 D reveal that the line representing the mean *Achievement in Physics* of both boys and girls of *Single-sex* schools and girls of *Coeducational* and *Single-sex* schools at three levels of *Self-Esteem* are not parallel. From Average *Self-Esteem* to High *Self-Esteem*, a synergistic interaction is seen in 4-3 A whereas a ceiling effect interaction is seen in 4-3 D. It can also be noted that boys score higher mean score than girls of *Single-sex* schools and girls of *Coeducational* schools have higher means at all the three levels of *Self-Esteem*.

Differences in the slope of the lines depicting the means in *Achievement in Physics* of boys and girls is seen dependent on whether they are from *Coeducational* school or *Single-sex* school. Higher mean achievement score is seen associated with *High Self-Esteem groups* irrespective of differences in *Sex* and *School type*.

4.2.5.1.4. Graphical Representation of Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physics for the Total Sample

Significant main effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement in Physics* was noticed in the three-way ANOVA, but significant first order interaction was noticed only for *Sex* by *School type* on *Achievement in Physics*. Moreover, second order interaction is also found to be significant at 0.05 level. Figure 4-4 shows a plot of the means so as to demonstrate the relationship between scores of *Achievement in Physics*, *Sex* and *School type* in the sample categorised into three nearly identical levels based on scores of *Attitude towards Science* namely Favourable – ; Moderately Favourable and Less Favourable group.

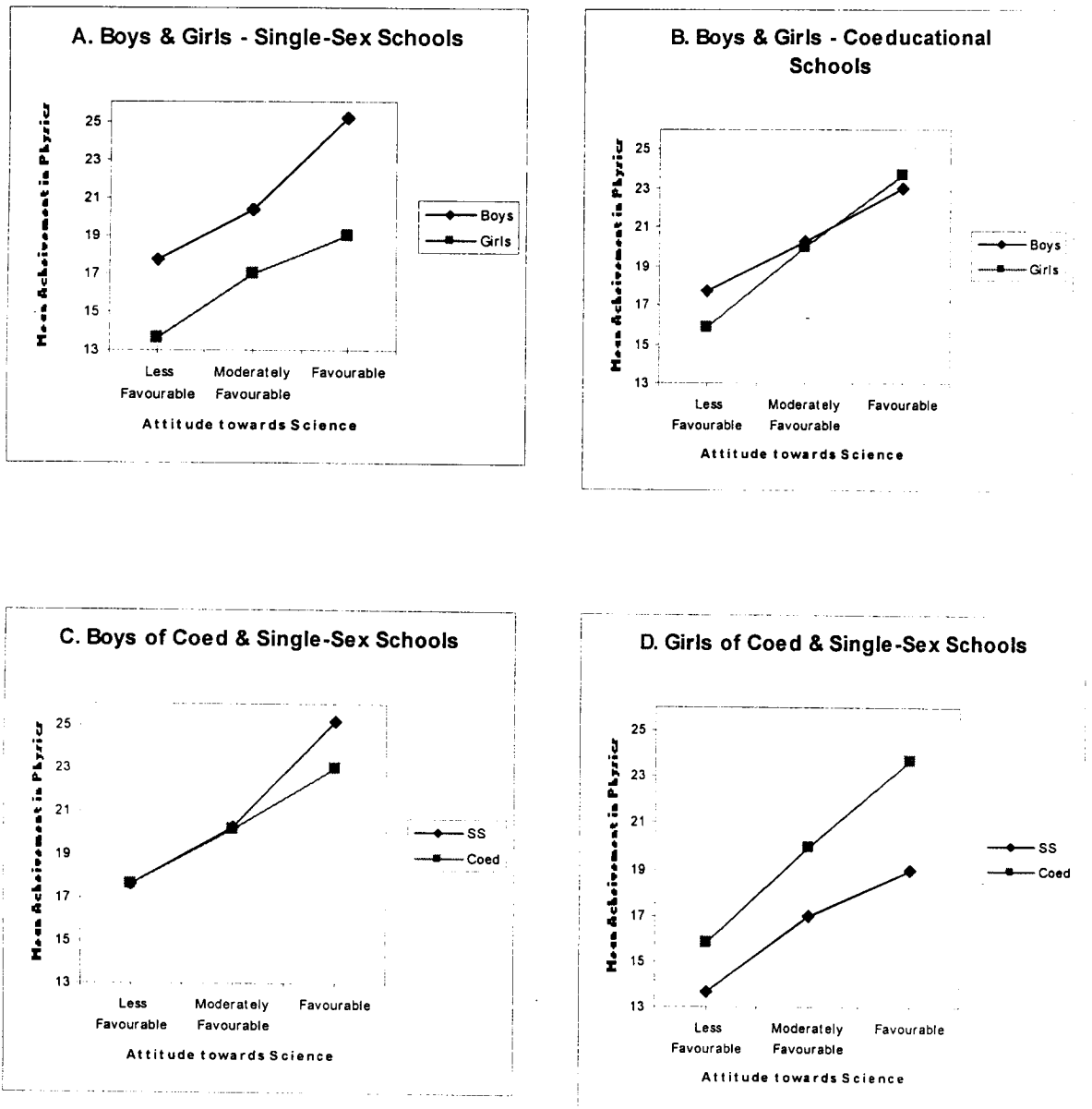


FIGURE - 4-4

Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physics

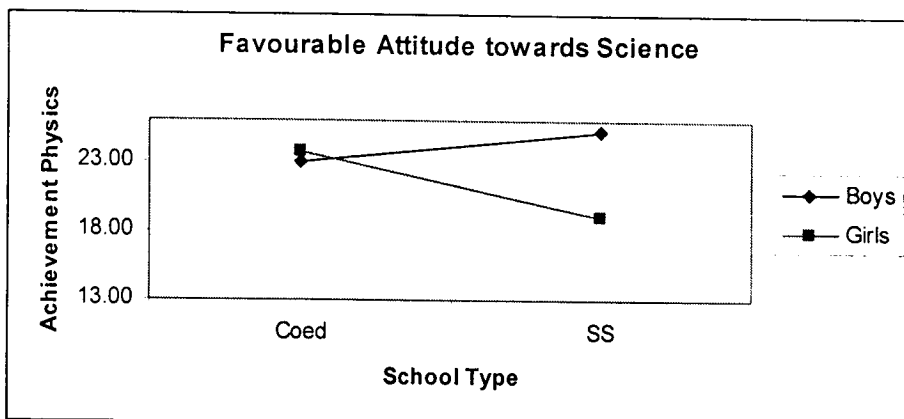
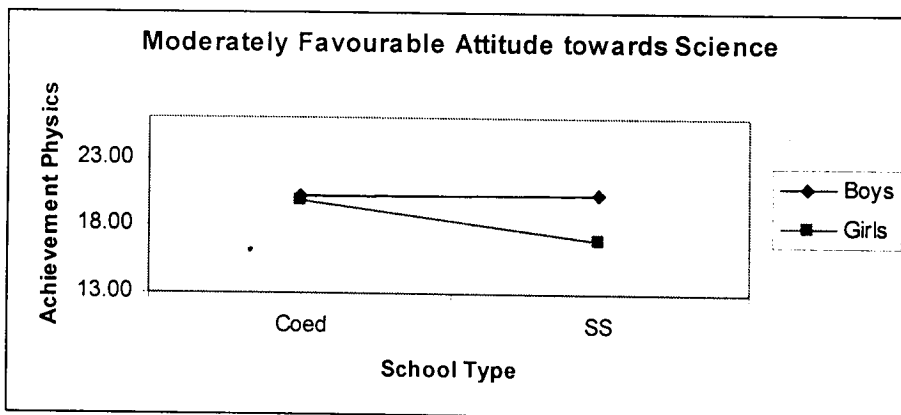
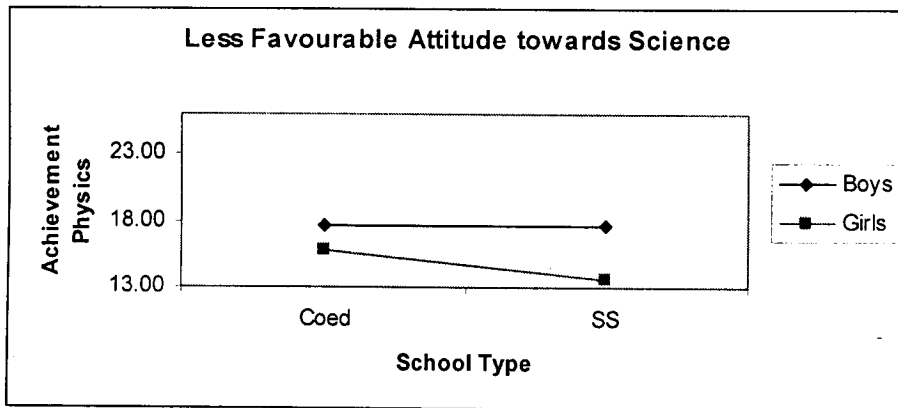


FIGURE - 4-4E

**Achievement in Physics by Attitude towards Science by Sex by
School Type**

An examination of the graph Figure 4-4 A shows that the four lines representing the mean scores in *Achievement in Physics* of boys and girls of *Coeducational* and *Single-sex* schools at three levels of *Attitude towards Science* are not horizontal. This suggests the significant main effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement in Physics*. The fact that the two lines separating the effect of *Sex* and *School type* on *Achievement* are not parallel further illustrates the interaction effect in the F-test. The slope of the lines further suggest that the interaction is a synergistic interaction, that is, the more favourable are of the subjects (both boys and girls) *Attitude towards Science*, the larger the scores in *Achievement in Physics* tend to be (i.e., downward slope of the line from Favourable – *Attitude towards Science* to Less – Favourable *Attitude towards Science*). The graph (Figure 4-4 E) also indicates that the *Sex* × *School type* interactions are not the same for the three different categories of the variable *Attitude towards Science*.

4.2.5.1.5. Graphical Representation of Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physics for the Total Sample

Since significant main effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Physics* was noticed and *Sex* by *School type* interaction was also found to be significant in the three –way factorial ANOVA, the interaction was studied graphically. The graph is presented as Figure 4-5.

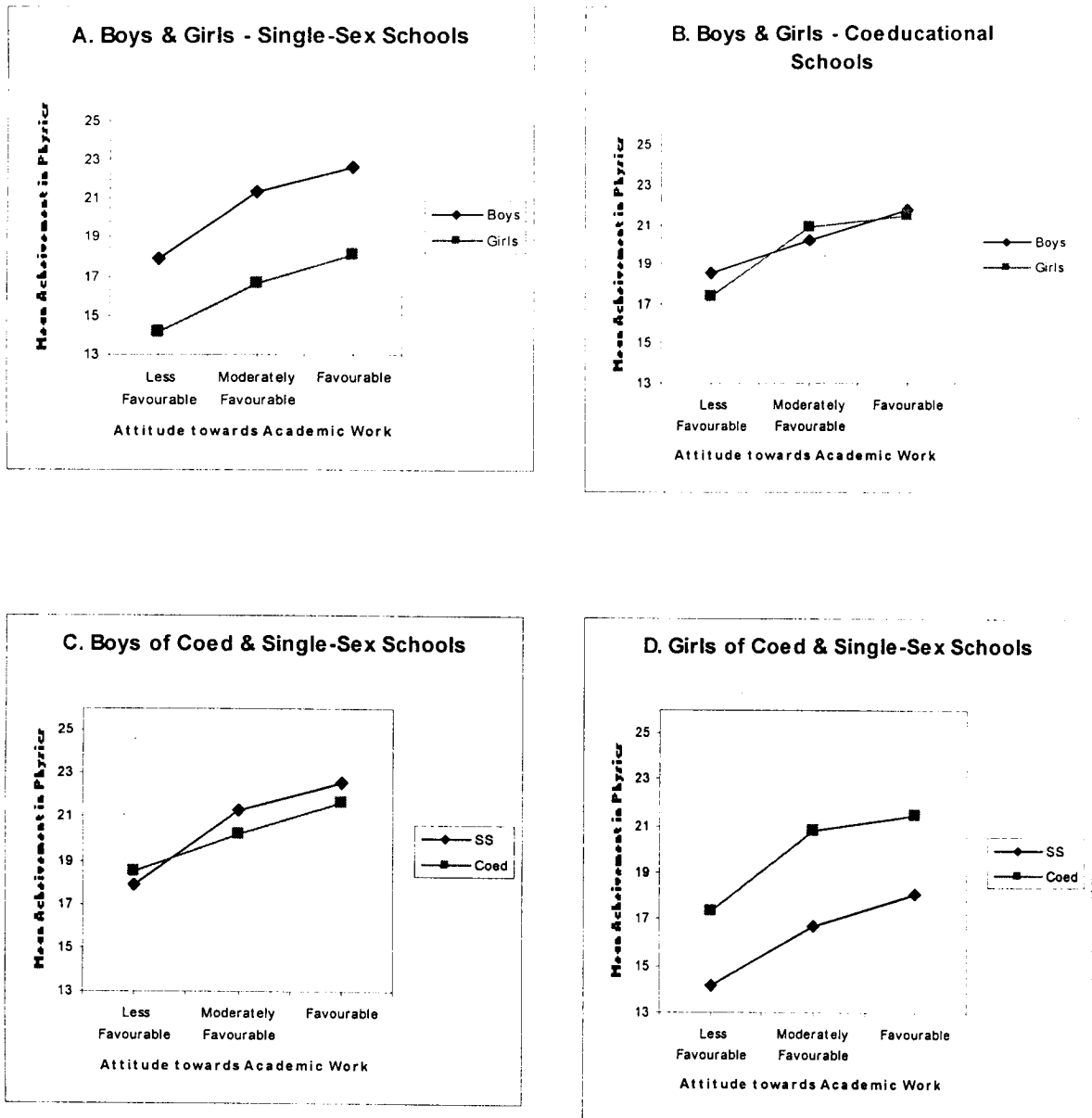


FIGURE - 4-5

Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physics

The fact that the four lines in Figure 4-5 A depicting the *Achievement in Physics* of boys and girls of three levels of *Attitude towards Academic Work* of *Coeducational* schools and *Single-sex* schools are horizontal suggests that the main effect of the three variables on achievement are significant. It is also noticed that the mean achievement scores of boys and girls irrespective of *School type* are not parallel, indicating that there is an interaction effect. It is noteworthy that *Sex* difference in *Achievement in Physics* is greater in *Single-sex* school as indicated by the wider gap of the lines. The slope of the lines suggest that the two variable interaction (synergistic interaction) are same for the third variable *Attitude towards Academic Work* at the three different levels (Figure 4-5 B). Hence, F-value was found to be not significant.

4.2.5.2.1 Graphical Representation of Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Chemistry for the Total Sample

An examination of the scores of variance in the three-way ANOVA shows how the independent variable *Classroom Learning Environment* might influence the variance of the scores on *Achievement in Chemistry* across the levels of the factors *Sex* and *School type*. *Sex* × *School type*-interaction noticed in the three-way ANOVA was illustrated by plotting graph with mean scores of *Achievement in Chemistry* plotted as the ordinate of the graph and the three groups of subjects categorised on the basis of *Classroom Learning Environment* marked as abscissa. The graph is presented in Figure 4-6.

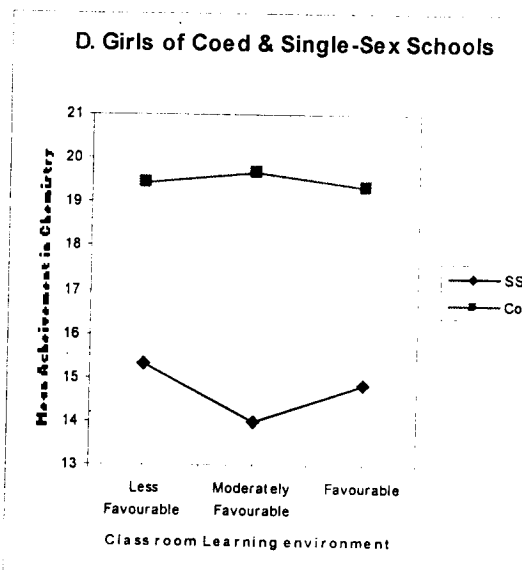
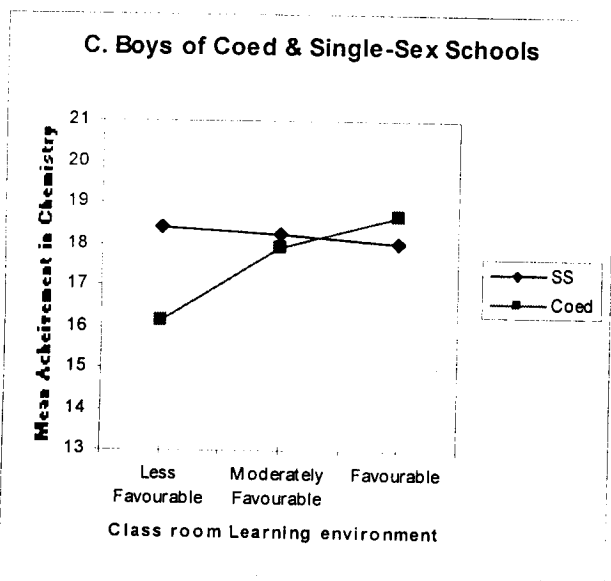
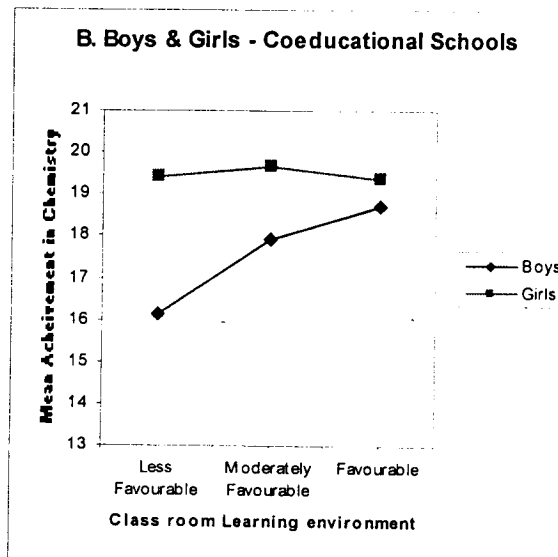
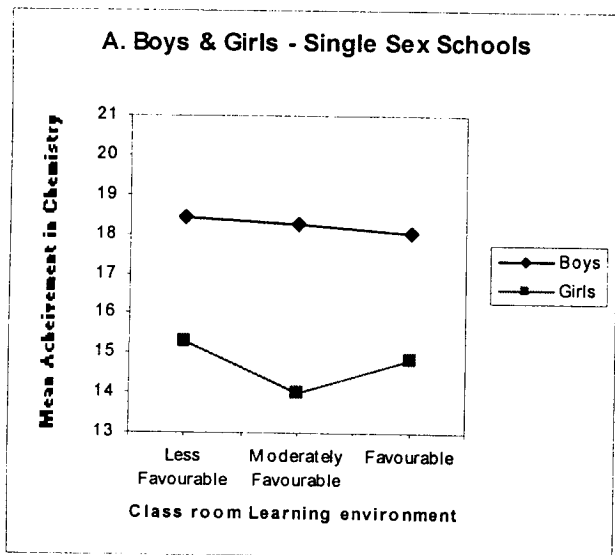


FIGURE - 4-6

Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Chemistry

The pattern of relationship among the variables namely *Classroom Learning Environment*, *Sex* and *School type* were examined separately for main effect and interaction effect. The fact that the two lines representing the mean achievement of boys and girls and school type are not horizontal suggests that these variables have main effect on *Achievement in Chemistry*. It can also be noticed that girls of *Single-sex* schools have low achievement scores when compared to boys. The pattern reverses in the case of boys and girls of *Coeducational* schools (Figure 4-6 B). The interaction is synergistic. The graph also suggests that mean *Achievement in Chemistry* of boys and girls are consistently different in *Single-sex* schools (boys having higher means). The means of boys and girls of *Coeducational* schools are almost same except in the *Less – Favourable Classroom Learning Environment* level. This indicates that Sex difference in *Achievement in Chemistry* is not similar in *Single-sex* schools and *Coeducational* schools. The slope of the lines also shows that the interaction of the two variables is same for the different categories of the *Classroom Learning Environment*. This fact indicates that there is no second order interaction.

4.2.5.2.2 Graphical Representation of Interaction Effect of Achievement Motivation Sex and School Type on Achievement in Chemistry for the Total Sample

In the three-way ANOVA significant main effect of only *School type* on *Achievement in Chemistry* was found to be significant. Also first order interaction effect of *Sex* × *School type* on *Achievement in Chemistry* was found to be significant beyond 0.01 level. The graph showing the relationship between scores of *Achievement in Chemistry*, *Sex* and *School type* in the sample categorised on the basis of three levels of *Achievement Motivation* is presented in Figure 4-7.

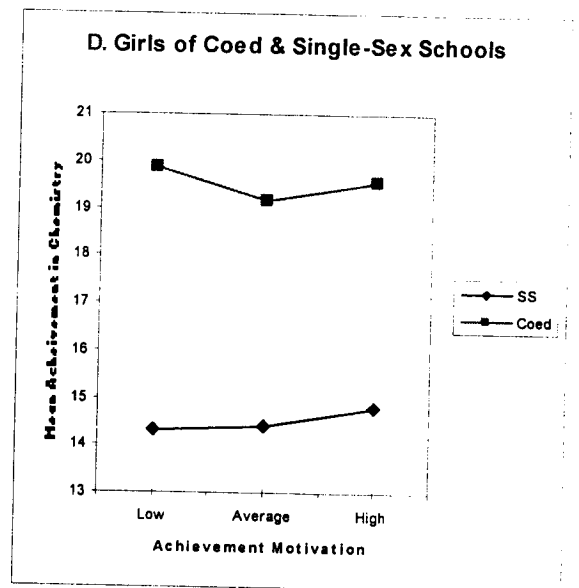
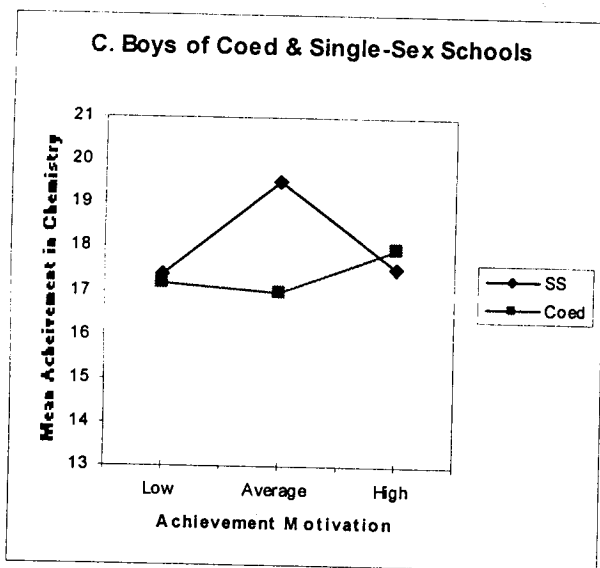
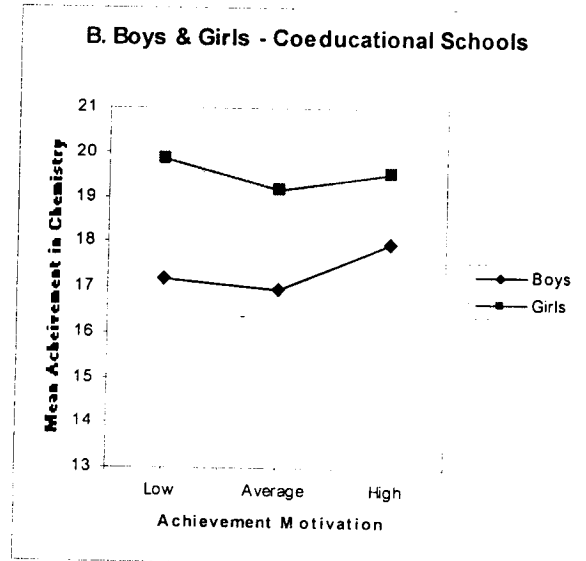
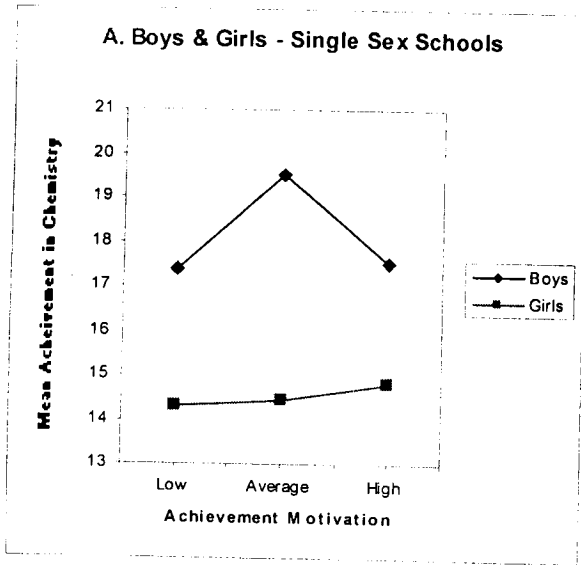


FIGURE - 4-7

Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Chemistry

The pattern of relationship of *Achievement in Chemistry* and *Achievement Motivation* of boys and girls were examined separately for the subjects of *Single-sex* and *Coeducational* schools. The slope of the line depicting the means in *Achievement* of boys and girls of *Single-sex* and *Coeducational* schools are not parallel. This indicates the joint effect of *Sex* and *School type* on *Achievement in Chemistry*. The interaction is synergistic from low to average levels of *Achievement Motivation*. It can also be noticed that boys in *Single-sex* schools have consistently higher means than girls in *Single-sex* schools over three levels of *Achievement Motivation*. On the other hand, girls' superiority is marked in *Coeducational* schools. Whether boys or girls are superior in mean *Achievement in Chemistry* depends on whether they are from *Coeducational schools* or *Single-sex* schools.

The graph further indicates that the first order interaction is same for the three levels of *Achievement Motivation*. Hence F is not significant in the second order interaction.

4.2.5.2.3 Graphical Representation of Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Chemistry for the Total Sample

Significant main effect was noticed for two out of the three variables (treated as independent variables), namely *Self-Esteem* and *School type* on *Achievement in Chemistry*. But only *Sex* by *School type* interaction was found to be significant. No second order interaction was found to be significant in the three-way ANOVA computed. Since of the first order interactions was found to be significant, an attempt was made to study the result of the interaction graphically. The pattern of relationship was plotted separately for boys and girls of *Single-sex* schools and *Coeducational* schools of the total sample. The graphical relationship of *Achievement in Chemistry* by *Self-Esteem* by *Sex* by *School type* is presented in Figure 4-8.

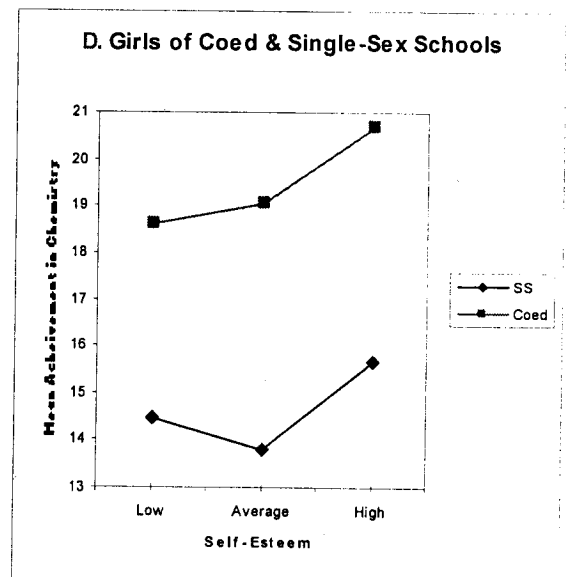
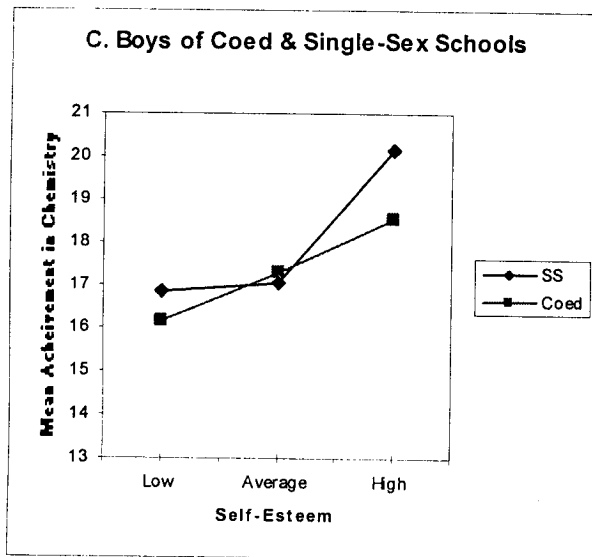
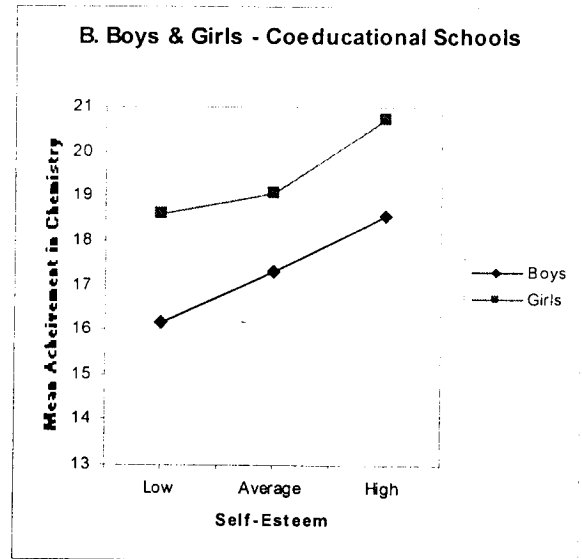
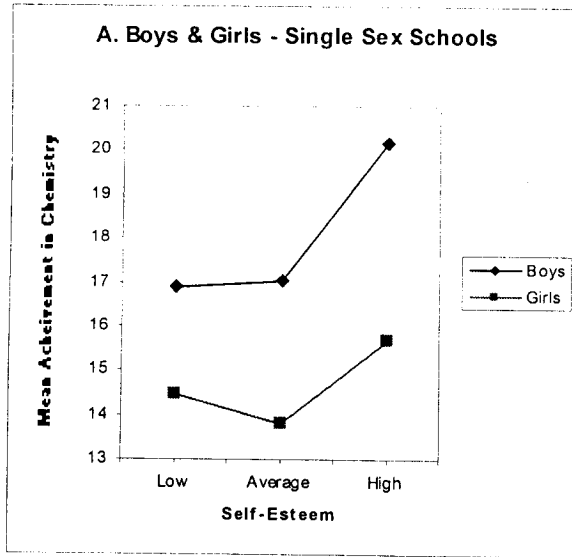


FIGURE - 4-8

Interaction Effect of Self-Esteem, Sex and School Type
on Achievement in Chemistry

An examination of the graph shows that the two lines representing average scores in *Achievement in Chemistry* of Boys and Girls of *Single-sex* schools and *Coeducational* schools are not parallel at the three levels of *Self-Esteem*. This illustrates the interaction effect of *Sex* and *School type* in the F-test. The slope of the lines further suggests that the higher the *Self-Esteem* scores of the subjects (for both boys and girls), the larger the scores in *Achievement in Chemistry* tend to be a synergistic interaction.

It is also noticed that boys score higher than girls in *Achievement in Chemistry* in *Single-sex* schools whereas girls score higher than boys in *Coeducational* schools. This trend is seen in all the three levels of *Self-Esteem*. Sex difference in *Achievement* is dependent on whether the subjects are from *Coeducational* or *Single-sex* schools. But the interaction is same for three different categories of the variable *Self-Esteem*; hence F-value for second order interaction is seen not significant.

4.2.5.2.4 Graphical Representation of Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Chemistry for the Total Sample

In the three-way ANOVA computed, significant main effect was noticed for *Attitude towards Science*, *Sex* and *School type* on *Achievement in Chemistry*. Besides first order interaction of *Sex* by *Attitude towards Science* and *Sex* by *School type* on *Achievement Chemistry* was also found to be significant. Also significant second order interaction was noticed. Figure 4-9 shows the graph plotted to study the pattern of relationship of the variables so as to demonstrate the interaction as revealed in the ANOVA.

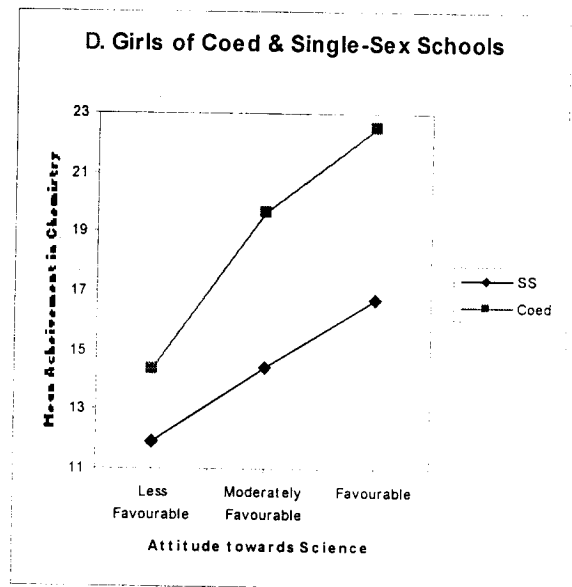
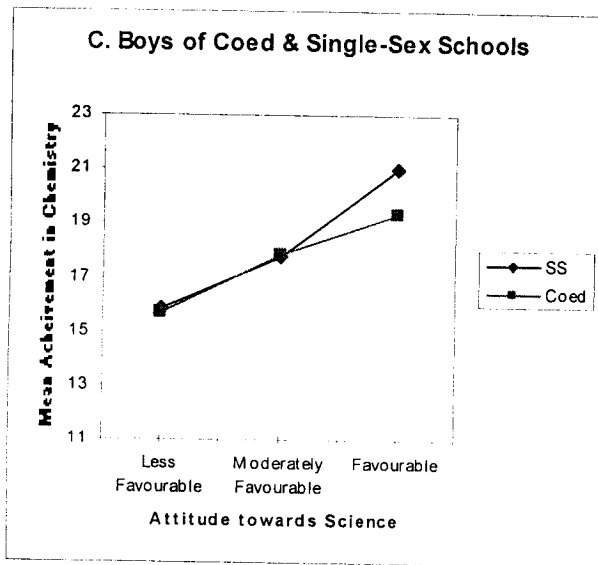
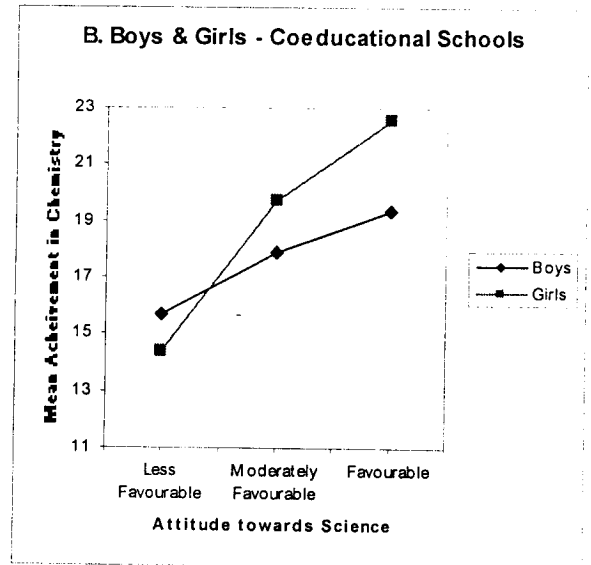
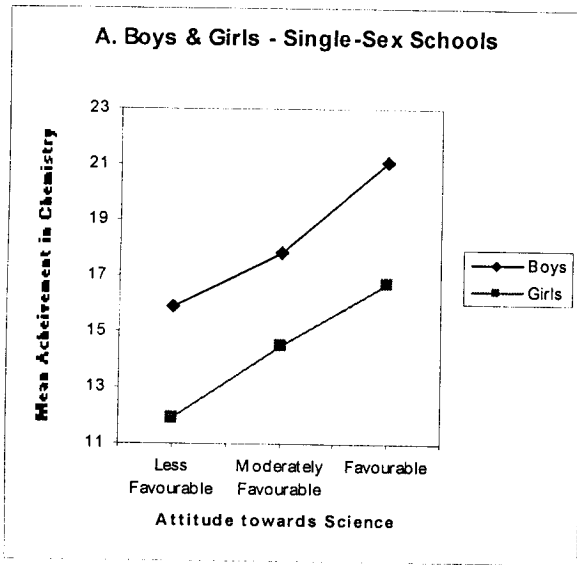


FIGURE - 4-9

Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Chemistry

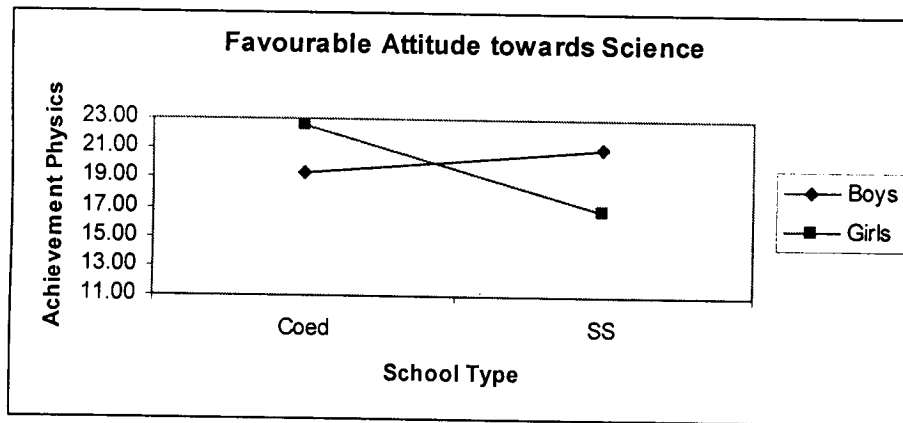
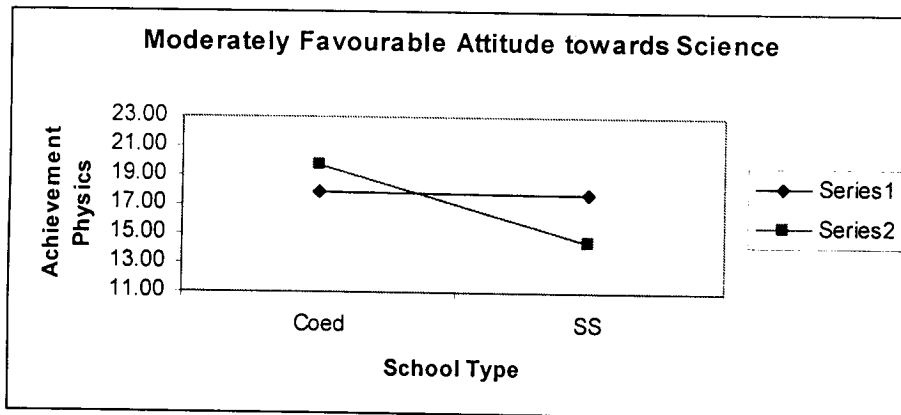
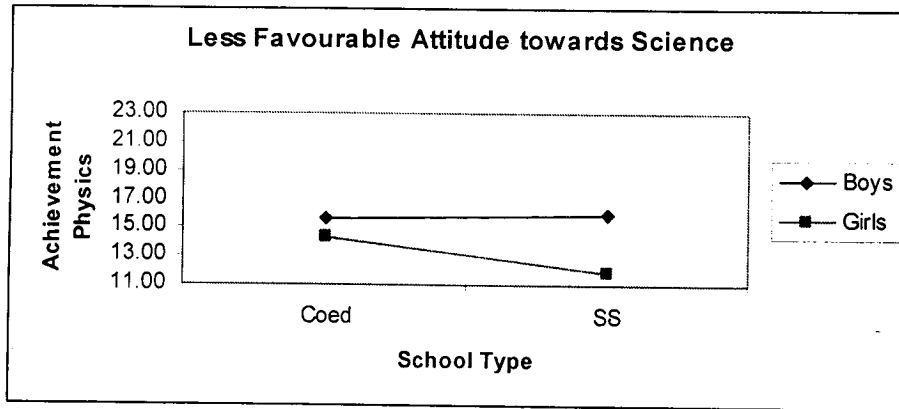


FIGURE - 4-9E

Achievement in Chemistry by Attitude towards Science by Sex by School Type

Looking at the graph, it can be seen that the lines depicting mean *Achievement in Chemistry* of Boys and Girls of three levels of *Attitude towards Science* are consistently different in *Single-sex* schools and *Coeducational* schools. Boys have higher achievement than girls in *Single-sex* schools in three levels of *Attitude towards Science*. The lines separating the effect of *Sex* and *School type* on *Achievement* are not parallel suggesting that there is an interaction effect. Sex difference is found reversed in favour of girls of *Coeducation* schools in the *Favourable – Attitude towards Science* level, that is the interaction is antagonistic interaction. This pattern suggests that $\text{Sex} \times \text{School type}$ interaction effect on *Achievement* is not same at the three levels of *Attitude towards Science*. Figure 4-9 E clearly shows this.

4.2.5.2.5 Graphical Representation of Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Chemistry for the Total Sample

it can be noticed from the three-way ANOVA that the main effect of *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Chemistry* is significant well beyond 0.01 level. Regarding the interaction between factors, only first order interaction of *Sex* by *School type* on *Achievement* is found to be significant. No second order interaction is found to be significant. Since one interaction is found to be significant, the joint effect of *School type* and *Sex* on *Achievement in Chemistry* was examined graphically by plotting the mean scores of *Achievement in Chemistry* for each category of the independent variables. The graph is presented in Figure 4-10.

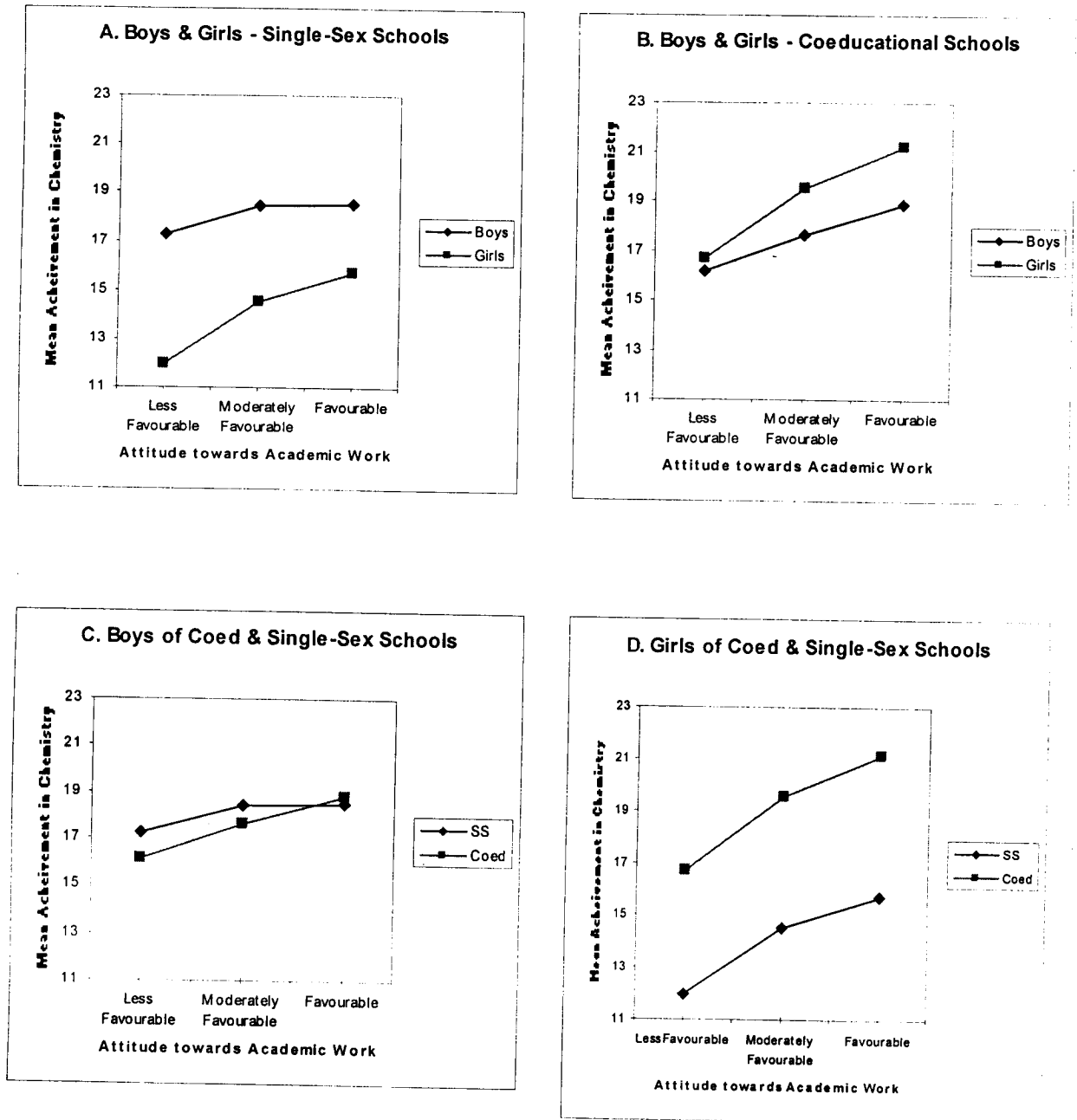


FIGURE - 4-10

Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Chemistry

The two lines depicting the effect of Sex on *Achievement in Chemistry* as a consequence of different levels of *Attitude towards Academic Work* are neither horizontal nor parallel for the subjects of *Single-sex* schools and *Coeducational* schools (Figure 4.10). This fact suggests that Sex difference exists in *Achievement*; high means are associated with boys in *Single-sex* schools (synergistic interaction) but the trend reverses to the advantage of girls in the *Coeducational* schools. Girls' superiority over boys is noticed at all the three levels of *Attitude towards Academic Work* in *Coeducational* schools. In other words, whether boys or girls score high in mean *Achievement in Chemistry* depends on whether they are from *Coeducational* schools or *Single-sex* schools. But it is also noticed that Sex \times *School type* interaction is the same for the different levels of *Attitude towards Academic Work* of the sample; hence F-value is not significant in the three-way interaction.

4.2.5.3.1 Graphical Representation of Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Physical Science for the Total Sample

In the three-way ANOVA computed, besides significant main effect of Sex and *School type* on *Achievement in Physical Science*, first order interaction effect of Sex and *School type* on *Achievement* were also noticed. *Classroom Learning Environment* has no significant main effect or interaction effect on *Achievement in Physical Science*. No significant second order interaction was noticed. Graph showing a plot of the means of *Achievement in Physical Science* so as to demonstrate the relationship between *Achievement* scores and *Classroom Learning Environment* of boys and girls in *Coeducational* schools and *Single-sex* schools is presented in Figure 4-11.

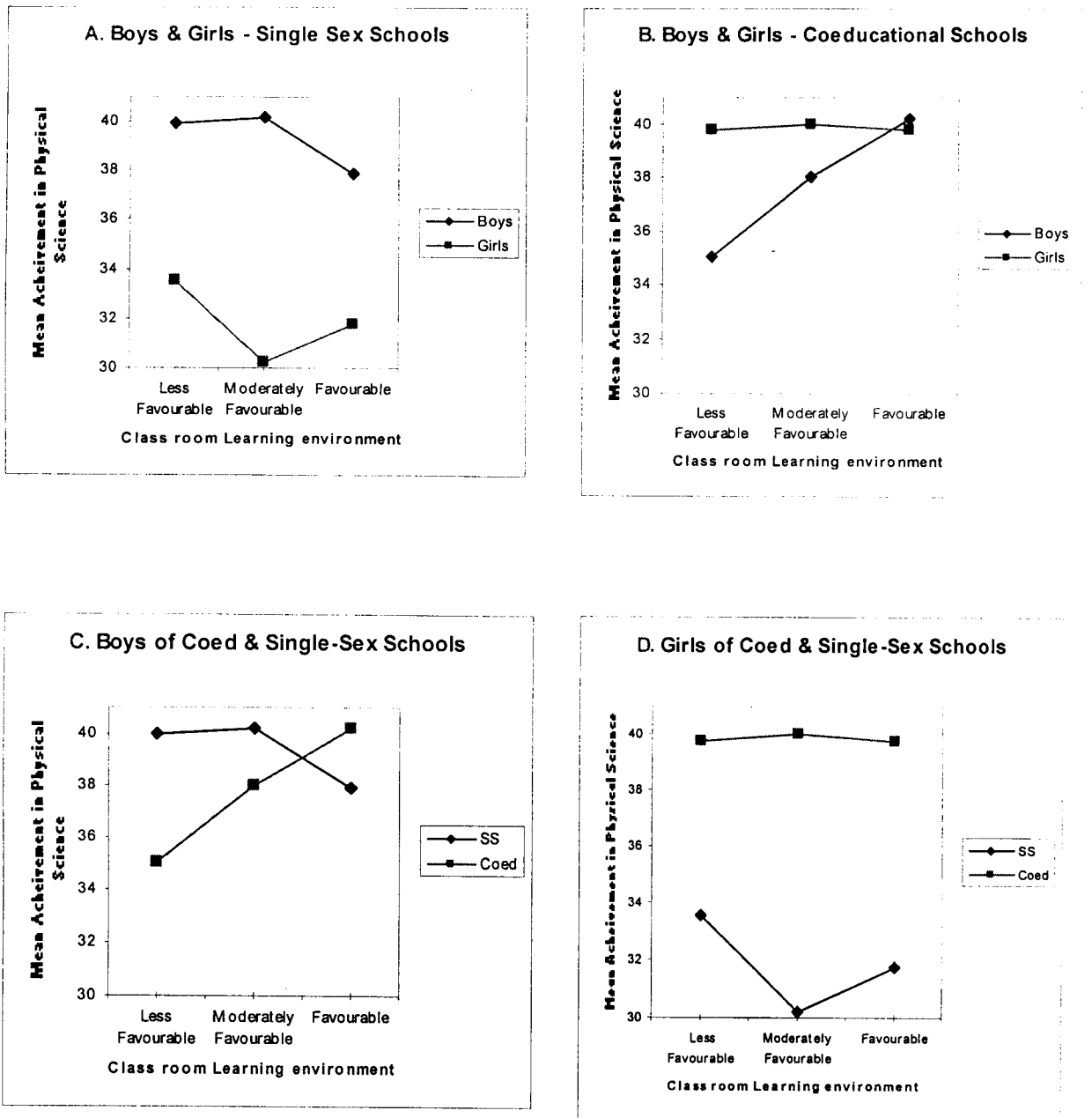


FIGURE - 4-11

Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Physical Science

An examination of the graph reveals that the separation of lines depicting mean achievement of boys and girls are not only parallel but wider than the lines separating boys and girls in mean achievement in *Coeducational* schools at the three levels of *Classroom Learning Environment*. It is also noticed that boy-girls difference narrow down from *Less – Favourable Classroom Learning Environment* to *Favourable Classroom Learning Environment*. Similarly, the differences in the mean *Achievement of Physical Science* of boys of *Coeducational* and *Single-sex* schools also narrow down from their *Less – Favourable* to *Favourable Classroom Learning Environment*. This fact that indicates that performance of boys and girls in *Achievement in Physical Science* depends on whether they are from *Coeducational* schools or *Single-sex* schools. Thus, the figures show a synergistic interaction. This pattern of interaction is the same for the three different categories of the variable *Classroom Learning Environment*. Hence, the F-ratio for second order interaction is found to be not significant.

4.2.5.3.2 Graphical Representation of Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Physical Science for the Total Sample

Since significant main effect of *Sex* and *School type* on *Achievement in Physical Science* was noticed and *Sex* by *School type* interaction was also found to be significant in the three-way factorial ANOVA, the interaction was studied graphically. F-value for second order interaction was also found to be significant. The graph is presented in Figure 4-12.

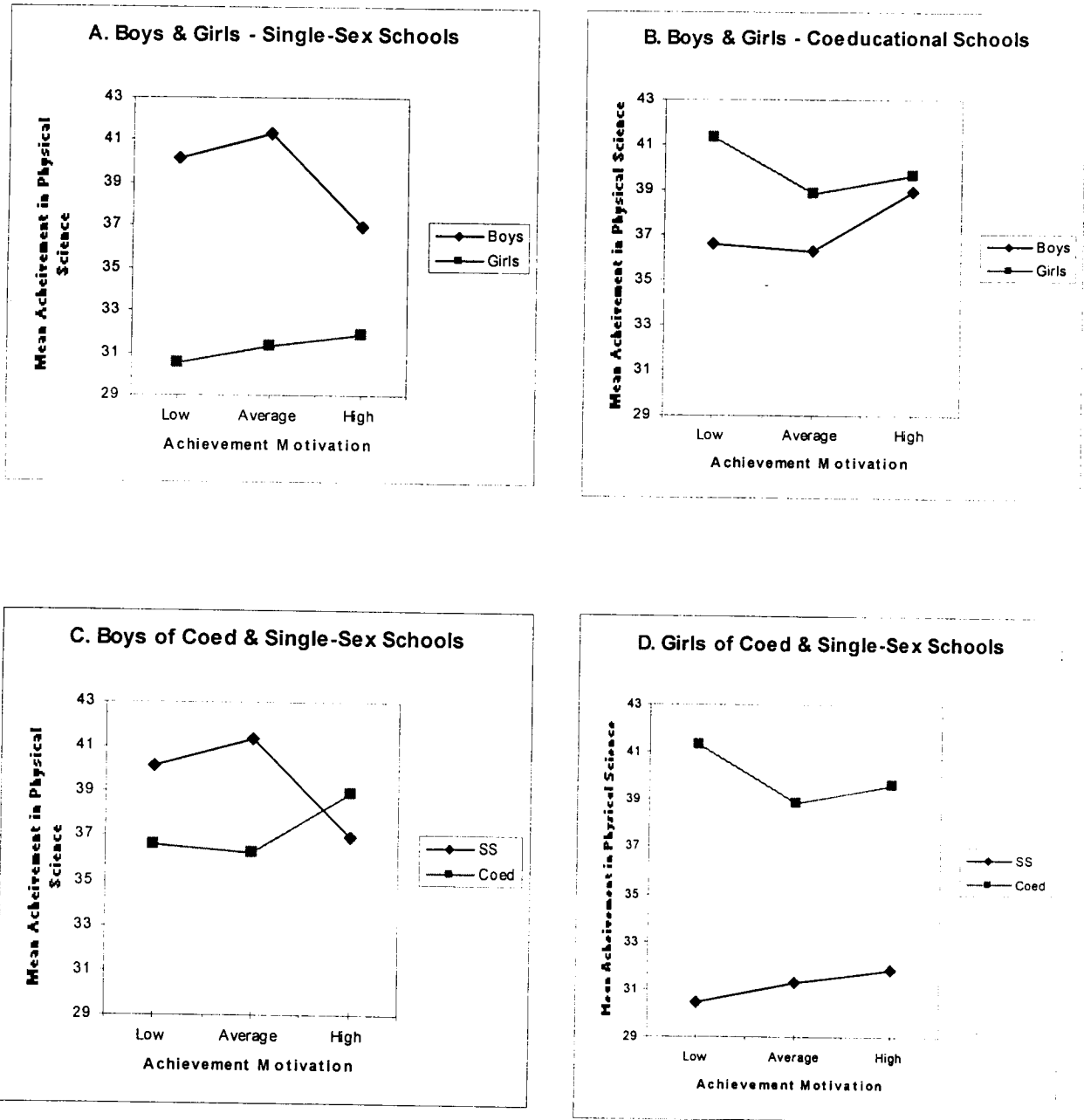


FIGURE - 4-12

Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Physical Science

It can be seen from the graph that two lines representing *Achievement in Physical Science* of boys and girls of *Single-sex* schools and *Coeducational* schools are neither horizontal nor parallel. This suggests that *Sex* influences *Achievement in Physical Science* for subjects of both *Single-sex* and *Coeducational* schools. It is also noticed that sex difference in achievement narrows from *Low – Achievement Motivation level* to *High – Achievement Motivation level* of the subjects. No sex difference is noticed in the high group in the *Coeducational* schools. Thus a ceiling effect interaction is seen in the figure. Another fact which is evident is that mean *Achievement in Physical Science* of girls in *Coeducational* schools are much higher than boys of *Coeducational* schools and girls of *Single-sex* schools. This indicates that whether boys or girls are superior in mean *Achievement in Physical Science* depends upon whether they are studying in *Coeducational* schools or *Single-sex* schools. Therefore, F-value for the first order interaction is found to be significant. Since the pattern of sex difference changes with the three levels of *Achievement Motivation*, second order interaction was also found to be significant.

4.2.5.3.3 Graphical Representation of Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Physical Science for the Total Sample

Significant main effect of *Self-Esteem*, *Sex* and *School type* on *Achievement in Physical Science* was noticed in the three-way ANOVA, but significant first order interaction was noticed only for *Sex* by *School type* on *Achievement*. No significant second order interaction was noticed. The main effect and the interaction effect are shown graphically in Figure 4-13.

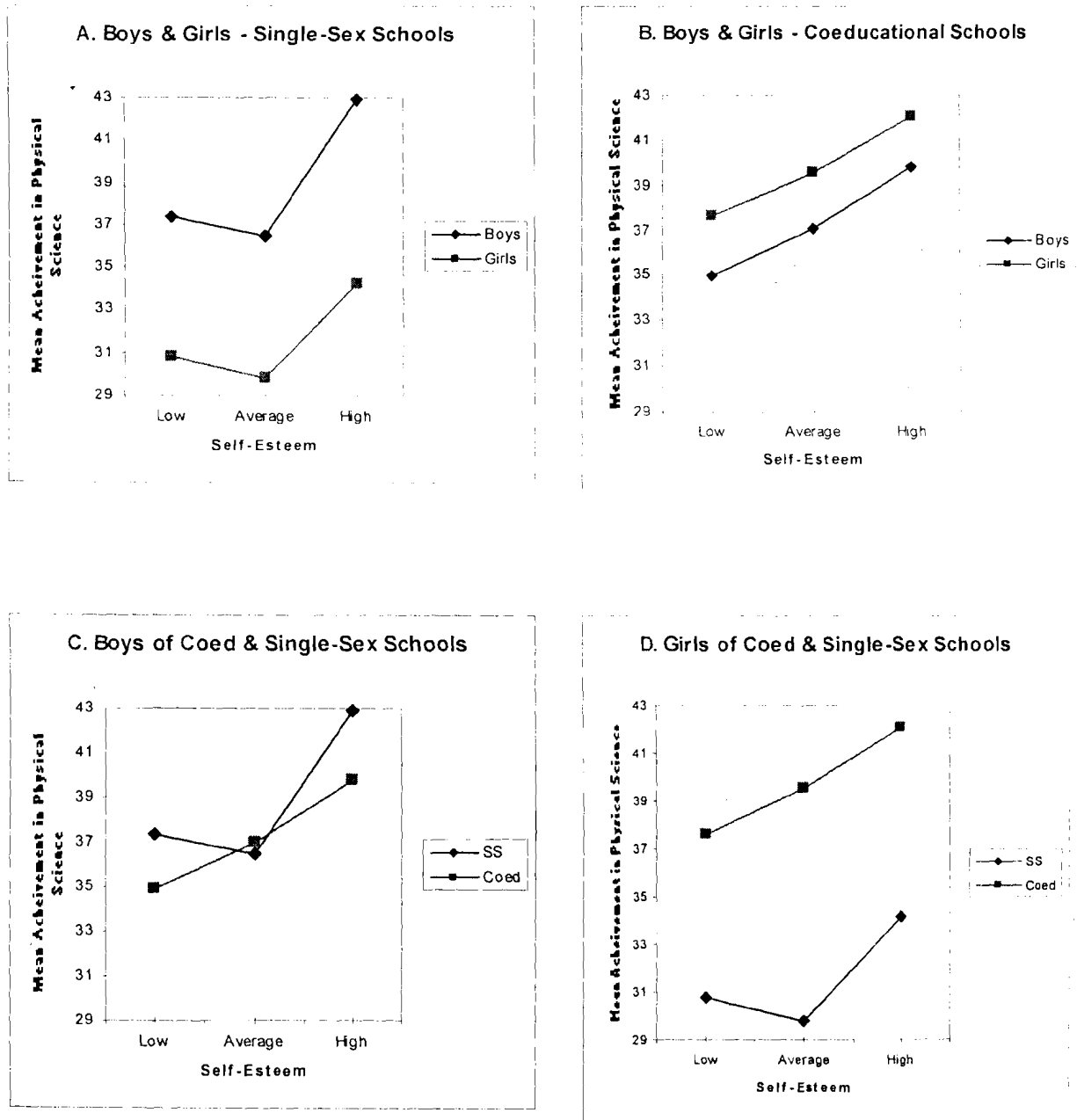


FIGURE - 4-13

Interaction Effect of Self-Esteem, Sex and School Type on
Achievement in Physical Science

An examination of the graph shows that the four lines representing the average scores in *Achievement in Physical Science* of boys and girls of *Coeducational* and *Single-sex* schools at the three levels of *Self-Esteem* are not horizontal. This suggests the significant main effect of *Self-Esteem*, *Sex* and *School type* on *Achievement*. The fact that the two lines separating the effect of *Sex* and *School type* on achievement are not parallel further illustrates the interaction effect in the F-test. The downward slope of the line from *High – Self-Esteem* to *Average self-Esteem* suggest a ceiling effect interaction – higher the Self-esteem, higher the score of *Achievement in Physical Science*.

4.2.5.3.4 Graphical Representation of Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physical Science for the Total Sample

In the three-way ANOVA computed, significant first order interaction was noticed only for *Sex* by *School type* on *Achievement in Physical Science*; besides, significant main effect of *Attitude towards Science*, *Sex* and *School type* on *Achievement*. Though other two first order interaction are not significant, second order interaction of *Attitude towards Science* by *Sex* by *School type* on *Achievement in Physical Science* at 0.05 level of significance. Therefore, the nature of the interaction of the variables was examined graphically. The graph is presented in Figure 4-14.

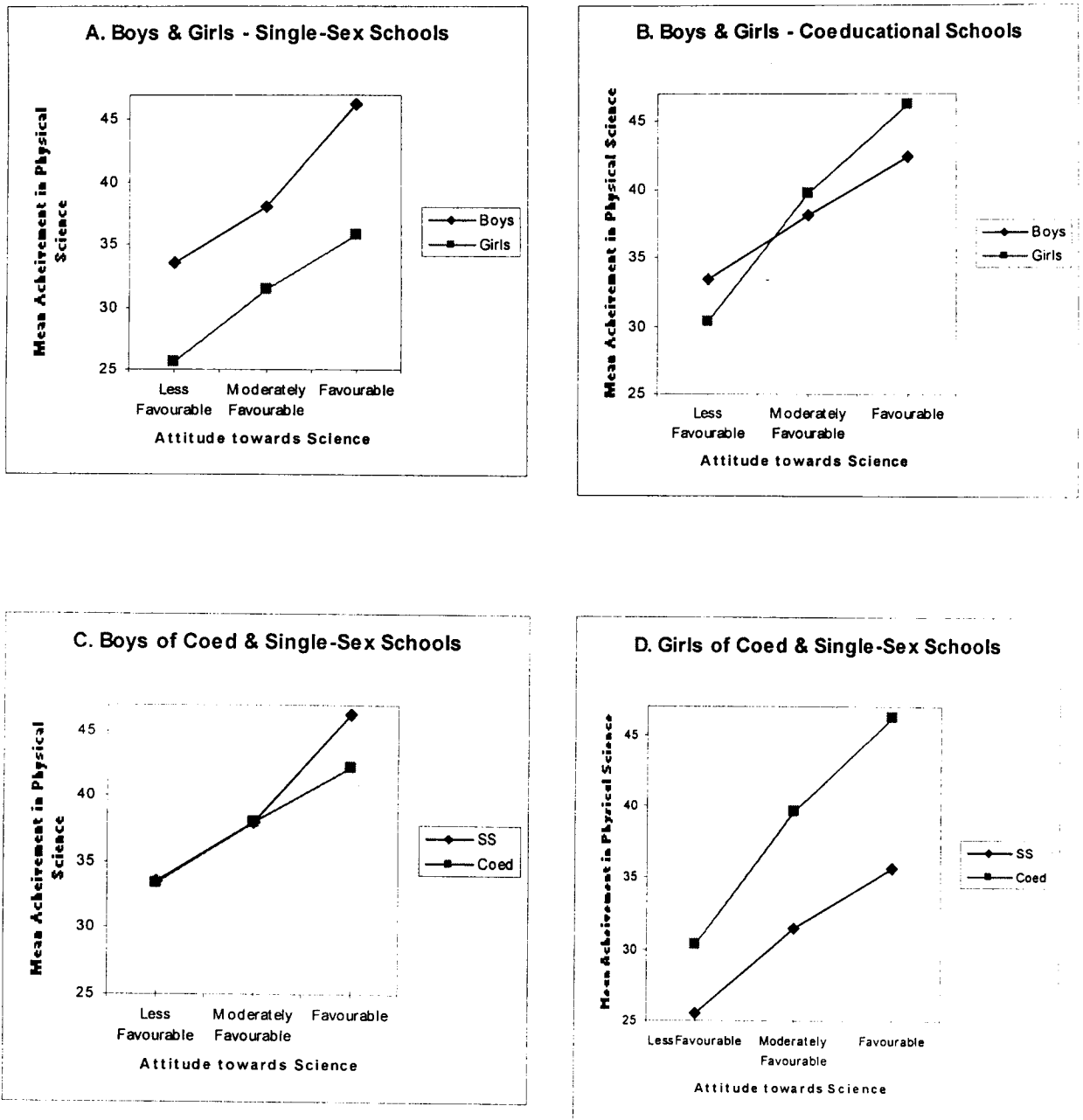


FIGURE - 4-14

Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physical Science

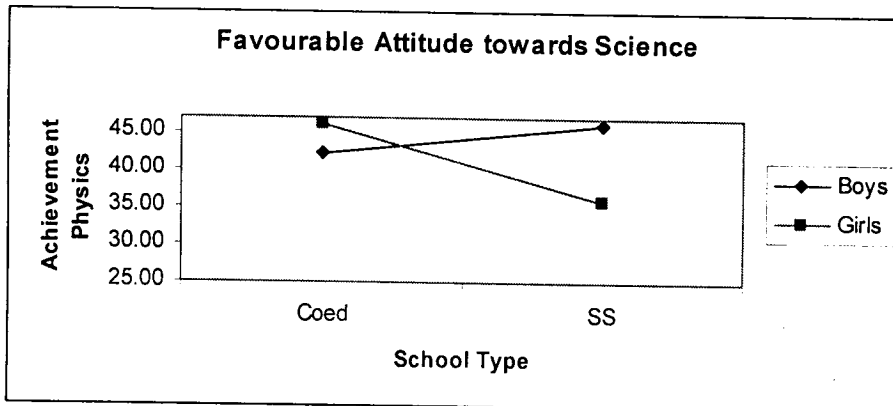
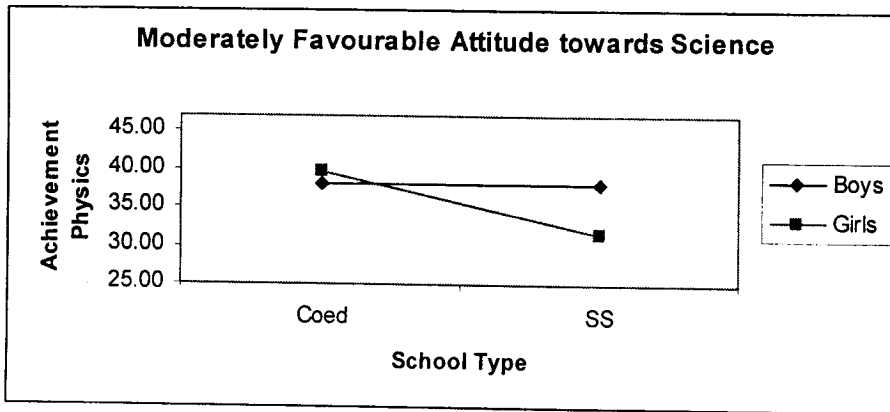
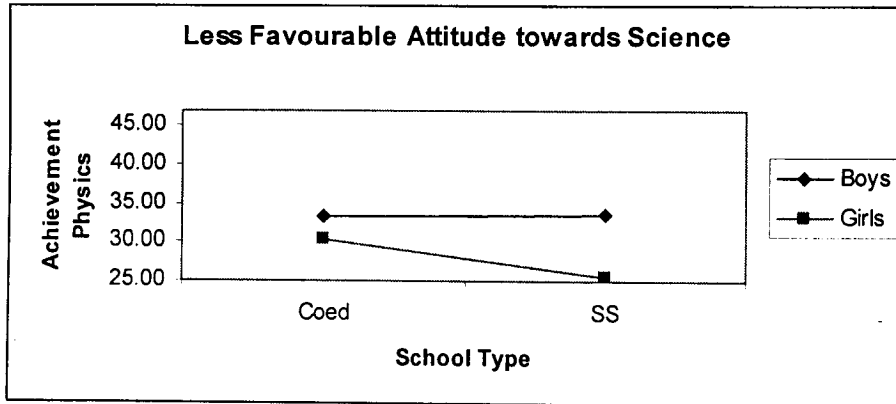


FIGURE - 4-14E

**Achievement in Physical Science by Attitude towards
Science by Sex by School Type**

Significant main effects of the select variables were evident from the fact that the lines representing mean achievement of girls and boys of *Single-sex* and *Coeducational* schools at three levels of *Attitude towards Science* are not horizontal. It can also be noticed from the downward slope of the lines that subjects with *More Favourable Attitude towards Science* have higher scores in *Achievement in Physical Science*. This illustrates a ceiling effect interaction.

While girls of *Coeducational* schools have higher mean achievement scores than boys of *Coeducational* schools, boys of *Single-sex* schools have advantage over girls of *Single-sex* schools. In other words, sex difference in mean achievement depends on school type for the subjects of all the three levels of *Attitude towards Science*. This trend is evident from the significant second order interaction. The difference in the Sex by School type interaction at three levels of Attitude towards Science depicted in Figure 4-14 E.

4.2.5.3.5 Graphical Representation of Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physical Science for the Total Sample

Even though significant main effect was noticed for all the three variables namely, *Attitude towards Academic Work*, *Sex* and *School type* on *Achievement in Physical Science*, significant first order interaction was noticed only for *Sex by School type*. Second order interaction was also found to be not significant. The main effect and interaction effect was shown graphically in Figure 4-15.

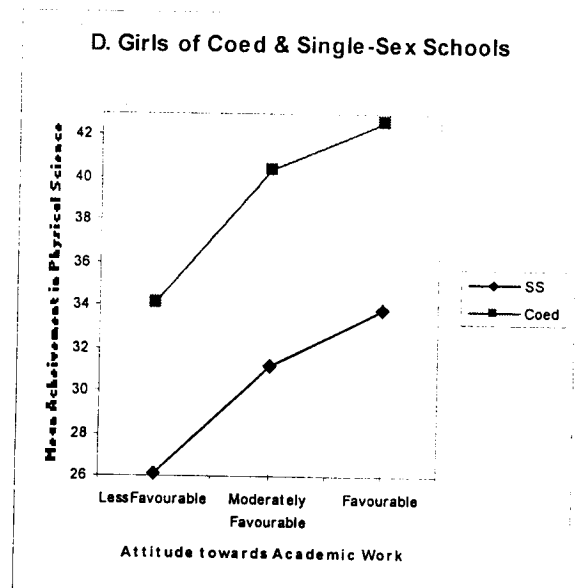
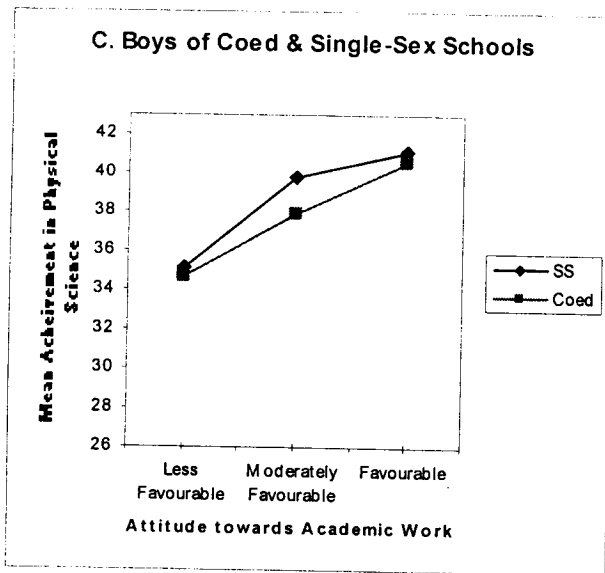
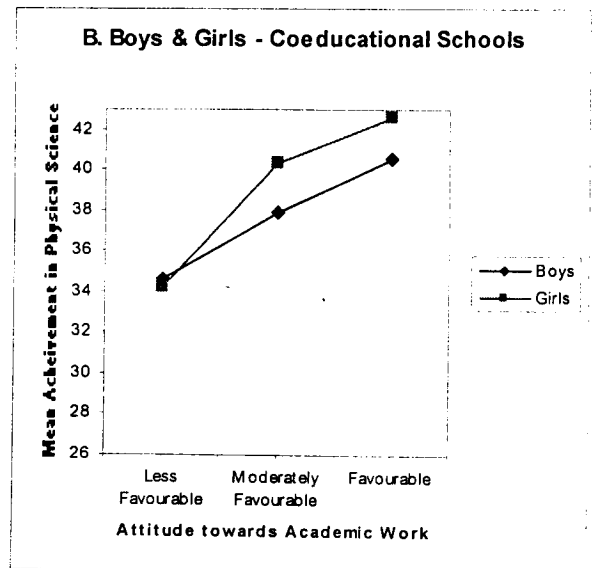
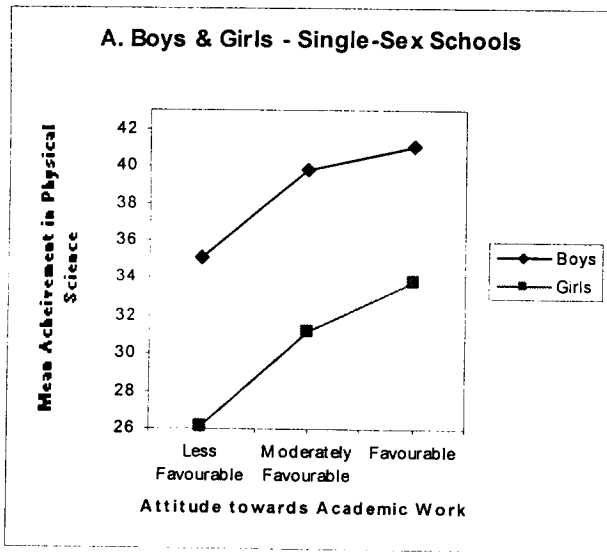


FIGURE - 4-15

Interaction Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physical Science

Sex difference in mean achievement in favour of boys was evident from the fact that the lines depicting the achievement are not parallel as evident from the Graph. On the other hand, boys and girls do not differ in achievement in *Coeducational* schools. But differences in the performance of boys and girls are seen at the three levels of *Attitude towards Academic Work*. It is also noticed that boys of *Coeducational* and *Single-sex* schools perform almost similarly. On the other hand, girls have high mean score in achievement in *Coeducation* schools than in *Single-sex* schools at the three levels of *Attitude towards Academic Work*, the interaction being synergistic. The graph therefore clearly indicates whether boys or girls perform better in the test of *Achievement in Physical Science* will depend upon whether they are from *Coeducational* schools or *Single-sex* schools.

Summary of the Graphical Representation of the Interaction of the Select Variables on Achievement in Physical Science

Summary of the graphical representation of the interaction effect of *Sex* and *School type* and each of the five select independent variables on *Achievement in Physics, Chemistry and Physical Science* (total) is given below.

- (i) Mean *Achievement in Physical Science* scores of boys and girls of three nearly identical levels of select independent variables namely, *Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* are consistently different in *Single-sex* schools but not in *Coeducational* schools.
- (ii) Boys have higher mean achievement in *Single-sex* schools.
- (iii) Girls' superiority in achievement is seen mostly in *Coeducational* schools.
- (iv) The interaction of *Sex* by *School type* by each of the five independent variables on achievement is either synergistic interaction or ceiling effect interaction.

4.3 INVESTIGATION OF GROUP DIFFERENCES

This part of the analysis of data of the study was undertaken with a view to make analytical comparison of relevant subgroups with regard to the mean score of the dependent variable after the data was analysed using Factorial ANOVA. A post-hoc comparison enable to test the null hypothesis that the means of the dependent variable scores (in the present study *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science*) for each level of the select independent variable will not be significantly different.

Summary of the three-way ANOVA revealed that there exists significant main effect on *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science* for the select variables *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work*. No significant main effect for variables *Classroom Learning Environment* and *Achievement Motivation* was noticed on any of the three dependent variables. It was also noticed that significant main effect of *School type* (in all the fifteen ANOVA computed) and main effect of *Sex* (thirteen of fifteen ANOVA computed) on achievement exist.

In the case of variables *Sex* and *School type*, the results of the ANOVA reveal that first order interaction of *Sex* by *School type* on achievement are significant in all the fifteen ANOVA. Hence, post-hoc comparison to identify groups for which significant mean difference in *Achievement in Physics*, *Chemistry* and *Physical Science* was attempted for the groups formed on the basis of two categories as follows:

- (i) Groups formed on the basis of *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work*
- (ii) Groups formed on the basis of *Sex* and *School type* and each of the five select independent variables.

The analysis is presented under the following heads:

4.3.1 Mean Difference in Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science among Three Groups of Pupils Categories on the Basis of Self-Esteem, Attitude towards Science and Attitude towards Academic Work

4.3.2 Mean Difference in Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science among Relevant Subgroups formed on the Basis of Select Independent Variables Sex and School Type

Details of the analysis and results of the comparison with respect to mean scores on Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science are presented in the following text:

4.3.1 Difference in Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science among Three Groups of Pupils Categories on the Basis of Self-Esteem, Attitude towards Science and Attitude towards Academic Work

Scheffé test of multiple comparison was used for comparing groups categorized into three levels on the basis of three select independent variables namely, *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work* (taken in pairs). The analysis of data is discussed separately for *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science* and is presented in the following text.

4.3.1.1 Difference in Achievement in Physics among Three Groups of Students Categorised on the Basis of Self-Esteem

Mean scores of Achievement in Physics of secondary school pupils of three nearly identical levels of Self-Esteem namely High – Self-Esteem group (H – SE), Average – self-Esteem group (A – SE) and Low – Self-Esteem group (L – SE) were compared (taken in pairs) for the sub

samples – boys, girls, students of Single-sex schools, Coeducational schools and for the total sample.

Scheffé's test was used to compare the mean scores of the relevant pairs of group means. The steps followed in applying the method were: (i) Calculating F-ratio between pairs of means using the within-group variance estimate; (ii) Consulting a table of F and obtaining the value of F required for significance at the 0.05 and 0.01 level for $df_1 = (K - 1)$ and $df_2 = (N - K)$ for the total sample and the four relevant sub samples separately; (iii) Using the formula $F' = (K - 1) F$, calculating the F' required for significance at 0.05 level and 0.01 level; and (iv) Comparing the value of F with the value of F' to decide the significance of difference between means. For any difference to be significant at the required level, F must be greater than or equal to F' .

Data and results of the comparison of mean Achievement in Physics scores of total sample and four sub samples of three nearly identical levels of Self-Esteem are presented in Table 4.24.

TABLE 4.24

Summary of the Group Difference in Mean Achievement in Physics for the Three Levels of Self-Esteem

Sl.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	H – SE and A – SE	12.88	351	6.06	9.36	0.01
		H – SE and L – SE	13.83	304	6.06	9.36	0.01
		A – SE and L – SE	0.17	315	6.06	9.36	NS
2.	Girls	H – SE and A – SE	5.58	309	6.06	9.36	NS
		H – SE and L – SE	16.13	294	6.06	9.36	0.01
		A – SE and L – SE	3.16	319	6.06	9.36	NS
3.	Single-sex	H – SE and A – SE	18.68	218	6.08	9.42	0.01
		H – SE and L – SE	15.75	210	6.08	9.42	0.01
		A – SE and L – SE	0.086	222	6.08	9.42	NS
4.	Coeducational	H – SE and A – SE	4.77	442	6.04	9.32	NS
		H – SE and L – SE	16.68	388	6.04	9.32	0.01
		A – SE and L – SE	4.38	412	6.04	9.32	NS
5.	Total	H – SE and A – SE	18.46	660	6.02	9.30	0.01
		H – SE and L – SE	32.59	598	6.02	9.30	0.01
		A – SE and L – SE	2.75	634	6.02	9.30	NS

H – SE : High Self-Esteem group ; L – SE : Low Self-Esteem group ; A – SE : Average Self-Esteem group.

NS – Not significant

A perusal of Table 4.24 reveals that the extreme group pairs, namely High – Self-Esteem Group and Low – Self-Esteem Group significantly differ in mean *Achievement in Physics* scores at 0.01 level of significance in the total sample and the four sub samples, namely, Boys, Girls, Single-sex school students and Coeducational school students. Significant difference at 0.01 level in the means of *Achievement in Physics* was noticed for H – SE and A – SE Group in the total sample, Boys and Single-sex school students.

On the other hand, no significant mean difference in *Achievement in Physics* is noticed between Average – Self-Esteem Group and Low – Self-Esteem Group in any five comparisons, i.e., total sample, Boys, Girls, students of Single-sex schools or Coeducational schools, the obtained F-ratio being less than the value of F' even at 0.05 level of significance for the corresponding degrees of freedom.

4.3.1.1.2 Mean Difference in Achievement in Physics Among Three Groups of Students Categorised on the Basis of Attitude towards Science

Mean scores in Achievement in Physics of pupils categorised into three levels on the basis of Attitude towards Science (Favourable – Attitude towards Science Group – F – ATS, Moderately – Favourable Attitude towards Science Group – M – ATS and Less – Favourable Attitude towards Science Group – L – ATS) were compared using Scheffé Test for total sample and four sub samples namely Boys, Girls, Single-sex school pupils and Coeducational school pupils. The results of the comparison are summarised and presented in Table 4.25.

TABLE 4.25

Summary of the Group Difference in Mean Achievement in Physics for the Three Levels of Attitude towards Science

Sl.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	F – ATS and M – ATS	34.53	311	6.06	9.36	0.01
		F – ATS and L – ATS	101.86	309	6.06	9.36	0.01
		M – ATS and L – ATS	17.47	350	6.06	9.36	0.01
2.	Girls	F – ATS and M – ATS	30.82	350	6.06	9.36	0.01
		F – ATS and L – ATS	117.84	270	6.06	9.36	0.01
		M – ATS and L – ATS	39.11	302	6.06	9.36	0.01
3.	Single-sex	F – ATS and M – ATS	23.56	230	6.08	9.42	0.01
		F – ATS and L – ATS	67.95	199	6.08	9.42	0.01
		M – ATS and L – ATS	9.95	221	6.08	9.42	0.01
4.	Coeducational	F – ATS and M – ATS	41.53	431	6.04	9.32	0.01
		F – ATS and L – ATS	135.30	380	6.04	9.32	0.01
		M – ATS and L – ATS	34.16	431	6.04	9.32	0.01
5.	Total	F – ATS and M – ATS	64.11	661	6.02	9.30	0.01
		F – ATS and L – ATS	201.83	579	6.02	9.30	0.01
		M – ATS and L – ATS	48.81	652	6.02	9.30	0.01

F – ATS : Favourable – Attitude towards Science group ; L – ATS : Less Favourable – Attitude towards Science Group

M – ATS : Moderately – Favourable Attitude towards Science group; NS – Not significant

As per Table 4.25, F-values obtained for the mean difference in *Achievement in Physics* for the three groups compared, taken in pairs, i.e., F – ATS and M – ATS, F – ATS and L – ATS, M – ATS and L – ATS for the total sample and the four sub samples are found to be well beyond the value of F' set for 0.01 level for appropriate degrees of freedom.

Since high means are associated with F – ATS group for the two comparisons F – ATS with M – ATS and F – ATS with L – ATS, this group can be considered to have advantage in *Achievement in Physics*.

4.3.1.1.3 Mean Difference in Achievement in Physics Among Three Groups of Students Categorised on the Basis of Attitude towards Academic Work

Group difference in mean *Achievement in Physics* for three identical groups of students based on *Attitude towards Academic Work* were studied (taken in pairs) using Scheffé test of multiple comparison. The groups compared were F – ATA and M – ATA; F – ATA and L – ATA and M – ATA and L – ATA. The data and the results are presented in Table 4.26.

TABLE 4.26

Summary of the Group Difference in Mean Achievement in Physics for the
Three Levels of Attitude towards Academic Work

SI.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	F – ATA and M – ATA	5.39	331	6.06	9.36	NS
		F – ATA and L – ATA	31.39	295	6.06	9.36	0.01
		M – ATA and L – ATA	13.21	344	6.06	9.36	0.01
2.	Girls	F – ATA and M – ATA	0.609	367	6.04	9.32	NS
		F – ATA and L – ATA	27.49	262	6.06	9.36	0.01
		M – ATA and L – ATA	22.49	293	6.06	9.36	0.01
3.	Single-sex	F – ATA and M – ATA	1.97	254	6.06	9.36	NS
		F – ATA and L – ATA	23.19	200	6.08	9.42	0.01
		M – ATA and L – ATA	12.98	196	6.08	9.42	0.01
4.	Coeducational	F – ATA and M – ATA	3.44	444	6.04	9.32	NS
		F – ATA and L – ATA	32.25	357	6.04	9.32	0.01
		M – ATA and L – ATA	18.84	441	6.04	9.32	0.01
5.	Total	F – ATA and M – ATA	4.24	698	6.02	9.30	NS
		F – ATA and L – ATA	50.08	557	6.02	9.30	0.01
		M – ATA and L – ATA	30.05	637	6.02	9.30	0.01

F – ATA : Favourable – Attitude towards Academic Work group ; L – ATA : Less Favourable – Attitude towards Academic Work Group M – ATA : Moderately – Favourable Attitude towards Academic Work group

As per Table 4.26, the extreme group pairs namely Favourable – Attitude towards Academic Work group and Less – Favourable Attitude towards Academic Work group significantly differ in mean *Achievement in Physics* scores at 0.01 level of significance in the total sample and the four sub samples namely *Boys, Girls, Single-sex* school students and *Coeducational* school students. Significant difference at 0.01 level in the means of *Achievement in Physics* was noticed for M – ATA and L – ATA group in the total sample, *Boys, Girls, Single – Sex* school students and *Coeducational* school students.

On the other hand, no significant mean difference in *Achievement in Physics* was noticed between F – ATA group and M – ATA group in any five comparisons, i.e., total sample, *Boys, Girls, students of Single-sex schools or Coeducational schools*. The obtained F-ratios are less than the value of F' even at 0.05 level of significance for the corresponding degrees of freedom.

4.3.1.2.1 Mean Difference in Achievement in Chemistry among Three Groups of Students Categorised on the Basis of Self – Esteem

Mean scores of *Achievement in Chemistry* for the total sample and sub samples, namely, *Boys, Girls, Single-sex school students and Coeducational school students* of three levels of *Self-Esteem* namely High – Self-Esteem Group (H – SE), Average Self-Esteem Group (A – SE) and Low – Self-Esteem group (L – SE) were compared in pairs. Results of the comparison of mean Achievement scores between H – SE and A – SE; H – SE and L – SE; A – SE and L – SE using Scheffé test of Multiple Comparison were summarised and presented in Table 4.27.

TABLE 4.27

Summary of the Group Difference in Mean Achievement in Chemistry for the Three Levels of Self-Esteem

Sl.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	H – SE and A – SE	9.89	351	6.06	9.36	0.01
		H – SE and L – SE	18.75	304	6.06	9.36	0.01
		A – SE and L – SE	1.79	315	6.06	9.36	NS
2.	Girls	H – SE and A – SE	9.90	309	6.06	9.36	0.01
		H – SE and L – SE	13.81	294	6.06	9.36	0.01
		A – SE and L – SE	0.50	319	6.06	9.36	NS
3.	Single-sex	H – SE and A – SE	14.90	218	6.08	9.42	0.01
		H – SE and L – SE	15.16	210	6.08	9.42	0.01
		A – SE and L – SE	0.01	222	6.08	9.42	NS
4.	Coeducational	H – SE and A – SE	7.20	442	6.04	9.32	0.05
		H – SE and L – SE	14.71	388	6.04	9.32	0.01
		A – SE and L – SE	1.95	412	6.04	9.32	NS
5.	Total	H – SE and A – SE	19.51	660	6.02	9.30	0.01
		H – SE and L – SE	31.03	598	6.02	9.30	0.01
		A – SE and L – SE	1.93	634	6.02	9.30	NS

H – SE : High Self-Esteem group ; L – SE : Low Self-Esteem group ; A – SE : Average Self-Esteem group.

NS – Not Significant

The obtained F – ratio for the extreme group pairs, i.e., H – SE and L – SE are well beyond the F' value at 0.01 level of significance for the corresponding degrees of freedom for the total sample and the four sub samples. Significant mean difference is found at 0.01 level for H – SE group and A – SE group for the total sample, Boys, Girls and Single-sex school students. But in the case of Coeducational school students, F' is significant at 0.05 level only.

No significant mean difference in *Achievement in Chemistry* was noticed between A – SE and L – SE Group in any of the five comparisons. In this case, the obtained F-ratios are less than the value F' even at 0.05 level of significance.

4.3.1.2.2 Mean Difference in Achievement in Chemistry among Three Groups of Students Categorised on the Basis of Attitude towards Science

Scheffé's test was used to compare the mean scores in *Achievement in Chemistry* of students categorised into three levels on the basis of scores on *Attitude towards Science*. The group pairs compared were F – ATS and M – ATS; F – ATS and L – ATS and M – ATS and L – ATS. Data and result of the comparison of mean *Achievement in Chemistry* scores for the total sample and four sub samples of three levels of Attitude towards Science and presented in Table 4.28.

TABLE 4.28

Summary of the Group Difference in Mean Achievement in Chemistry for the Three Levels of Attitude towards Science

Sl.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	F – ATS and M – ATS	74.78	311	6.06	9.36	0.01
		F – ATS and L – ATS	245.26	309	6.06	9.36	0.01
		M – ATS and L – ATS	57.39	350	6.06	9.36	0.01
2.	Girls	F – ATS and M – ATS	88.80	350	6.06	9.36	0.01
		F – ATS and L – ATS	403.44	270	6.06	9.36	0.01
		M – ATS and L – ATS	151.75	302	6.06	9.36	0.01
3.	Single-sex	F – ATS and M – ATS	64.76	230	6.08	9.42	0.01
		F – ATS and L – ATS	181.64	199	6.08	9.42	0.01
		M – ATS and L – ATS	38.88	221	6.08	9.42	0.01
4.	Coeducational	F – ATS and M – ATS	100.89	431	6.04	9.32	0.01
		F – ATS and L – ATS	428.74	380	6.04	9.32	0.01
		M – ATS and L – ATS	140.41	431	6.04	9.32	0.01
5.	Total	F – ATS and M – ATS	163.99	661	6.02	9.30	0.01
		F – ATS and L – ATS	603.35	579	6.02	9.30	0.01
		M – ATS and L – ATS	174.49	652	6.02	9.30	0.01

F – ATS : Favourable – Attitude towards Science group ; L – ATS : Less Favourable – Attitude towards Science Group

M – ATS : Moderately – Favourable Attitude towards Science group

As per Table 4.28, F-values obtained for the mean difference in *Achievement in Chemistry* for three groups compared, taken in pairs, i.e., F – ATS and M – ATS, F – ATS and L – ATS, M – ATS and L – ATS for the total sample and the four sub samples are found to be well beyond the value of F' set at 0.01 level of significance for appropriate degrees of freedom.

4.3.1.2.3 Mean Difference in Achievement in Chemistry among Three Groups of Students Categorised on the Basis of Attitude towards Academic Work

The mean scores on *Achievement in Chemistry* for total sample, Boys, Girls, Single-sex students and Coeducational students categorised into three groups based on *Attitude towards Academic Work* (F – ATA, M – ATA and L – ATA Groups) were compared and examined for the significance of difference.

Results of the comparison of mean Achievement scores using Scheffé's test were summarised and presented in Table 4.29.

TABLE 4.29

Summary of the Group Difference in Mean Achievement in Chemistry for the
Three Levels of Attitude towards Academic Work

Sl.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	F – ATA and M – ATA	12.56	331	6.06	9.36	0.01
		F – ATA and L – ATA	81.52	295	6.06	9.36	0.01
		M – ATA and L – ATA	36.81	344	6.06	9.36	0.01
2.	Girls	F – ATA and M – ATA	5.06	367	6.04	9.32	NS
		F – ATA and L – ATA	111.27	262	6.06	9.36	0.01
		M – ATA and L – ATA	80.43	293	6.06	9.36	0.01
3.	Single-sex	F – ATA and M – ATA	3.94	254	6.08	9.42	NS
		F – ATA and L – ATA	56.69	200	6.08	9.42	0.01
		M – ATA and L – ATA	33.75	196	6.08	9.42	0.01
4.	Coeducational	F – ATA and M – ATA	20.45	444	6.04	9.32	0.01
		F – ATA and L – ATA	142.06	357	6.04	9.32	0.01
		M – ATA and L – ATA	71.93	441	6.04	9.32	0.01
5.	Total	F – ATA and M – ATA	15.86	698	6.02	9.30	0.01
		F – ATA and L – ATA	171.92	557	6.02	9.30	0.01
		M – ATA and L – ATA	100.00	637	6.02	9.30	0.01

F – ATA : Favourable – Attitude towards Academic Work group; L – ATA : Less Favourable – Attitude towards Academic Work Group M – ATA : Moderately – Favourable Attitude towards Academic Work group; NS – Not significant

As per Table 4.29, the obtained F-ratios for the pairs F-ATA – L-ATA are found to be significant beyond 0.01 level for the total sample, Boys, Girls, Single-sex school students and Coeducational school students. Significant mean difference at 0.01 level is noticed for the comparison of F-ATA – M-ATA for the total sample, Boys and Coeducational students. But for the sub samples Girls and Single-sex school students, no significant mean difference was found to exist since, the F-ratios are less than the value of F' even at 0.05 level.

4.3.1.3.1 Mean Difference in Achievement in Physical Science among Three Groups of Students Categorised on the Basis of Self – Esteem

Data and results of the comparison of mean *Achievement in Physical Science* scores of total sample and four sub samples of three nearly identical levels of *Self-Esteem* are presented in Table 4.30.

TABLE 4.30

Summary of the Group Difference in Mean Achievement in Physical Science for the Three Levels of Self-Esteem

Sl.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	H – SE and A – SE	13.65	351	6.06	9.36	0.01
		H – SE and L – SE	18.65	304	6.06	9.36	0.01
		A – SE and L – SE	0.84	315	6.06	9.36	NS
2.	Girls	H – SE and A – SE	8.92	309	6.06	9.36	0.05
		H – SE and L – SE	17.67	294	6.06	9.36	0.01
		A – SE and L – SE	1.79	319	6.06	9.36	NS
3.	Single-sex	H – SE and A – SE	20.12	218	6.08	9.42	0.01
		H – SE and L – SE	18.49	210	6.08	9.42	0.01
		A – SE and L – SE	0.01	222	6.08	9.42	NS
4.	Coeducational	H – SE and A – SE	7.09	442	6.04	9.32	0.05
		H – SE and L – SE	18.56	388	6.04	9.32	0.01
		A – SE and L – SE	3.49	412	6.04	9.32	NS
5.	Total	H – SE and A – SE	22.70	660	6.02	9.30	0.01
		H – SE and L – SE	37.73	598	6.02	9.30	0.01
		A – SE and L – SE	2.72	634	6.02	9.30	NS

H – SE : High Self-Esteem group ; L – SE : Low Self-Esteem group ; A – SE : Average Self-Esteem group.

NS – Not Significant

An examination of Table 4.30 reveals that the extreme group pairs namely High – Self-esteem Group and Low – Self-Esteem Group significantly differ in mean *Achievement in Physical Science* scores at 0.01 level of significance in the total sample and the four sub samples. Significant difference at 0.01 level in the means of *Achievement in Physical Science* was noticed for H – SE and A – SE Group in the total sample, Boys and Single-sex school students. In the case of Girls and Coeducational school students, the F-ratio is significant only at 0.05 level.

On the other hand, no significant mean difference in *Achievement in Physical Science* was noticed between Average – Self-Esteem Group and Low – Self-Esteem Group in any of the five comparisons, i.e., total sample, Boys, Girls, students of Single-sex schools or Coeducational schools, the obtained F-ratios being less than the value of F' even at 0.05 level of significance for the corresponding degrees of freedom.

4.3.1.3.1 Mean Difference in Achievement in Physical Science among Three Groups of Students Categorised on the Basis of Attitude towards Science

Mean scores in *Achievement in Physical Science* of pupils categorised into three levels on the basis of Attitude towards Science (Favourable – Attitude towards Science Group – F – ATS. Moderately Favourable – Attitude towards Science Group – M – ATS and Less – Favourable Attitude towards Science group L – ATS) were compared using Scheffé's test for total sample and four sub samples namely Boys, Girls, Single-sex school students and Coeducational school students. The results of the comparison are summarised and presented in Table 4.31.

TABLE 4.31

Summary of the Group Difference in Mean Achievement in Physical Science for the Three Levels of Attitude towards Science

SI.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	F – ATS and M – ATS	26.69	311	6.06	9.36	0.01
		F – ATS and L – ATS	87.50	309	6.06	9.36	0.01
		M – ATS and L – ATS	20.29	350	6.06	9.36	0.01
2.	Girls	F – ATS and M – ATS	31.57	350	6.06	9.36	0.01
		F – ATS and L – ATS	142.90	270	6.06	9.36	0.01
		M – ATS and L – ATS	53.91	302	6.06	9.36	0.01
3.	Single-sex	F – ATS and M – ATS	22.98	230	6.08	9.42	0.01
		F – ATS and L – ATS	64.49	199	6.08	9.42	0.01
		M – ATS and L – ATS	13.77	221	6.08	9.42	0.01
4.	Coeducational	F – ATS and M – ATS	35.68	431	6.04	9.32	0.01
		F – ATS and L – ATS	151.58	380	6.04	9.32	0.01
		M – ATS and L – ATS	49.67	431	6.04	9.32	0.01
5.	Total	F – ATS and M – ATS	57.79	661	6.02	9.30	0.01
		F – ATS and L – ATS	213.82	579	6.02	9.30	0.01
		M – ATS and L – ATS	61.74	652	6.02	9.30	0.01

F – ATS : Favourable – Attitude towards Science group ; L – ATS : Less Favourable – Attitude towards Science Group

M – ATS : Moderately – Favourable Attitude towards Science group

As per Table 4.31, F-values obtained for the mean difference in *Achievement in Physical Science* for the three groups compared, taken into pairs, i.e., F – ATS and M – ATS, F – ATS and L – ATS , M – ATS and L – ATS for the total sample and the four sub samples are found to be well beyond the value of F' set for 0.01 level for appropriate degrees of freedom.

Since high means are associated with F – ATS group for the two comparisons F – ATS with M – ATS and F – ATS with L – ATS, this groups can be considered to have advantage in Achievement in Physical Science.

4.3.1.3.1 Mean Difference in Achievement in Physical Science among Three Groups of Students Categorised on the Basis of Attitude towards Academic Work

Group difference in mean Achievement in Physical Science for three identical groups of students based on *Attitude towards Academic Work* were studied (taken in pairs) using Scheffé's test of Multiple Comparison. The groups compared were F – ATA and M – ATA; F – ATA and L – ATA and M – ATA and L – ATA. The data and results are presented in Table 4.32.

TABLE 4.32

**Summary of the Group Difference in Mean Achievement in Physical Science for the
Three Levels of Attitude towards Academic Work**

SI.No.	Sample	Groups Compared	F-value	N	Value required for Significance		Level of Significance
					0.05	0.01	
1.	Boys	F – ATA and M – ATA	3.75	331	6.06	9.36	NS
		F – ATA and L – ATA	24.37	295	6.06	9.36	0.01
		M – ATA and L – ATA	10.99	344	6.06	9.36	0.01
2.	Girls	F – ATA and M – ATA	1.52	367	6.04	9.32	NS
		F – ATA and L – ATA	33.44	262	6.06	9.36	0.01
		M – ATA and L – ATA	24.18	293	6.06	9.36	0.01
3.	Single-sex	F – ATA and M – ATA	1.18	254	6.08	9.42	NS
		F – ATA and L – ATA	17.03	200	6.08	9.42	0.01
		M – ATA and L – ATA	10.12	196	6.08	9.42	0.01
4.	Coeducational	F – ATA and M – ATA	6.15	444	6.04	9.32	0.05
		F – ATA and L – ATA	42.65	357	6.04	9.32	0.01
		M – ATA and L – ATA	21.61	441	6.04	9.32	0.01
5.	Total	F – ATA and M – ATA	4.79	698	6.02	9.30	NS
		F – ATA and L – ATA	52.01	557	6.02	9.30	0.01
		M – ATA and L – ATA	30.28	637	6.02	9.30	0.01

F – ATA : Favourable – Attitude towards Academic Work group; L – ATA : Less Favourable – Attitude towards Academic Work Group M – ATA : Moderately – Favourable Attitude towards Academic Work group; NS – Not significant

As per Table 4.32, the extreme group pairs, i.e., F – ATA Group and L – ATA group significantly differ in mean *Achievement in Physical Science* scores at 0.01 level of significance in the total sample and the four sub samples namely Boys, Girls, Single-sex school students and Coeducational school students. Significant difference at 0.01 level in the means of *Achievement in Physical Science* was noticed for M – ATA and L – ATA Group in the total sample, Boys, Girls, Single-sex school students and Coeducational school students.

On the other hand, no significant mean difference in *Achievement in Physical Science* was noticed between F – ATA Group and M – ATA Group in any four comparison i.e., total sample, Boys, Girls and Single-sex school students. But F – ATA Group and M – ATA Group significantly differ in mean *Achievement in Physical Science* in the case of Coeducational school students at 0.05 level of significance.

4.3.2 Mean Differences in Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science among Relevant Subgroups Formed on the Basis of Select Independent Variables, Sex and School Type

Since significant main effect and first order interaction of Sex by School type on *Achievement in Physics, Chemistry and Physical Science* were noticed in all the fifteen ANOVA computed, comparison of means were further critical ratios for the following group pairs:

- (i) Comparison of boys and girls of three nearly identical groups formed on the basis of select qualitative variables in Single-sex schools
- (ii) Comparison of boys and girls of three nearly identical groups formed on the basis of select qualitative variables in the Coeducational schools.
- (iii) Comparison of boys of Single-sex schools and Coeducational schools – (sample grouped into three identical groups on the basis of select qualitative variables)

- (iv) Comparison of girls of Single-sex schools and Coeducational schools (sample grouped into three identical groups on the basis of select qualitative variables)

Means, standard deviations and t-values were computed for each group pair. The results were interpreted using two-tailed test of significance for appropriate degrees of freedom.

Details of the comparison of means of relevant subgroups and the interpretation of results are discussed below.

4.3.2.1 Comparison of Mean Achievement in Physics of Boys and Girls of Three nearly Identical Groups formed on the Basis of Select Qualitative Variables – Single-sex Schools

Data and results of the comparison between boys and girls of three identical groups formed on the basis of select variables viz., Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work studying in Single-sex schools are presented in Table 4.33.

TABLE 4.33

Summary of Difference in Mean Achievement in Physics of Boys and Girls of Three nearly Identical Groups formed on the Basis of Select Qualitative Variables in Single-sex Schools

SI.No.	Category		Boys			Girls			t-value	Level of Significance
			Mean	S.D	N	Mean	S.D	N		
1.	Classroom Learning Environment (CLE)	L – CLE	21.51	6.34	43	18.23	5.98	22	1.98	0.05
		M – CLE	21.90	5.17	59	16.21	4.85	77	6.55	0.01
		F – CLE	19.86	6.59	66	16.88	5.70	58	2.66	0.01
2.	Achievement Motivation (AM)	L – AM	22.73	6.32	37	16.16	5.14	38	4.88	0.01
		A – AM	21.80	6.41	60	16.85	5.57	75	4.76	0.01
		H – AM	19.42	5.37	71	17.05	5.22	44	2.31	0.05
3.	Self-Esteem (SE)	L – SE	20.51	6.23	43	16.33	4.99	64	3.81	0.01
		A – SE	19.43	5.60	60	15.98	4.85	55	3.49	0.01
		H – SE	22.77	6.08	65	18.53	6.28	38	4.88	0.01
4.	Attitude towards Science (ATS)	L – ATS	17.67	4.96	52	13.65	3.05	43	4.59	0.01
		M – ATS	20.31	5.27	64	16.98	5.04	62	3.59	0.01
		F – ATS	25.17	5.75	52	19.00	6.01	52	5.30	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	17.87	5.13	38	14.15	4.11	33	3.29	0.01
		M – ATA	21.34	6.29	68	16.67	5.07	57	4.48	0.01
		F – ATA	22.55	5.80	62	18.07	5.70	67	4.38	0.01

As per Table 4.33, it can be noticed that significant sex difference in mean *Achievement in Physics* exist for all the three identical subgroups of students of *Single-sex* schools formed on the basis of *Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* (value of thirteen out of fifteen critical ratios are significant beyond 0.01 level and the remaining two at 0.05 level).

Boys and girls of different levels of *Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* of *Single-sex* schools can be considered to be not similar in their mean *Achievement in Physics*. High means are seen associated with boys of *Single-sex* schools in all the fifteen comparisons.

4.3.2.2 Comparison of Mean Achievement in Physics of Boys and Girls of Three nearly Identical Groups formed on the Basis of Select Qualitative Variables – Coeducational Schools

Results of the t-test to find out whether significant sex difference in mean *Achievement in Physics* exist (for sample of three levels formed on the basis of five select independent variables from *Coeducational* schools) are presented in Table 4.34.

TABLE 4.34

Summary of Difference in Mean Achievement in Physics of Boys and Girls of Three nearly Identical Groups formed on the Basis of Select Qualitative Variables in Coeducational Schools

SI.No.	Category	CO ED Boys			CO ED Girls			t-value	Level of Significance	
		Mean	S.D	N	Mean	S.D	N			
1.	Classroom Learning Environment (CLE)	L – CLE	18.90	6.07	127	20.33	6.34	79	1.61	NS
		M – CLE	20.09	4.89	113	20.34	6.58	115	0.32	NS
		F – CLE	21.49	5.50	77	20.37	6.12	110	1.28	NS
2.	Achievement Motivation (AM)	L – AM	19.45	6.33	91	21.42	6.77	98	2.05	0.05
		A – AM	19.33	4.91	110	19.67	6.10	120	0.46	NS
		H – AM	20.94	5.54	116	20.08	6.05	86	1.04	NS
3.	Self-Esteem (SE)	L – SE	18.79	5.85	91	18.97	6.76	88	0.18	NS
		A – SE	19.69	5.58	121	20.51	6.13	112	1.06	NS
		H – SE	21.26	5.21	105	21.35	6.03	104	0.11	NS
4.	Attitude towards Science (ATS)	L – ATS	17.68	5.72	122	15.85	5.32	68	2.15	0.05
		M – ATS	20.19	4.92	112	19.94	5.62	129	0.36	NS
		F – ATS	22.98	4.82	83	23.70	5.85	107	0.91	NS
5.	Attitude towards Academic Work (ATA)	L – ATA	18.51	5.54	116	17.38	7.12	61	1.16	NS
		M – ATA	20.19	5.46	122	20.84	6.36	142	0.88	NS
		F – ATA	21.71	5.45	79	21.46	5.22	101	0.32	NS

Table 4.34 indicates that significant sex difference (0.05 level of significance) in mean *Achievement in Physics* exist only for two out of fifteen comparisons. The groups are the following:

Low – Achievement Motivation Group – High mean for Girls
Low – Attitude towards Science Group - High mean for boys

All other thirteen t-values are not significant even at 0.05 level. Boys and girls of *Coeducational* schools can therefore be considered identical with respect to their mean *Achievement in Physics*.

4.3.2.3 Comparison of Mean Achievement in Physics of Boys of Single-sex Schools and Coeducational Schools

The sample of boys of *Single-sex* schools and *Coeducational* schools grouped into three nearly identical levels on the basis of each of the five qualitative variables. The details of the t-test computed between the mean *Achievement in Physics* of boys of *Single-sex schools* and *Coeducational* schools are presented in Table 4.35.

TABLE 4.35

Summary of Difference in Mean Achievement in Physics of Boys of Single-sex Schools and Coeducational Schools – (Three Identical Group of Boys formed on the Basis of Select Qualitative Variables)

Sl.No.	Category	Single-sex (Boys)			Coeducational (Boys)			t-value	Level of Significance	
		Mean	S.D	N	Mean	S.D	N			
1.	Classroom Learning Environment (CLE)	L – CLE	21.51	6.34	43	18.90	6.07	127	2.41	0.05
		M – CLE	21.90	5.17	59	20.09	4.89	113	2.25	0.05
		F – CLE	19.86	6.59	66	21.49	5.50	77	1.60	NS
2.	Achievement Motivation (AM)	L – AM	22.73	6.32	37	19.45	6.33	91	2.64	0.01
		A – AM	21.80	6.41	60	19.33	4.91	110	2.79	0.01
		H – AM	19.42	5.37	71	20.94	5.54	116	1.83	NS
3.	Self-Esteem (SE)	L – SE	20.51	6.23	43	18.79	5.85	91	1.54	NS
		A – SE	19.43	5.60	60	19.69	5.58	121	0.29	NS
		H – SE	22.77	6.08	65	21.26	5.21	105	1.71	NS
4.	Attitude towards Science (ATS)	L – ATS	17.67	4.96	52	17.68	5.72	122	0.01	NS
		M – ATS	20.31	5.27	64	20.19	4.92	112	0.16	NS
		F – ATS	25.17	5.75	52	22.98	4.82	83	2.37	0.05
5.	Attitude towards Academic Work (ATA)	L – ATA	17.87	5.13	38	18.51	5.54	116	0.63	NS
		M – ATA	21.34	6.29	68	20.19	5.46	122	1.31	NS
		F – ATA	22.55	5.80	62	21.71	5.45	79	0.88	NS

Significant difference between boys of *Single-sex* and *Coeducational* schools in mean *Achievement in Physics* was found to exist in only five out of the fifteen group pairs compared. The pairs are given below.

Less – Favourable Classroom Learning

Environment Group – 0.05 level

Moderately– Favourable Classroom

Learning Environment Group – 0.05 level

Low – Achievement Motivation Group – 0.01 level

Average – Achievement Motivation Group – 0.01 level

Favourable – Attitude towards Science Group – 0.05 level

High means are seen associated with boys of *Single-sex* schools in all these five comparisons. No significant mean difference is noticed in the other ten comparisons.

4.3.2.4 Comparison of Mean Achievement in Physics of Girls of Single-sex Schools and Coeducational Schools

Data and results of the t-test of comparison of girls of *Single-sex* schools and *Coeducational* schools in mean *Achievement in Physics* are presented in Table 4.36.

TABLE 4.36

Summary of Difference in Mean Achievement in Physics of Girls of Single-sex Schools and Coeducational Schools – (Three Identical Group of Girls formed on the Basis of Select Qualitative Variables)

Sl.No.	Category		Single-sex (Girls)			Coeducational (Girls)			t-value	Level of Significance
			Mean	S.D	N	Mean	S.D	N		
1.	Classroom Learning Environment (CLE)	L – CLE	18.23	5.98	22	20.33	6.34	79	1.38	NS
		M – CLE	16.21	4.85	77	20.34	6.58	115	4.69	0.01
		F – CLE	16.88	5.70	58	20.37	6.12	110	3.58	0.01
2.	Achievement Motivation (AM)	L – AM	16.16	5.14	38	21.42	6.77	98	4.30	0.01
		A – AM	16.85	5.57	75	19.67	6.10	120	3.22	0.01
		H – AM	17.05	5.22	44	20.08	6.05	86	2.81	0.01
3.	Self-Esteem (SE)	L – SE	16.33	4.99	64	18.97	6.76	88	2.62	0.01
		A – SE	15.98	4.85	55	20.51	6.13	112	4.76	0.01
		H – SE	18.53	6.28	38	21.35	6.03	104	2.42	0.05
4.	Attitude towards Science (ATS)	L – ATS	13.65	3.05	43	15.85	5.32	68	2.45	0.05
		M – ATS	16.98	5.04	62	19.94	5.62	129	3.50	0.01
		F – ATS	19.00	6.01	52	23.70	5.85	107	4.68	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	14.15	4.11	33	17.88	7.12	61	2.37	0.05
		M – ATA	16.67	5.07	57	20.84	6.36	142	4.40	0.01
		F – ATA	18.07	5.70	67	21.46	5.22	101	3.94	0.01

The results of the comparison of *Achievement in Physics* of girls of *Single-sex* schools and *Coeducational* schools reveal that the obtained t-values for mean difference are significant in fourteen out of fifteen comparisons. It is to be noted that high means are seen associated with girls of Coeducational schools in all the fourteen comparisons.

The group pair for which t-value is not significant is Less – Favourable Classroom Learning Environment Group.

4.3.2.5 Comparison of Mean Achievement in Chemistry of Boys and Girls of Three nearly Identical Groups formed on the basis of Select Qualitative Variables – Single-sex Schools

Details of the comparison of mean *Achievement in Chemistry* of boys and girls of *Single-sex* schools are presented in Table 4.37.

TABLE 4.37

Summary of Difference in Mean Achievement in Chemistry of Boys and Girls Three nearly Identical Groups Formed on the Basis of Select Qualitative Variables in Single-sex Schools

Sl.No.	Category		Boys			Girls			t-value	Level of Significance
			Mean	S.D	N	Mean	S.D	N		
1.	Classroom Learning Environment (CLE)	L – CLE	18.42	6.24	43	15.32	3.43	22	2.14	0.05
		M – CLE	18.25	5.99	59	14.00	5.17	77	4.41	0.01
		F – CLE	18.02	5.37	66	14.86	4.58	58	3.47	0.01
2.	Achievement Motivation (AM)	L – AM	17.38	5.85	37	14.32	5.75	38	2.26	0.05
		A – AM	19.53	6.03	60	14.43	4.58	75	5.55	0.01
		H – AM	17.51	5.41	71	14.80	4.13	44	2.82	0.01
3.	Self-Esteem (SE)	L – SE	16.86	5.80	43	14.44	4.35	64	2.44	0.05
		A – SE	17.03	5.51	60	13.78	4.97	55	3.28	0.01
		H – SE	20.17	5.56	65	15.66	4.95	38	4.09	0.01
4.	Attitude towards Science (ATS)	L – ATS	15.88	5.58	52	11.88	3.92	43	3.92	0.01
		M – ATS	17.78	4.26	64	14.45	4.35	62	4.31	0.01
		F – ATS	21.04	6.50	52	16.73	4.78	52	3.81	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	17.24	4.74	38	11.94	3.95	33	5.00	0.01
		M – ATA	18.44	6.07	68	14.54	4.85	57	3.88	0.01
		F – ATA	18.53	6.07	62	15.73	4.57	67	2.95	0.01

Fifteen t-values were computed for comparing the mean *Achievement in Chemistry* of relevant subgroups of boys and girls of *Single-sex* schools. Table 4.37 reveals that significant sex difference exists in achievement since all the fifteen t-values are significant; twelve t-values are significant beyond 0.01 level of significance.

It can also be noted that high means are associated with boys of *Single-sex* schools in all the fifteen comparisons.

4.3.2.6 Comparison of Mean Achievement in Chemistry of Boys and Girls of Three nearly Identical Groups formed on the basis of Select Qualitative Variables – Coeducational Schools

Mean, standard deviation and t-value computed for the comparison of mean *Achievement in Chemistry* of boys and girls of *Coeducational* schools are presented in Table 4.38.

TABLE 4.38

Summary of Difference in Mean Achievement Chemistry of Boys and Girls Three nearly Identical Groups Formed on the Basis of Select Qualitative Variables in Coeducational Schools

SI.No.	Category		CO-ED Boys			CO-ED Girls			t-value	Level of Significance
			Mean	S.D	N	Mean	S.D	N		
1.	Classroom Learning Environment (CLE)	L – CLE	16.14	5.87	127	19.43	6.32	79	3.78	0.01
		M – CLE	17.91	5.44	113	19.67	7.30	115	2.05	0.05
		F – CLE	18.70	5.51	77	19.36	5.68	110	0.79	NS
2.	Achievement Motivation (AM)	L – AM	17.18	5.84	91	19.86	6.36	98	3.00	0.01
		A – AM	16.96	5.87	110	19.18	6.45	120	2.70	0.01
		H – AM	17.97	5.47	116	19.53	6.70	86	1.81	NS
3.	Self-Esteem (SE)	L – SE	16.15	5.93	91	18.61	6.47	88	2.64	0.01
		A – SE	17.32	5.51	121	19.06	6.49	112	2.20	0.05
		H – SE	18.55	5.58	105	20.71	6.35	104	2.60	0.01
4.	Attitude towards Science (ATS)	L – ATS	15.66	5.35	122	14.38	3.90	68	1.71	NS
		M – ATS	17.87	5.71	112	19.67	6.40	129	2.29	0.05
		F – ATS	19.31	5.57	83	22.53	5.90	107	3.80	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	16.14	5.59	116	16.67	5.51	61	0.60	NS
		M – ATA	17.65	5.18	122	19.54	6.71	142	2.52	0.05
		F – ATA	18.85	6.33	79	21.15	6.16	101	2.44	0.05

The results of the comparison of means reveal that obtained t-values are significant for eleven out of fifteen comparisons. These group pairs are listed below.

Less Favourable – Class Learning

Environment Group : .01 level

Moderately – Favourable Classroom

Learning Environment Group : .05 level

Low – Achievement Motivation Group : .01 level

Average – Achievement Motivation Group : .01 level

Low – self-Esteem Group : .01 level

Average – Self-Esteem Group : .05 level

High – Self-Esteem Group : .01 level

Moderately Favourable – Attitude

towards Science Group : .05 level

Favourable – Attitude towards Science Group : .05 level

Moderately Favourable – Attitude towards

Academic Work Group : .05 level

Favourable – Attitude towards Science Group : .05 level

High means are associated with girls in fourteen out of fifteen comparisons except for the group pair – Less – Favourable Attitude towards Science Group.

4.3.2.7 Comparison of Mean Achievement in Chemistry of Boys of Single-sex Schools and Coeducational Schools

Results of the test of significance of difference in mean *Achievement in Chemistry* of boys of *Single-sex* schools and *Coeducational* schools are presented in Table 4.39.

TABLE 4.39

Summary of Difference in Mean Achievement in Chemistry of Boys of Single-sex Schools and Coeducational Schools – (Three Identical Groups of Boys Formed on the Basis of Select Qualitative Variables)

Sl.No.	Category		Single-sex (Boys)			Coeducational (Boys)			t-value	Level of Significance
			Mean	S.D	N	Mean	S.D	N		
1.	Classroom Learning Environment (CLE)	L – CLE	18.42	6.24	43	16.14	5.87	127	2.15	0.05
		M – CLE	18.25	5.99	59	17.91	5.44	113	0.38	NS
		F – CLE	18.02	5.37	66	18.70	5.51	77	0.75	NS
2.	Achievement Motivation (AM)	L – AM	17.38	5.85	37	17.18	5.84	91	0.18	NS
		A – AM	19.53	6.03	60	16.96	5.87	110	2.69	0.01
		H – AM	17.51	5.41	71	17.97	5.47	116	0.57	NS
3.	Self-Esteem (SE)	L – SE	16.86	5.80	43	16.15	5.93	91	0.64	NS
		A – SE	17.03	5.51	60	17.32	5.51	121	0.33	NS
		H – SE	20.17	5.56	65	18.55	5.58	105	1.83	NS
4.	Attitude towards Science (ATS)	L – ATS	15.88	5.58	52	15.66	5.35	122	0.25	NS
		M – ATS	17.78	4.26	64	17.87	5.71	112	0.10	NS
		F – ATS	21.04	6.50	52	19.31	5.57	83	1.63	NS
5.	Attitude towards Academic Work (ATA)	L – ATA	17.24	4.74	38	16.14	5.59	116	1.08	NS
		M – ATA	18.44	6.07	68	17.65	5.18	122	0.95	NS
		F – ATA	18.53	6.07	62	18.85	6.33	79	0.30	NS

The obtained t-values as per Table 4.39 reveal that significant difference in mean *Achievement in Chemistry* of boys of *Single-sex* schools and *Coeducational* schools exist only in two out of fifteen comparisons. The group pairs are the following:

Less Favourable – Classroom Learning Environment Group : .05 level
Average – Achievement Motivation Group : .01 level

In these two cases, high means are associated with boys of *Single-sex* schools.

4.3.2.8 Comparison of Mean Achievement in Chemistry of Girls of Single-sex Schools and Coeducational Schools

Details of the t-test computed to compare the mean *Achievement in Chemistry* of girls of *Single-sex* schools and *Coeducational* schools are presented in Table 4.40.

TABLE 4.40

Summary of Difference in Mean Achievement in Chemistry of Girls of Single-sex Schools and Coeducational Schools – (Three Identical Groups of Girls Formed on the Basis of Select Qualitative Variables)

SI.No.	Category	Single-sex (Girls)			Coeducational (Girls)			t-value	Level of Significance	
		Mean	S.D	N	Mean	S.D	N			
1.	Classroom Learning Environment (CLE)	L – CLE	15.32	3.43	22	19.43	6.32	79	2.90	0.01
		M – CLE	14.00	5.17	77	19.67	7.30	115	5.87	0.01
		F – CLE	14.86	4.58	58	19.36	5.68	110	5.17	0.01
2.	Achievement Motivation (AM)	L – AM	14.32	5.75	38	19.86	6.36	98	4.65	0.01
		A – AM	14.43	4.58	75	19.18	6.45	120	5.53	0.01
		H – AM	14.80	4.13	44	19.53	6.70	86	4.26	0.01
3.	Self-Esteem (SE)	L – SE	14.44	4.35	64	18.61	6.47	88	4.45	0.01
		A – SE	13.78	4.97	55	19.06	6.49	112	5.29	0.01
		H – SE	15.66	4.95	38	20.71	6.35	104	4.40	0.01
4.	Attitude towards Science (ATS)	L – ATS	11.88	3.92	43	14.38	3.90	68	3.25	0.01
		M – ATS	14.45	4.35	62	19.67	6.40	129	5.78	0.01
		F – ATS	16.73	4.78	52	22.53	5.90	107	6.14	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	11.94	3.95	33	16.67	5.51	61	4.32	0.01
		M – ATA	14.54	4.85	57	19.54	6.71	142	5.08	0.01
		F – ATA	15.73	4.57	67	21.15	6.16	101	6.12	0.01

It can be seen from Table 4.40 that all the obtained t-values are significant beyond 0.01 level. It can also be noticed that high means in *Achievement in Chemistry* are associated with girls of Coeducational schools in all the fifteen comparisons.

4.3.2.9 Comparison of Mean Achievement in Physical Science of Boys and Girls of Three nearly identical Groups formed on the Basis of select Qualitative Variables – Single Sex Schools

Results of the t-test to find out whether significant sex difference in mean *Achievement in Physical Science* exist for samples of three levels formed on the basis of five select independent variables from *Single-sex* schools are presented in Table 4.41.

TABLE 4.41

Summary of Difference in Mean Achievement in Physical Science of Boys and Girls of Three nearly Identical Groups Formed on the Basis of Select Qualitative Variables in Single-sex Schools

SI.No.	Category	Boys			Girls			t-value	Level of Significance	
		Mean	S.D	N	Mean	S.D	N			
1.	Classroom Learning Environment (CLE)	L – CLE	39.93	12.01	43	33.55	8.70	22	2.18	0.05
		M – CLE	40.15	10.10	59	30.21	8.62	77	6.14	0.01
		F – CLE	37.88	10.75	66	31.74	9.52	58	3.32	0.01
2.	Achievement Motivation (AM)	L – AM	40.11	11.49	37	30.47	9.75	38	3.87	0.01
		A – AM	41.33	11.57	60	31.28	9.04	75	5.62	0.01
		H – AM	36.93	9.54	71	31.84	8.37	44	2.89	0.01
3.	Self-Esteem (SE)	L – SE	37.37	11.45	43	30.77	8.14	64	3.45	0.01
		A – SE	36.47	9.75	60	29.76	8.62	55	3.86	0.01
		H – SE	42.94	10.51	65	34.18	10.36	38	4.06	0.01
4.	Attitude towards Science (ATS)	L – ATS	33.56	9.43	52	25.53	5.74	43	4.83	0.01
		M – ATS	38.09	8.15	64	31.44	8.11	62	4.56	0.01
		F – ATS	46.21	11.44	52	35.73	9.68	52	4.99	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	35.11	8.61	38	26.09	6.54	33	4.84	0.01
		M – ATA	39.78	11.71	68	31.21	8.57	57	4.55	0.01
		F – ATA	41.08	10.63	62	33.81	9.39	67	4.09	0.01

As per Table 4.41, it can be noticed that significant sex difference in mean Achievement in Physical Science exist for all the fifteen comparisons. In all these groups except the Less Favourable – Classroom Learning Environment Group, the obtained t-values are significant beyond 0.01 level.

It can also be noticed that high means are associated with boys of Single-sex schools in all the fifteen comparisons.

4.3.2.10 Comparison of Mean Achievement in Physical Science of Boys and Girls of Three nearly identical groups formed on the Basis of Select Qualitative Variables – Coeducational Schools

Details of the comparison of mean *Achievement in Physical Science* of boys and girls of *Coeducational* schools are presented in Table 4.42.

TABLE 4.42

Summary of Difference in Mean Achievement in Physical Science of Boys and Girls of Three nearly Identical Groups Formed on the Basis of Select Qualitative Variables in Coeducational Schools

Sl.No.	Category	CO-ED Boys			CO-ED Girls			t-value	Level of Significance	
		Mean	S.D	N	Mean	S.D	N			
1.	Classroom Learning Environment (CLE)	L – CLE	35.04	10.86	127	39.76	11.90	79	2.91	0.01
		M – CLE	38.00	9.39	113	40.01	12.99	115	1.33	NS
		F – CLE	40.19	9.99	77	39.79	10.85	110	0.26	NS
2.	Achievement Motivation (AM)	L – AM	36.63	11.15	91	41.34	12.18	98	2.75	0.01
		A – AM	36.29	9.79	110	38.84	11.70	120	1.78	NS
		H – AM	38.91	10.04	116	39.62	11.94	86	0.45	NS
3.	Self-Esteem (SE)	L – SE	34.95	10.73	91	37.65	12.13	88	1.57	NS
		A – SE	37.02	10.11	121	39.57	11.85	112	1.77	NS
		H – SE	39.81	9.74	105	42.06	11.58	104	1.51	NS
4.	Attitude towards Science (ATS)	L – ATS	33.34	10.14	122	30.32	8.07	68	2.10	0.05
		M – ATS	38.05	9.26	112	39.61	11.03	129	1.17	NS
		F – ATS	42.29	9.67	83	46.23	10.93	107	2.58	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	34.65	10.10	116	34.15	11.68	61	0.29	NS
		M – ATA	37.84	9.64	122	40.37	12.28	142	1.84	NS
		F – ATA	40.56	10.73	79	42.60	10.44	101	1.28	NS

Table 4.42 indicates that significant sex difference in mean *Achievement in Physical Science* exist only for four out of fifteen comparisons.

The groups are the following:

Less Favourable – Classroom Learning Environment Group : 0.01 level

Low – Achievement Motivation Group : 0.01 level

Less Favourable – Attitude towards science Group : 0.05 level

Favourable Attitude towards Science Group : 0.01 level

High means are associated with girls in twelve out of fifteen comparisons except for the following groups – Favourable – Classroom Learning Environment Group, Less – Favourable Attitude towards Science Group and Less – Favourable Attitude towards Academic Work Group.

4.3.2.11 Comparison of Mean Achievement in Physical science of Boys of Single-sex Schools and Coeducational Schools

Data and results of the comparison of boys of *Single-sex* schools and *Coeducational* schools in mean *Achievement in Physical Science* are presented in Table 4.43.

TABLE 4.43

Summary of Difference in Mean Achievement in Physical Science of Boys of Single Sex Schools and Coeducational Schools – (Three Identical Groups of Boys Formed on the Basis of Select Qualitative Variables)

SI.No.	Category		Single-sex (Boys)			Coeducational (Boys)			t-value	Level of Significance
			Mean	S.D	N	Mean	S.D	N		
1.	Classroom Learning Environment (CLE)	L – CLE	39.93	12.01	43	35.04	10.86	127	2.47	0.05
		M – CLE	40.15	10.10	59	38.00	9.39	113	1.38	NS
		F – CLE	37.88	10.75	66	40.19	9.99	77	1.33	NS
2.	Achievement Motivation (AM)	L – AM	40.11	11.49	37	36.63	11.15	91	1.58	NS
		A – AM	41.33	11.57	60	36.29	9.79	110	2.99	0.01
		H – AM	36.93	9.54	71	38.91	10.04	116	1.33	NS
3.	Self-Esteem (SE)	L – SE	37.37	11.45	43	34.95	10.73	91	1.19	NS
		A – SE	36.47	9.75	60	37.02	10.11	121	0.35	NS
		H – SE	42.94	10.51	65	39.81	9.74	105	1.96	0.05
4.	Attitude towards Science (ATS)	L – ATS	33.56	9.43	52	33.34	10.14	122	0.13	NS
		M – ATS	38.09	8.15	64	38.05	9.26	112	0.03	NS
		F – ATS	46.21	11.44	52	42.29	9.67	83	2.12	0.05
5.	Attitude towards Academic Work (ATA)	L – ATA	35.11	8.61	38	34.65	10.10	116	0.25	NS
		M – ATA	39.78	11.71	68	37.84	9.64	122	1.23	NS
		F – ATA	41.08	10.63	62	40.56	10.73	79	0.29	NS

Significant difference between boys of *Single-sex* and *Coeducational* schools in mean *Achievement in Physical Science* was found to exist only four out of fifteen groups compared. The pairs are given below:

Less Favourable – Classroom Learning Environment Group	: 0.05 level
Average – Achievement Motivation Group	: 0.01 level
High – self-Esteem Group	: 0.05 level
Favourable – Attitude towards Science Group	: 0.05 level

High means are seen associated with boys of *Single-sex* schools in twelve out of fifteen comparisons.

4.3.2.12 Comparison of Mean Achievement in Physical Science of Girls of Single-sex Schools and Coeducational Schools

Mean, standard deviation and t-values computed for the comparison of mean *Achievement in Physical Science* of girls of *Single-sex* schools and *Coeducational* schools are presented in Table 4.44.

TABLE 4.44

Summary of Difference in Mean Achievement in Physical Science of Girls of Single Sex Schools and Coeducational Schools – (Three Identical Groups of Girls Formed on the Basis of Select Qualitative Variables)

SI.No.	Category	Single-sex (Girls)			Coeducational (Girls)			t-value	Level of Significance	
		Mean	S.D	N	Mean	S.D	N			
1.	Classroom Learning Environment (CLE)	L – CLE	33.55	8.70	22	39.76	11.90	79	2.26	0.05
		M – CLE	30.21	8.62	77	40.01	12.99	115	5.79	0.01
		F – CLE	31.74	9.52	58	39.79	10.85	110	4.74	0.01
2.	Achievement Motivation (AM)	L – AM	30.47	9.75	38	41.34	12.18	98	4.88	0.01
		A – AM	31.28	9.04	75	38.84	11.70	120	4.75	0.01
		H – AM	31.84	8.37	44	39.62	11.94	86	3.83	0.01
3.	Self-Esteem (SE)	L – SE	30.77	8.14	64	37.65	12.13	88	3.91	0.01
		A – SE	29.76	8.62	55	39.57	11.85	112	5.44	0.01
		H – SE	34.18	10.36	38	42.06	11.58	104	3.66	0.01
4.	Attitude towards Science (ATS)	L – ATS	25.53	5.74	43	30.32	8.07	68	3.36	0.01
		M – ATS	31.44	8.11	62	39.61	11.03	129	5.17	0.01
		F – ATS	35.73	9.68	52	46.23	10.93	107	5.86	0.01
5.	Attitude towards Academic Work (ATA)	L – ATA	26.09	6.54	33	34.15	11.68	61	3.62	0.01
		M – ATA	31.21	8.57	57	40.37	12.28	142	5.13	0.01
		F – ATA	33.81	9.39	67	42.60	10.44	101	5.53	0.01

The results of the comparison of *Achievement in Physical Science* of Girls of *Single-sex* schools and *Coeducational* schools reveal that the obtained t-values for mean difference are significant in all the fifteen comparisons beyond 0.01 level except for L – CLE group (.05 level). It is also noted that high means are seen associated with girls of *Coeducational* schools in all the fifteen comparisons.

Discussion of the Results of Post Hoc Comparison

A. Multiple comparison with regard to Mean Achievement scores in Physics, Chemistry and Physical Science of students of three nearly identical levels of *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work* of the total sample; boys and girls in the sample; *Single-sex* school students and *Coeducational* school students reveal the following:

- (i) For the groups formed on the basis of the *Attitude towards Science*, all the forty five group pair comparisons (fifteen for each dependent variable) were found to be significantly different for the mean scores.
- (ii) For the groups formed on the basis of the variable *Attitude towards Academic Work*, ten out of fifteen group-pair comparisons show significant mean difference in *Achievement in Physics*, thirteen out of fifteen show significant mean difference in *Achievement in Chemistry* and eleven out of fifteen show significant mean difference in *Achievement in Physical Science*. Extreme group pairs (F-ATA – L-ATA) show significant difference in all the fifteen comparisons.
- (iii) When the group pairs of nearly identical levels of *Self-Esteem* were subjected to post-hoc comparison, it was found that significant mean difference exist in eight out of fifteen in *Achievement in Physics*; ten out of fifteen in *Achievement in Chemistry* and ten out of fifteen in *Achievement in Physical*

Science. Here also, extreme groups (H-SE – L-SE) show significant difference in all the fifteen comparisons.

- B. Results of the comparison of mean scores of *Achievement in Physics*, *Chemistry* and *Physical Science* of comparable groups based on sex and school type reveal the following:
- (i) When sex difference was examined for the sample in *Single-sex* schools, it was found that significant difference exist in (a) *Achievement in Physics* for fourteen out of fifteen comparisons; (b) *Achievement in Chemistry* for all the fifteen comparisons; and (c) *Achievement in Physical Science* for all the comparisons. High means are associated with boys.
 - (ii) Significant sex difference in *Coeducational* schools exist in (a) *Achievement in Physics* only in two out of fifteen comparisons; (b) *Achievement in Chemistry* in eleven out of fifteen comparisons. But in *Achievement in Physical Science*, significant sex difference in means exist only for four out of fifteen comparisons: High means are associated with girls.
 - (iii) When difference in mean achievement scores of boys between *Single-sex* schools and *Coeducational* schools were examined, it was found that significant difference exist only in five out of fifteen comparisons for *Achievement in Physics*, two out of fifteen comparisons for *Achievement in Chemistry* and four out of fifteen comparisons in *Achievement in Physical Science*. High means are associated with boys of *Single-sex* schools.
 - (iv) When difference in mean achievement scores of girls between *Single-sex* schools and *Coeducational* schools were examined, it was found that significant difference exist in fourteen out of fifteen comparisons for *Achievement in Physics*, all the fifteen comparisons for *Achievement in Chemistry* and *Achievement in*

Physical Science. High means are associated with girls of *Coeducational* schools.

The graph presented in Figures 4-1 to 4-15 substantiate more clearly the above findings regarding boy/girl differences in *Achievement in Physical Science* of differential levels of subjects categorised on the basis of select independent variables and also differences in achievement of boys and girls of *Single-sex* and *Co-educational* schools.

4.4. PREDICTION OF HIGH – ; AVERAGE – ; AND LOW – ACHIEVERS IN PHYSICAL SCIENCE USING THE SELECT INDEPENDENT VARIABLES, SEX AND SCHOOL TYPE AND THE EFFECTIVENESS OF THE PREDICTORS

In this section of the analysis, an attempted was made to derive the linear discriminant functions in terms of the significant predictors and thereby to estimate their effectiveness in predicting group membership based on the dependent variable. In the present study, discriminant analysis was used to predict High – ; Average – ; and Low – Achievers in Physics, Chemistry and Physical Science separately. Besides, the five independent variables selected for the study (which are all qualitative variables, Sex of the subjects and *Type of school* based on sex enrolment (*Single-sex* schools and *Coeducational* schools) were also included as predictor variables. When three-way ANOVA was done, it was noticed that *Sex* and *Type of school* have significant main effect and first order interaction effect on *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science*. Hence the inclusion of these two variables (Sex and Type of schools) as predictor variables. These seven variables were considered as predictor variables for discriminant analysis. Statistical Package for Social Science (SPSS) was used for analysing the data for estimating the effectiveness of seven predictor variables in predicting group membership, namely High – Achievers; Average – Achievers; and Low – Achievers in Physics, Chemistry and Physical Science separately. Details of the analysis and discussion of

results are presented in the following text separately for Achievers in Physics, Chemistry and Physical Science.

4.4.1 Predicting Group Membership of Low – ; Average – ; and High – Achievers In Physics

As described in Chapter 3, the subjects were categorised into Low – ‘ Average – ‘ and High – Achievers in Physics on the basis of mean and standard deviation of scores on Achievement in Physics as cut – off point.

Analysis of Group Difference

As a preliminary step, in order to examine whether there is a statically significant difference among the means of the three groups, namely Low – ; Average – ; and High – Achievers in Physics in each of the seven predictor variables Univariate ANOVA was done. For this purpose, Wilk’s Lambda and F-values were estimated. These values along with the preliminary data such as means and standard deviations of the seven predictor variables for Low – ; Average – ; and High Achievers in Physics for the total sample (N = 946) are presented in Table 4.45.

TABLE 4.45

Univariate Statistics of Significant Predictor Variables

SI.No.	Predictor Variables	Low – Achievers in Physics		Average – Achievers in Physics		High – Achievers in Physics		Total Sample		Wilk's Lambda	F-value
		Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D		
1.	Classroom Learning Environment	88.18	17.10	88.22	15.13	88.52	17.03	88.31	16.39	0.99	0.04
2.	Self – Esteem	37.62	7.71	39.52	7.66	40.81	8.14	39.35	7.94	0.97	12.81
3.	Achievement Motivation	71.41	12.35	72.49	11.69	71.25	11.99	71.74	12.00	0.99	1.05
4.	Attitude towards Science	129.66	15.73	136.61	14.01	145.54	14.61	137.39	16.09	0.84	89.31
5.	Attitude towards Academic Work	114.91	17.71	120.77	14.52	123.01	13.21	119.67	15.55	0.95	23.13
6.	Sex	1.59	0.49	1.44	0.50	1.44	0.50	1.49	0.50	0.98	8.83
7.	School Type	1.56	0.49	1.68	0.47	1.73	0.44	1.66	0.48	0.97	10.80

As per Table 4.45, it can be noted that the values obtained for Wilk's Lambda (λ) for the predictor variables *Classroom Learning Environment*, *Self-Esteem*, *Achievement Motivation*, *Attitude towards Science*, *Attitude towards Academic Work*, *Sex* and *School Type* are 0.99, 0.97, 0.99, 0.84, 0.95, 0.98 and 0.97 respectively. The values obtained for λ is almost equal to one except for the variable *Attitude towards Science*, i.e. mean score of the variable *Attitude towards Science* differ significantly among the three groups.

When the Univariate F-ratios were examined, the obtained F-value for the predictor variables *Self-Esteem* (12.81); *Attitude towards Science* (89.31); *Attitude towards Academic Work* (23.13); *Sex* (8.83); and *School Type* (10.80) were found to exceed the critical value of accepted limit set for 0.01 level of significant for *df* 2, 943. The F-ratios for the variable *Classroom Learning Environment* and *Achievement Motivation* are not significant even at 0.05 level. These results thus suggest that except for *Classroom Learning Environment* and *Achievement Motivation*, mean scores of all the other five variables are significantly different for the groups Low – ; Average – ; and High – Achievers.

Interdependence among the Seven Predictor Variables

In the next step, interdependence, if any, among the predictor variables were examined and hence a pooled correlation matrix by averaging the correlation matrices of the three groups Low – ; Average – ; and High – Achievers in Physics was estimated. The matrix is presented in Table 4.46.

TABLE 4.46

Pooled Correlation Matrix of the Seven Predictor Variables with Achievement in Physics

Predictor Variable	V₄	V₁₀	V₁₈	V₁₉	V₂₀	Sex	School Type
Classroom Learning Environment (V ₄)	1.00						
Self-Esteem (V ₁₀)	0.38	1.00					
Achievement Motivation (V ₁₈)	0.33	0.44	1.00				
Attitude towards Science (V ₁₉)	0.27	0.18	0.16	1.00			
Attitude towards Academic Work (V ₂₀)	0.28	0.20	0.21	0.37	1.00		
Sex	0.16	-0.04	-0.09	0.17	0.15	1.00	
School Type	-0.12	0.02	-0.08	-0.11	-0.15	0.02	1.00

The value of correlation coefficients vide Table 4.46 range from -0.15 to 0.44; all the obtained 'r's are less than 0.50. The low relationships observed among the variables suggest that there is not much interdependence among the variables.

Discriminant Functions

For the calculation of the linear discriminant functions which serve as the basis for categorisation of the population into Low – ; Average – ; and High – Achievers (at the same time minimising the probability of prior miscategorisation), two assumptions of the data must be met. They are the following:

- (i) each group must be a sample from a multivariate normal population and
- (ii) the population covariance matrices of the group must all be equal.

The preliminary analysis provided in section 4.1 was undertaken with a view to understand the nature of the score distribution. The results revealed that the five predictor variables do not deviate very much from what is expected for a normal distribution. Qualitative binary variables as independent variables are also recommended by some authors as reported in the Manual of SPSS.

To test the quality of the group covariance matrices, Box's M test was done which is based on the group covariance matrices. The result of Box's M test is presented in Table 4.47.

TABLE 4.47

Box's M Test for Equality of Group Variance Matrices

Groups	Rank	Log determinants
Low – achievers in Physics	7	22.17
Average – achievers in Physics	7	21.44
High – Achievers in Physics	7	21.35
Pooled within group Covariance Matrix	7	21.76
Box M 113.39	Approximate F 2.0037**	Degrees of Freedom (56, 2502452.4)

As per Box's M test given in Table 4.47, the value of F is 2.004 which is greater than 1.54, the tabled value of F required for significance at 0.01 level for df 56, 2502452.4. This results suggests that a significant difference in the Covariance matrices of the groups exists, even though the value of obtained F is small and also the difference between the obtained and tabled F is small. The small difference may possibly be due to the sensitivity of the test. Even though the two basic assumptions were not perfectly satisfied, as this will not badly affect the result, discriminant analysis was proceeded.

By discriminant function analysis, two linear combinations of the seven predictor variables were formed. This helps to assign cases to groups Low – ; Average – ; and High – Achievers in Physics. The unstandardised and standardised canonical discriminant function coefficients are presented in Table 4.48.

TABLE 4.48
Unstandardised and Standardised Canonical
Discriminant Function Coefficients

Predictor Variables	Unstandardised Canonical Discriminant Function Coefficients		Standardised Canonical Discriminant Function Coefficients	
	Function 1	Function 2	Function 1	Function 2
Classroom Learning Environment X_1	-0.01	-0.002	-0.18	-0.03
Self-Esteem X_2	0.03	-0.01	0.25	-0.11
Achievement Motivation X_3	-0.02	0.03	-0.25	0.37
Attitude towards Science X_4	0.05	-0.03	0.84	-0.55
Attitude towards Academic Work X_5	0.01	0.04	0.24	0.70
Sex X_6	-0.79	-1.06	-0.39	-0.53
School Type X_7	0.76	0.67	0.35	0.31
Constant	-8.55	-1.29	-	-

The first and second linear discriminant equations can be formed on the basis of the data provided in Table 4.48. The equations formed on the basis of unstandardised discriminant coefficients are the following:

$$D_1 = -0.01 X_1 + 0.03 X_2 - 0.02 X_3 + 0.05 X_4 + 0.01 X_5 - 0.79 X_6 + 0.76 X_7 - 8.55 \quad \text{and}$$

$$D_2 = -0.002 X_1 - 0.01 X_2 + 0.03 X_3 - 0.03 X_4 + 0.04 X_5 - 1.06 X_6 + 0.67 X_7 - 1.29$$

Where X_1 , X_2 , X_3 , X_4 , X_5 , X_6 , and X_7 are the individual scores obtained for the seven predictor variables, namely *Classroom Learning Environment*, *Self-Esteem*, *Achievement Motivation*, *Attitude towards Science*, *Attitude towards Academic Work*, *Sex* and *School Type* respectively.

The first and second discriminant function in terms of the standardised discriminant function coefficients for the same as

$$\begin{aligned}
 D_1 &= -0.18 Z_1 + 0.25 Z_2 - 0.25 Z_3 + 0.84 Z_4 \\
 &\quad + 0.24 Z_5 - 0.39 Z_6 + 0.35 Z_7 \quad \text{and} \\
 D_2 &= -0.03 Z_1 - 0.11 Z_2 + 0.37 Z_3 - 0.55 Z_4 \\
 &\quad + 0.70 Z_5 - 0.53 Z_6 + 0.31 Z_7
 \end{aligned}$$

Group centroids of the two discriminant functions (Function 1 and Function 2) for the three groups Low – ; Average – ; and High – Achievers in Physics are given in Table 4.49.

TABLE 4.49

**Group Centroids of the Discriminant Functions for Low – ;
Average – ; and High – Achievers in Physics**

Group	Function 1	Function 2
Low – Achievers in Physics	-0.72	-0.09
Average – Achievers in Physics	0.01	0.16
High – Achievers in Physics	0.66	-0.09

The group centroids given in Table 4.49 suggests that the first function distinguishes High – Achievers from Average – and Low – Achievers in Physics and the second function distinguishes Low – Achievers from High and Average – Achievers in Physics. The proof of the same is provided in Figure 4-16.

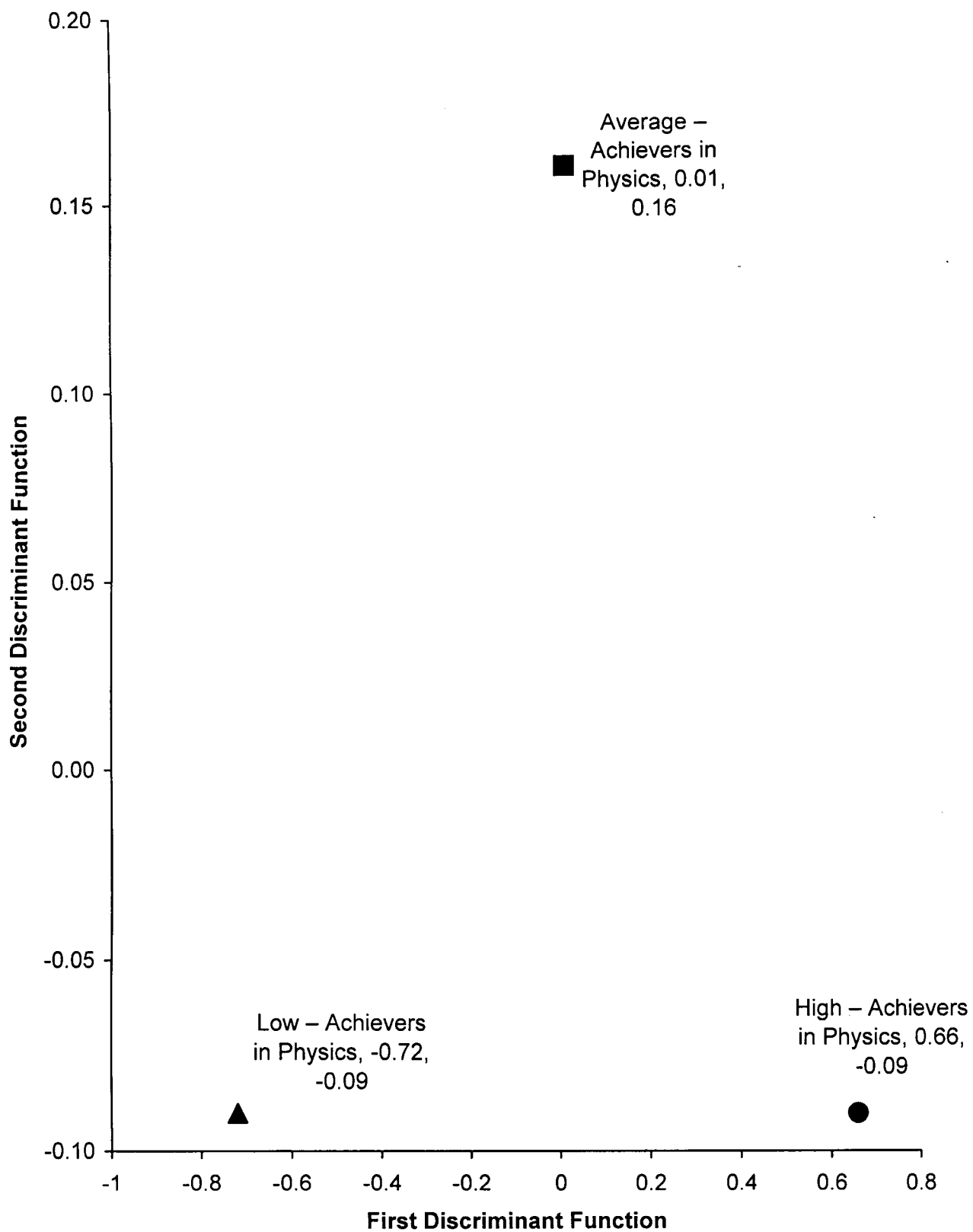


Figure - 4-16
Discriminant Function Plots of the Function 1 and Function 2
(Centroids of the Three Groups Low, Average and High Achievers
in Physics on the Two Discriminant Functions)

Significance of the Discriminant Functions

Important statistics of the discriminant functions such as Eigen value (an indicator of the effectiveness of the function), percentage of the variance accounted by each discriminant function, cumulative percentages, canonical correlations (a measure of the degree of association between the discriminant scores and the groups), Wilk's lambda (λ) and chi-square values are presented in Table 4.50.

TABLE 4.50

Statistical Indicators of the Effectiveness of the Discriminant Functions

Function	Eigen Value	Percent of Variances	Cumulative percent	Canonical Correlation	Wilk's Lambda	Chi-square	DF
Function 1	0.31	95.55	95.55	0.49	0.752	268.13**	14
Function 2	0.02	4.45	100.00	0.12	0.986	13.53*	6

* $p < 0.05$ and ** $p < 0.01$

For the first discriminant function, the obtained Eigen value is 0.31 which indicates that the function derived is effective to a good extent for discriminating High – Achievers from Average – Achievers and Low – Achievers in Physics and also that the coefficient of effectiveness is 95.40; the percentage of variance accounted by Function 1 being 95.55. The discriminant scores of the first function for the particular data set therefore account for a very large proportion of the discrimination power of this analysis. The value of canonical correlation is 0.49, which indicates that the discriminant scores and the group variables are substantially related. Moreover, the chi-square value 268.13 which exceeds the critical limit set at 0.01 level of significance also suggests that Function 1 is significant enough to discriminate High – Achievers from Average – ; and Low – Achievers in Physics.

For the second discriminant function, the Eigen value is only 0.02 suggesting that the index of effectiveness of the function is only 4.60. The percentage of variance is 4.45 and cumulative percent is 100. The value of canonical correlation is 0.12. The low value of canonical correlation suggests that the discriminant scores have a low relationship with the groups of variables. The chi-square value obtained is 13.53 ($p < 0.05$) which suggests that Function 2 is significant at 0.05 level to distinguish Low – Achievers from High – and Average – Achievers.

Classification of Cases Using the Discrimination Functions

Using the discriminant function equation, it is possible to calculate the discriminant score of each of the case in the sample. The value of this discriminant score then enables to determine the group in which the individual cases is classified. That is, determination of correctly classified or misclassified cases into three groups as Low – ; Average – ; and High – Achievers in Physics.

The success rate for prediction of membership of the grouping variables categorised using the discriminant functions developed in the analysis is presented in Table 4.51 which is titled as *Confusion Matrix*.

TABLE 4.51

Confusion Matrix of the Cases Correctly Classified and Misclassified

Actual Group	No. of Cases	Predicted Group Membership		
		Low – Achievers	Average – Achievers	High – Achievers
Low – Achievers in Physics	298	190 (63.8%)	62 (20.8%)	46 (15.4%)
Average – Achievers in Physics	333	107 (32.1%)	108 (32.4%)	118 (35.4%)
High – Achievers in Physics	315	44 (14.0%)	65 (20.6%)	206 (65.4%)

Table 4.51 shows that, of the 298 cases of the Low – Achievers in Physics, 190 cases (63.8%) were misclassified. Of the 333 cases pre-categorised as Average – Achievers, 108 cases (32.4%) are correctly classified and 225 (67.6%) are misclassified. Of the 315 cases of High – Achievers, 206 cases (65.4%) are correctly classified and 109 cases (34.6%) are misclassified. High – Achievers in Physics are more accurately classified (65% correctly) and Low – Achievers comes second with 63.8 per cent correctly and Average – Achievers last with 32.4 per cent.

The total per cent of cases thus correctly classified is 53.28 per cent which is an index of the effectiveness of the discriminant functions. This suggests that if the two functions are used to assign new cases to the three groups of High – ; Average and Low – Achievers in Physics, the functions will classify the cases with the misclassified rate of 46.72 per cent.

Correlation between Predictor Variables and Canonical Discriminant Functions

By estimating the correlation between the values of the discriminant functions and the values of each variable, it is possible to examine the contribution of each of the predictor variables to the discriminant functions. The estimated pooled within group correlations between predictor variables and canonical discriminant functions in the order of the magnitude of correlations within functions are presented in Table 4.52.

TABLE 4.52

**Pooled Within – Groups Correlations Between Predictor
Variables and Canonical Discriminant Functions**

Predictor Variables	Function 1	Function 2
Attitude towards Science	0.78*	-0.39
Self-Esteem	0.29*	0.10
School Type	0.27*	0.22
Sex	-0.21	-0.55*
Attitude towards Academic Work	0.38	0.41*
Achievement Motivation	-0.01	0.39*
Classroom Learning Environment	0.01	-0.03*

Table 4.52 suggest that among the seven significant predictor variables three variables, namely, *Attitude towards Science* (0.78), *Self-Esteem* (0.29) and *School type* (0.27) have high association with Function 1 and the four variables *Sex* (0.55), *Attitude towards Academic Work* (0.41), *Achievement Motivation* (0.39) and *Classroom Learning Environment* (0.03) have association with Function 2.

Classification Function Coefficients

Fisher's linear discriminant function coefficients derived to assign new cases into the three groups Low – ; Average – ; and High – Achievers in Physics are given in Table 4.53.

TABLE 4.53

Fisher's Linear Discriminant Function Coefficients of
Low – ; Average – ; and High – Achievers in Physics

Variables	Low – Achievers	Average – Achievers	High – Achievers
Classroom Learning Environment	0.08	0.07	0.06
Self-Esteem	0.05	0.07	0.10
Achievement Motivation	0.32	0.31	0.29
Attitude towards Science	0.43	0.46	0.50
Attitude towards Academic Work	0.29	0.31	0.31
Sex	2.91	2.07	1.82
School Type	10.89	11.62	11.94
Constant	-72.95	-79.29	-84.74

Using the Fisher's coefficients, a case is assigned to the groups for which it has the largest discriminant score. This is calculated using the coefficients and the score on the variable.

FINDINGS

- (i) The two discriminant functions in terms of standardised discriminant functions for the seven significant predictors namely,

$$D_1 = -0.18 Z_1 + 0.25 Z_2 - 0.25 Z_3 + 0.84 Z_4 \\ + 0.24 Z_5 - 0.39 Z_6 + 0.35 Z_7 \quad \text{and}$$

$$D_2 = -0.03 Z_1 - 0.11 Z_2 + 0.37 Z_3 - 0.55 Z_4 \\ + 0.70 Z_5 - 0.53 Z_6 + 0.31 Z_7$$

are efficient enough to discriminate significantly the three groups of differential achievers with a success rate of 53.28 per cent for correct classifications.

- (ii) The coefficient of effectiveness of the First function for discriminating High – Achievers from Average – and Low – Achievers in Physics is 95.40 and the coefficient of effectiveness of Function 2 for discriminating Low – Achievers from Average – and High – Achievers in Physics is 4.60.

4.4.2 Predicting Group Membership of Low – ; Average – ; and High – Achievers in Chemistry

Seven select predictor variables namely *Classroom Learning Environment, Self-Esteem, Achievement Motivation, Attitude towards Science, Attitude towards Academic Work, Sex* and *School Type* taken together are examined for their capability to discriminate significantly among Low – Achievers, Average – Achievers and High – Achievers in Chemistry. The analysis and discussion of the results are described below.

Analysis of Group Difference

At first, Univariate ANOVA was done to examine significant differences in each of the seven variables, for the three groups – Low – ; Average – ; and High – Achievers in Chemistry. Wilk's Lambda and F-ratios were estimated for this purpose. The data and the results of the Univariate ANOVA are presented in Table 4.54.

TABLE 4.54

Univariate Statistics of Significant Predictor Variables

Sl.No.	Predictor Variables	Low – Achievers in Chemistry		Average – Achievers in Chemistry		High – Achievers in Chemistry		Total Sample		Wilk's Lambda	F-value
		Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D		
1.	Classroom Learning Environment	86.19	16.84	89.38	15.69	89.15	16.59	88.31	16.39	0.99	3.62
2.	Self – Esteem	37.71	7.52	39.77	7.78	40.48	8.28	39.35	7.94	0.98	10.10
3.	Achievement Motivation	70.88	12.88	73.04	11.19	71.09	11.90	71.73	12.00	0.99	3.25
4.	Attitude towards Science	129.69	15.86	137.19	14.13	145.16	14.71	137.39	16.09	0.85	81.23
5.	Attitude towards Academic Work	115.85	16.93	119.99	15.14	123.05	13.73	119.67	15.55	0.97	16.75
6.	Sex	1.51	0.50	1.45	0.49	1.50	0.50	1.49	0.50	0.99	1.36
7.	School Type	1.59	0.49	1.61	0.49	1.77	0.42	1.66	0.48	0.97	13.19

The values obtained for Lambda (λ) as per Table 4.54 for the predictor variables are almost equal to one for the variables *Classroom Learning Environment* (0.99), *Self-Esteem* (0.98), *Achievement Motivation* (0.99), *Attitude towards Academic Work* (0.97), *Sex* (0.99) and *School Type* (0.97). But for the variable *Attitude towards Science*, the obtained λ is 0.85 which suggests that the mean scores of the variable differ significantly among the three groups. F-ratios obtained for the variables *Self-Esteem* (10.10), *Attitude towards Science* (81.21), *Attitude towards Academic Work* (16.75) and *School type* (13.19) were found to be significant beyond 0.01 level. But the F-ratios for the variable *Classroom Learning Environment*, *Achievement Motivation* and *Sex* are not significant even at 0.05 level. These results indicate that mean scores of four out of the seven variables are significantly different for the groups Low – ; Average – ; and High – Achievers in Chemistry.

Interdependence among the Seven Predictor Variables

Interdependence among the seven predictor variables was examined next. A pooled correlation matrix of the seven predictor variables was estimated for this purpose. The matrix is presented in Table 4.55.

TABLE 4.55

Pooled Correlation Matrix of the Seven Predictor Variables with Achievement in Chemistry

Predictor Variable	V ₄	V ₁₀	V ₁₈	V ₁₉	V ₂₀	Sex	School Type
Classroom Learning Environment (V ₄)	1.00						
Self-Esteem (V ₁₀)	0.36	1.00					
Achievement Motivation (V ₁₈)	0.33	0.43	1.00				
Attitude towards Science (V ₁₉)	0.24	0.19	0.15	1.00			
Attitude towards Academic Work (V ₂₀)	0.27	0.21	0.20	0.38	1.00		
Sex	0.16	-0.06	-0.09	0.13	0.12	1.00	
School Type	-0.13	0.03	-0.08	-0.11	-0.14	0.01	1.00

An examination of the Table 4.55 reveals that the correlation coefficients range from -0.14 to 0.43, all the obtained values are less than 0.50. This result suggests that there is not much interdependence among the variables.

Discriminant Functions

In order to calculate the linear discriminant function, the data was examined whether it satisfied the two basic assumptions. The preliminary analysis of the data revealed that the distribution of the scores of five predictor variables approximate normal distribution. *Sex* and *School type* was included since they are qualitative binary variables. Box's M test was done to test the quality of the group covariance matrix. The result of Box's M is presented in Table 4.56.

TABLE 4.56

Box's M Test for Equality of Group Variance Matrices

Groups	Rank	Log determinants
Low – Achievers in Chemistry	7	22.27
Average – Achievers in Chemistry	7	21.55
High – Achievers in Chemistry	7	21.23
Pooled within group Covariance Matrix	7	21.83
Box M	Approximate F	Degrees of Freedom
145.13	2.5644**	(56, 2464524.5)

** $p < 0.01$

The value of F obtained is 2.5644 which exceeds the critical limit of F-ratio (1.54) set at 0.01 level for df 56, 2464524.5. The result suggests a significant difference in the covariance matrices of the groups. Discriminant analysis was proceeded even though the two basic assumptions were not perfectly satisfied.

In order to assign cases to three groups namely Low – ; Average –; and High – Achievers in Chemistry, two linear combinations of the seven predictor variables were formed. The unstandardised and standardised canonical discriminant function coefficients are presented in Table 4.57.

TABLE 4.57
Unstandardised and Standardised Canonical
Discriminant Function Coefficients

Predictor Variables	Unstandardised Canonical Discriminant Function Coefficients		Standardised Canonical Discriminant Function Coefficients	
	Function 1	Function 2	Function 1	Function 2
Classroom Learning Environment X_1	-0.0001	-0.01	-0.03	0.28
Self-Esteem X_2	0.02	0.01	0.17	0.09
Achievement Motivation X_3	-0.01	0.04	-0.21	0.49
Attitude towards Science X_4	0.05	0.003	0.88	0.05
Attitude towards Academic Work X_5	0.009	0.003	0.15	0.06
Sex X_6	-0.28	-0.94	-0.14	-0.47
School Type X_7	0.89	-0.90	0.42	-0.43
Constant	-9.7	-2.9	-	-

The equation formed on the basis of unstandardised discriminant coefficients are the following:

$$D_1 = -0.001 X_1 + 0.02 X_2 - 0.01 X_3 + 0.05 X_4 + 0.009 X_5 - 0.28 X_6 + 0.89 X_7 - 9.7 \quad \text{and}$$

$$D_2 = -0.01 X_1 + 0.01 X_2 + 0.04 X_3 + 0.003 X_4 + 0.003 X_5 - 0.94 X_6 + 0.90 X_7 - 2.9$$

Where $X_1, X_2, X_3, X_4, X_5, X_6,$ and X_7 are the individual scores obtained for the seven predictor variables.

The first and second discriminant function in terms of the standardised discriminant function coefficients for the same as

$$\begin{aligned}
 D_1 &= -0.03 Z_1 + 0.17 Z_2 - 0.21 Z_3 + 0.88 Z_4 \\
 &\quad + 0.15 Z_5 - 0.14 Z_6 + 0.42 Z_7 \quad \text{and} \\
 D_2 &= 0.28 Z_1 + 0.09 Z_2 + 0.49 Z_3 + 0.05 Z_4 \\
 &\quad + 0.06 Z_5 - 0.47 Z_6 - 0.43 Z_7
 \end{aligned}$$

Group centroids of the two discriminant functions (Function 1 and Function 2) for the three groups Low – ; Average – ; and High – Achievers in Chemistry are given in Table 4.58.

TABLE 4.58

**Group Centroids of the Discriminant Functions for Low – ;
Average – ; and High – Achievers in Chemistry**

Group	Function 1	Function 2
Low – Achievers in Chemistry	-0.57	-0.09
Average – Achievers in Chemistry	-0.06	0.15
High – Achievers in Chemistry	0.62	-0.07

The group centroids given in Table 4.58 suggests that the first function distinguishes High – Achievers from Average – and Low – Achievers in Chemistry and the second function distinguishes Low – Achievers from High and Average Achievers in Chemistry. Figure 4-17 provides the Discriminant Function plots of Function 1 and Function 2.

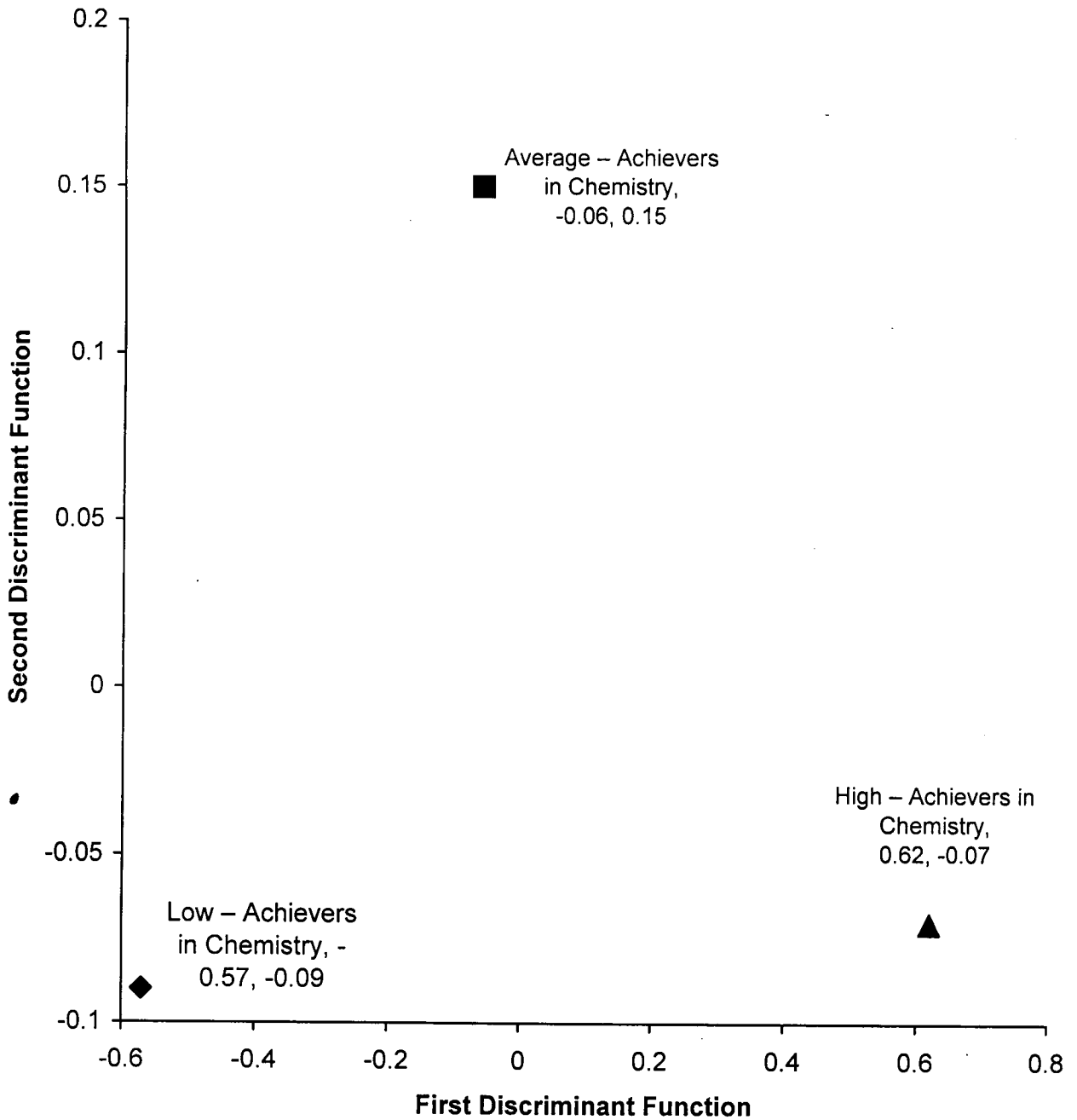


Figure - 4-17
Discriminant Function Plots of the Function 1 and Function 2
(Centroids of the Three Groups Low, Average and High Achievers
in Chemistry on the Two Discriminant Functions)

Significance of the Discriminant Functions

Important statistical indicators suggesting the effectiveness of discriminant functions (Eigen value, percent of variance, canonical correlation, Wilk's lambda and chi-square) are presented in Table 4.59.

TABLE 4.59

Statistical Indicators of the Effectiveness of the Discriminant Functions

Function	Eigen Value	Percent of Variances	Cumulative percent	Canonical Correlation	Wilk's Lambda	Chi-square	DF
Function 1	0.23	94.55	94.55	0.43	0.80	206.96**	14
Function 2	0.01	5.45	100.00	0.11	0.99	12.39*	6

* $p < 0.05$ and ** $p < 0.01$

As per Table 4.59, it can be noted that the Eigen value obtained is 0.23 which can be considered to be a fairly good indicator of effectiveness to discriminate High – Achievers from Average and Low – Achievers in Chemistry. The percentage of variance accounted by Function 1 is 94.55. The coefficient of effectiveness is 94.65. The discriminant scores on the first function for this particular data set therefore account for a very large proportion of the discrimination power of the analysis. The value of canonical correlation is 0.43 which shows that the discriminant scores and the group variables are related markedly. Moreover, the chi-square value is 206.96 which is significant beyond 0.01 level. This suggests that Function 1 is significant enough to discriminate High – Achievers from Average and Low – Achievers in Chemistry.

The Eigen value for the second discriminant function is only 0.01 suggesting that the index of effectiveness of the function is only 5.35 with a percentage variance of 5.45. The value of canonical correlation is 0.11 which suggests only a low relationship of the discriminant scores with the group of variables. The obtained chi-square value 12.39 suggests that Function 2 is

significant at 0.05 level to distinguish Low – Achievers from High and Average – Achievers in Chemistry.

Classification of Cases Using the Discriminant Functions

Having found out the discriminant function, the discriminant score of each of the case in the sample are calculated, the value of which enables to determine the group in which the individual case is classified (or misclassified) such as Low – ; Average – ; or High – Achievers in Chemistry.

The confusion matrix (success rate for prediction of group membership) of the cases correctly classified and misclassified is presented in Table 4.60.

TABLE 4.60

Confusion Matrix of the Cases Correctly Classified and Misclassified

Actual Group	No. of Cases	Predicted Group Membership		
		Low – Achievers	Average – Achievers	High – Achievers
Low – Achievers in Chemistry	297	182 (61.3%)	54 (18.2%)	61 (20.5%)
Average – Achievers in Chemistry	345	124 (35.9%)	94 (27.2%)	127 (36.8%)
High – Achievers in Chemistry	304	52 (17.1%)	52 (17.1%)	200 (65.8%)

Table 4.60 shows that, of the 297 cases of the Low – Achievers in Chemistry, 182 cases (61.3%) correctly classified and 115 cases (38.7%) were misclassified. Out of the 345 Average – Achievers, 124 (35.9%) are correctly classified whereas 221 (64.1%) cases are misclassified. Of the 304 cases of High – Achievers in Chemistry, 200 cases (65.8%) are classified correctly and 35.2 per cent were misclassified. It can be noted that High – Achievers in Chemistry are more accurately classified (65.8%) followed by

Low – Achievers (61.3%). The total percentage of cases thus correctly classified is 50.32 per cent.

Correlation between Predictor Variables and Canonical Discriminant Functions

The contribution of each of the predictor variables to the discriminant function was examined by estimating the pooled within group correlation between the predictor variables and canonical discriminant functions. The results are presented in the order of the magnitude of correlations in Table 4.61.

TABLE 4.61

Pooled Within – Groups Correlations Between Predictor Variables and Canonical Discriminant Functions

Predictor Variables	Function 1	Function 2
Attitude towards Science	0.86*	0.22
Attitude towards Academic Work	0.39*	0.28
Achievement Motivation	-0.00009	0.72*
School Type	0.33	-0.51*
Classroom Learning Environment	0.14	0.49*
Sex	-0.004	-0.47*
Self-Esteem	0.29	0.45*

Table 4.61 reveals that of the seven predictor variables, two attitudinal variables namely *Attitude towards Science* (0.86) and *Attitude towards Academic Work* (0.39) have high association with Function 1 and the other five other variables *Achievement Motivation* (0.72), *School type* (0.51), *Classroom Learning Environment* (0.49), *Sex* (0.47) and *Self-Esteem* (0.45) have association with Function 2.

Classification Function Coefficients

Fisher's linear discriminant function coefficients derived to assign new cases into the three groups Low – ; Average n– ; and High – Achievers in Chemistry are given Table 4.62.

TABLE 4.62

**Fisher's Linear Discriminant Function Coefficients of
Low – ; Average – ; and High – Achievers in Chemistry**

Variables	Low – Achievers	Average – Achievers	High – Achievers
Classroom Learning Environment	0.09	0.09	0.09
Self-Esteem	0.04	0.05	0.06
Achievement Motivation	0.33	0.32	0.30
Attitude towards Science	0.42	0.45	0.49
Attitude towards Academic Work	0.28	0.29	0.29
Sex	3.58	3.20	3.22
School Type	11.12	11.35	12.17
Constant	-73.50	-79.15	-85.29

Using the Fisher's coefficients, a case is assigned to the groups for which it has the largest discriminant score. This is calculated using the coefficients and the score on the variable.

Findings

- (i) The two discriminant functions in terms of standardised discriminant functions for the seven significant predictors namely,

$$D_1 = -0.03 Z_1 + 0.17 Z_2 - 0.21 Z_3 + 0.88 Z_4 + 0.15 Z_5 - 0.14 Z_6 + 0.42 Z_7 \quad \text{and}$$

$$D_2 = 0.28 Z_1 + 0.09 Z_2 + 0.49 Z_3 + 0.05 Z_4 + 0.06 Z_5 - 0.47 Z_6 - 0.43 Z_7$$

are efficient enough to discriminate significantly the three groups of differential achievers with a success rate of 53.28 per cent for correct classification.

- (ii) The coefficient of effectiveness of the First function for discriminating High – Achievers from Average – and Low – Achievers in Chemistry is 94.65 and the coefficient of effectiveness of Function 2 for discriminating Low – Achievers from Average – and High – Achievers in Chemistry is 5.35.

4.4.3 Predicting Group Membership of Low – ; Average – ; and High – Achievers in Physical Science

In an attempt to investigate the discrimination among Low – ; Average – ; and High – Achievers in Physical Science, seven predictor variables, namely, *Classroom Learning Environment*, *Self-Esteem*, *Achievement Motivation*, *Attitude towards Science*, *Attitude towards Academic Work*, *Sex* and *School Type* were taken together and examined for their capability for discrimination power. The analysis and discussion of the results are described in the following text.

Analysis of Group Difference

Preliminary step was to examine whether significant differences exist in the means of each of the seven variables among Low – ; Average and High – Achievers in Physical Science. Wilk's lambda and F-ratios were estimated for this purpose. The results of the Univariate ANOVA calculated for this purpose are presented in Table 4.63.

TABLE 4.63

Univariate Statistics of Significant Predictor Variables

Sl.No.	Predictor Variables	Low – Achievers		Average – Achievers		High – Achievers		Total Sample		Wilk's Lambda	F-value
		Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D		
1.	Classroom Learning Environment	87.22	16.95	88.58	15.81	89.17	16.45	88.30	16.39	0.99	1.13
2.	Self – Esteem	37.39	7.55	39.89	7.82	40.82	8.09	39.35	7.94	0.97	15.71**
3.	Achievement Motivation	71.00	12.59	73.08	11.49	70.92	11.84	71.73	12.00	0.99	3.44
4.	Attitude towards Science	129.64	15.83	137.10	14.28	146.15	13.90	137.39	16.09	0.83	94.51**
5.	Attitude towards Academic Work	115.60	17.38	119.98	14.51	123.71	13.48	119.67	15.55	0.96	21.32**
6.	Sex	1.56	0.49	1.42	0.49	1.48	0.50	1.49	0.50	0.98	6.72*
7.	School Type	1.59	0.49	1.64	0.48	1.75	0.44	1.66	0.48	0.98	8.33*

It can be noted from Table 4.63 that the values obtained for Lambda for the variables *Classroom Learning Environment*, *Self-Esteem*, *Achievement Motivation*, *Attitude towards Academic Work*, *Sex* and *School Type* are 0.99, 0.97, 0.99, 0.96, 0.98 and 0.98 respectively: all the values are almost equal to 1 (one). But for the variable *Attitude towards Science*, the obtained Lambda is 0.83. The result suggests that the three groups differ significantly among themselves for the variable *Attitude towards Science*. When F-ratios were examined, the values obtained were found to be significant beyond 0.01 level for the variables Self-Esteem (15.71), Attitude towards Science (94.51), Attitude towards Academic Work (21.32), Sex (6.72), School Type (8.33). For the variables Classroom Learning Environment and Achievement Motivation, F-ratios are not significant even at 0.05 level. The result suggest that there exist significant mean difference for the groups Low – ; Average – ; and High – Achievers in Physical Science (taken in pairs) for five out of the seven predictor variables.

Interdependence among the Seven Predictor Variables

In order to examine whether the seven predictor variables are interrelated or not, a pooled correlation matrix of the three groups was estimated. The matrix is presented in Table 4.64.

TABLE 4.64
Pooled Correlation Matrix of the Seven Predictor Variables with Achievement in Physical Science

Predictor Variable	V ₄	V ₁₀	V ₁₈	V ₁₉	V ₂₀	Sex	School Type
Classroom Learning Environment (V ₄)	1.00						
Self-Esteem (V ₁₀)	0.37	1.00					
Achievement Motivation (V ₁₈)	0.33	0.44	1.00				
Attitude towards Science (V ₁₉)	0.25	0.17	0.16	1.00			
Attitude towards Academic Work (V ₂₀)	0.27	0.20	0.21	0.37	1.00		
Sex	0.16	-0.04	-0.09	0.16	0.14	1.00	
School Type	-0.13	0.03	-0.08	-0.10	-0.14	0.01	1.00

As per Table 4.64, it can be noted that the correlation coefficients range from -0.14 to 0.44; all the obtained values are less than 0.50. This result suggests that the variables selected are not much interdependent.

Discriminant Functions

Next step is to calculate the linear discriminant function. The data was therefore first examined whether it satisfied the two assumptions.

- (a) The distribution of the scores of the five predictor variables approximate normal distribution as revealed from preliminary analysis given in Section 4.1. Sex and School type were included since they are qualitative binary variables.
- (b) Box's M test was done to test the equality of group covariance matrix. The result of Box's M test is presented in Table 4.65.

TABLE 4.65

Box's M Test for Equality of Group Variance Matrices

Groups	Rank	Log determinants
Low – Achievers in Physical Science	7	22.26
Average – Achievers in Physical Science	7	21.44
High – Achievers in Physical Science	7	21.22
Pooled within group Covariance Matrix	7	21.78
Box M 129.00	Approximate F 2.2794**	Degrees of Freedom (56, 2439951.0)

** $p < 0.01$

It can be noted from Table 4.65 that the value of obtained F is 2.2794 which exceeds the critical limit of F –ratio 1.54 set at 0.01 level of significance for df 56, 2439951. The result suggests a significant difference in

the covariance matrices of the groups. The discriminant analysis was proceeded since the two assumptions were satisfied to a greater extent.

As the next step, two linear combinations of the seven predictor variables were formed so as to assign cases to the three groups namely Low – ; Average – ; and High – Achievers in Physical Science. The unstandardised and standardised Canonical Discriminant Function Coefficients are presented in Table 4.66.

TABLE 4.66
Unstandardised and Standardised Canonical
Discriminant Function Coefficients

Predictor Variables	Unstandardised Canonical Discriminant Function Coefficients		Standardised Canonical Discriminant Function Coefficients	
	Function 1	Function 2	Function 1	Function 2
Classroom Learning Environment X_1	-0.006	-0.002	-0.11	0.04
Self-Esteem X_2	0.03	-0.02	0.28	-0.18
Achievement Motivation X_3	-0.02	-0.04	-0.27	-0.51
Attitude towards Science X_4	0.05	0.01	0.86	0.17
Attitude towards Academic Work X_5	0.12	-0.007	0.19	-0.12
Sex X_6	-0.57	1.38	-0.28	0.69
School Type X_7	0.68	0.38	0.32	0.18
Constant	-9.09	0.40	-	-

The equations formed on the basis of unstandardised discriminant coefficients are the following:

$$D_1 = -0.006 X_1 + 0.03 X_2 - 0.02 X_3 + 0.05 X_4 + 0.12 X_5 - 0.57 X_6 + 0.68 X_7 - 9.09 \quad \text{and}$$

$$D_2 = -0.002 X_1 - 0.02 X_2 - 0.04 X_3 + 0.01 X_4 - 0.007 X_5 + 1.38 X_6 + 0.38 X_7 + 0.40$$

Where $X_1, X_2, X_3, X_4, X_5, X_6,$ and X_7 are the individual scores obtained for the seven predictor variables.

The first and second discriminant function in terms of the standardised discriminant function coefficients for the same is

$$\begin{aligned}
 D_1 &= -0.11 Z_1 + 0.28 Z_2 - 0.27 Z_3 + 0.86 Z_4 \\
 &\quad + 0.19 Z_5 - 0.28 Z_6 + 0.32 Z_7 \quad \text{and} \\
 D_2 &= 0.04 Z_1 - 0.18 Z_2 - 0.51 Z_3 + 0.17 Z_4 \\
 &\quad - 0.12 Z_5 + 0.69 Z_6 + 0.18 Z_7
 \end{aligned}$$

Group centroids of the two discriminant functions (Function 1 and Function 2) for the three groups Low – ; Average – ; and High – Achievers in Physical Science are given in Table 4.67.

TABLE 4.67

**Group Centroids of the Discriminant Functions for Low – ;
Average – ; and High – Achievers in Physical Science**

Group	Function 1	Function 2
Low – Achievers in Physical Science	-0.64	-0.09
Average – Achievers in Physical Science	-0.001	-0.17
High – Achievers in Physical Science	0.69	0.09

The group centroids given in Table 4.67 suggests that the first function distinguishes High – Achievers from Average – and Low – Achievers in Physical Science and the second function distinguishes Low – Achievers from High and Average Achievers in Physical Science. Figure 4–18 provides the Discriminant Function plots of Function 1 and Function 2.

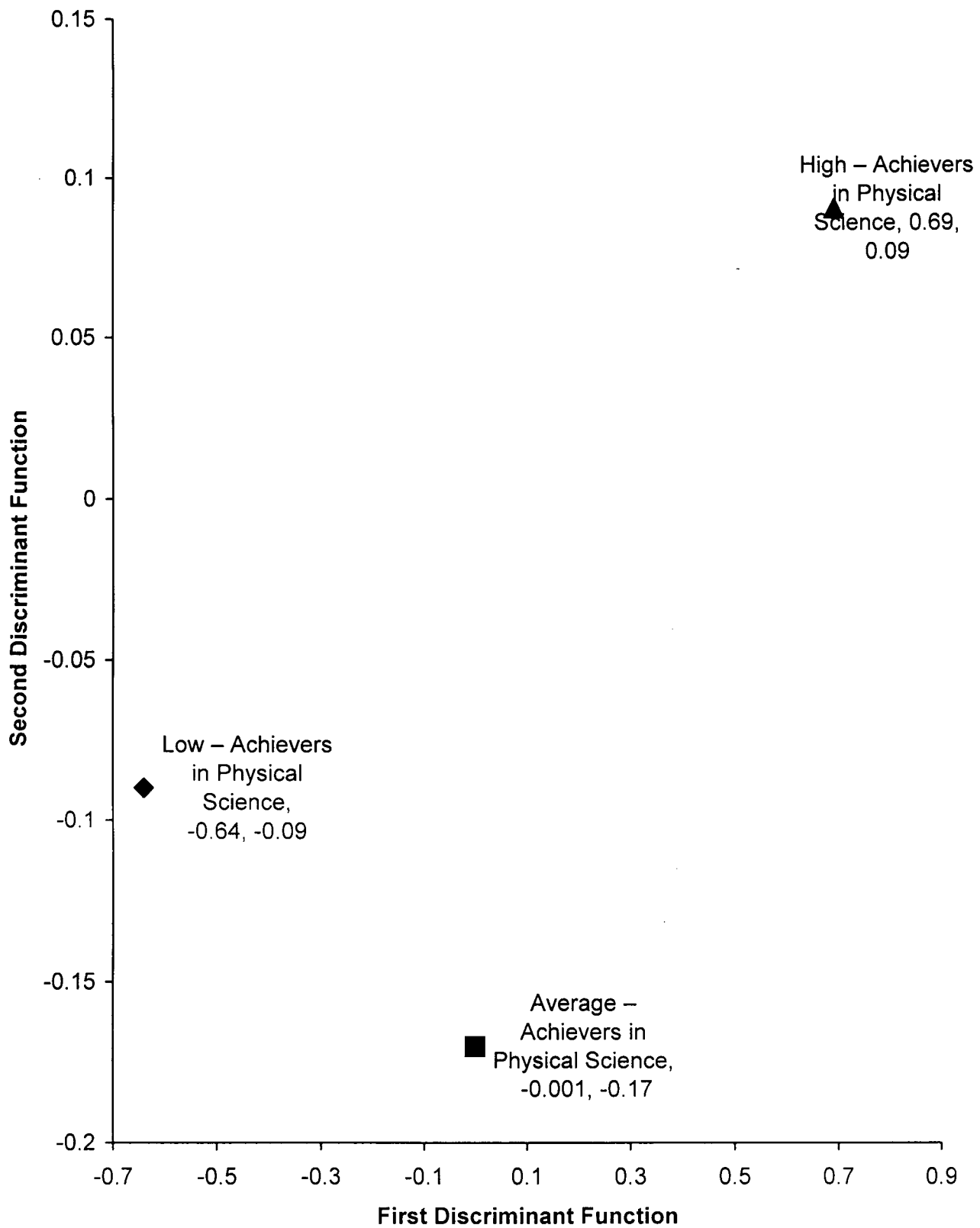


Figure - 4-18
Discriminant Function Plots of the Function 1 and Function 2
(Centroids of the Three Groups Low, Average and High Achievers
in Physical Science on the Two Discriminant Functions)

Significance of the Discriminant Functions

Important statistics of the discriminant functions such as Eigen value, percentage of variance, canonical correlation, Wilk's lambda and chi-square values are presented in Table 4.68.

TABLE 4.68

Statistical Indicators of the Effectiveness of the Discriminant Functions

Function	Eigen Value	Percent of Variances	Cumulative percent	Canonical Correlation	Wilk's Lambda	Chi-square	DF
Function 1	0.29	94.31	94.31	0.47	0.77	251.83**	14
Function 2	0.02	5.69	100.00	0.13	0.98	16.02*	6

* $p < 0.05$ and ** $p < 0.01$

Table 4.68 indicates that the obtained Eigen value is 0.29 that can be considered to be a fairly good indicator of effectiveness to discriminate High – achievers from Average and Low – achievers in Physical Science. For Function 1, the coefficient of effectiveness is 94.37 and the percentage of variance accounted is found to be 94.31. The discriminant scores of the first function for this particular data set therefore account for a very large proportion of the discrimination power of this analysis. The value of canonical correlation is 0.47 which shows that the discriminant scores and the group of variables are related markedly. The chi-square value is found to be 251.83 which is significant beyond 0.01 level suggesting that Function 1 is significant enough to discriminate High – Achievers from Average and Low – Achievers in Physical Science.

The Eigen value for the second discriminant function is only 0.02 with a percentage variance of 5.69. The index of effectiveness is only 5.63. The value of canonical correlation is found to be 0.13 suggesting only a low relationship of the discriminant scores with the select group of variables. The chi-square value is found to be 16.02 which suggest that Function 2 is

capable of distinguishing Low – Achievers from High and Average – Achievers in Physical Science at 0.05 level of significance.

Classification of Cases Using the Discriminant Functions

The discriminant score of each of the case in the sample can be calculated when the discriminant function is found out. The value of the discriminant score enables to determine the group in which individual case is classified (or misclassified) such as Low – ; Average – ; or High – Achievers in Physical Science.

The confusion matrix (success rate for prediction of group membership of the cases correctly) classified or misclassified is presented in Table 4.69.

TABLE 4.69

Confusion Matrix of the Cases Correctly Classified and Misclassified

Actual Group	No. of Cases	Predicted Group Membership		
		Low – Achievers	Average – Achievers	High – Achievers
Low – Achievers in Physical Science	312	192 (61.5%)	69 (22.1%)	51 (16.3%)
Average – Achievers in Physical Science	346	119 (34.4%)	111 (32.1%)	116 (33.5%)
High – Achievers in Physical science	288	36 (12.5%)	59 (20.5%)	193 (67.0%)

Percent of grouped cases correctly classified : 52.43%

Table 4.69 shows that of the 312 cases of Low – Achievers in Physical Science, 192 cases (61.5%) were correctly classified and 120 cases (38.5%) were misclassified. Out of 346 cases, 111 cases of Average – Achievers (32.1%) are correctly classified whereas 235 cases (67.9%) are misclassified. Of the 288 cases of High – Achievers in Physical Science, 193 cases (67.0%) are classified correctly and 33 per cent were misclassified. It

can be noted High –Achievers in Physical Science are more accurately classified (67.0%) followed by Low – Achievers (61.5%). The total percentage of cases thus correctly classified is 52.43 per cent.

Correlation between Predictor Variables and Canonical Discriminant Functions

The pooled within group correlation between the predictor variables and canonical discriminant function was estimated next so as to examine the contribution of each of the predictor variables to the discriminant function. The results are presented in the order of magnitude of correlation in Table 4.70.

TABLE 4.70

Pooled Within – Groups Correlations Between Predictor Variables and Canonical Discriminant Functions

Predictor Variables	Function 1	Function 2
Attitude towards Science	0.84*	0.11
Attitude towards Academic Work	0.39*	-0.12
School Type	0.24*	0.21
Sex	-0.12	0.76*
Achievement Motivation	-0.005	-0.65*
Self-Esteem	0.33	-0.41*
Classroom Learning Environment	0.09	-0.95*

The results presented in Table 4.70 reveals that of the seven predictor variables, three variables namely *Attitude towards Science* (0.84), *Attitude towards Academic Work* (0.39) and *School type* (0.24) have high association with Function 1. The other four variables namely *Sex* (0.76),

Achievement Motivation (0.65), *Self-Esteem* (0.41) and *Classroom Learning Environment* (0.95) have association with Function 2.

Classification Function Coefficients

Fisher's linear discriminant function coefficients derived to assign new cases into three groups Low – ; Average – ; and High – Achievers in Physical Science are given in Table 4.71.

TABLE 4.71

**Fisher's Linear Discriminant Function Coefficients of
Low – ; Average – ; and High – Achievers in Physical Science**

Variables	Low – Achievers	Average – Achievers	High – Achievers
Classroom Learning Environment	0.08	0.08	0.08
Self-Esteem	0.06	0.09	0.11
Achievement Motivation	0.32	0.32	0.29
Attitude towards Science	0.44	0.47	0.51
Attitude towards Academic Work	0.29	0.30	0.30
Sex	3.23	2.49	2.47
School Type	10.92	11.26	11.84
Constant	-73.76	-79.50	-85.98

Using the Fisher's coefficients, a case is assigned to the groups for which it has the largest discriminant score. This is calculated using the coefficients and the score on the variable.

Findings

- (i) The two discriminant functions in terms of standardised discriminant functions for the seven significant predictors namely,

$$D_1 = -0.11 Z_1 + 0.28 Z_2 - 0.27 Z_3 + 0.86 Z_4 \\ + 0.19 Z_5 - 0.28 Z_6 + 0.32 Z_7$$

$$D_2 = 0.04 Z_1 - 0.18 Z_2 - 0.51 Z_3 + 0.17 Z_4 \\ - 0.12 Z_5 + 0.69 Z_6 + 0.18 Z_7$$

are efficient enough to discriminate significantly the three groups of differential achievers with a success rate of 52.43 per cent for correct classification.

- (ii) The coefficient of effectiveness of the First function for discriminating High – Achievers from Average – and Low – Achievers in Physical Science is 94.37 and the coefficient of effectiveness of Function 2 for discriminating Low – Achievers from Average – ; and High – Achievers in Physical Science is 5.63.

4.5 CONCLUSIONS AND INTERPRETATIONS

The results have been grouped under relevant heads and discussed so as to arrive at a conclusion. The discussion of the results and interpretations are presented below.

The summary of the results of three-way ANOVA using each of the independent variables *Classroom Learning Environment*, *Self-Esteem*, *Achievement Motivation Attitude towards Science* and *Attitude towards Academic Work* along with *Sex* and *School type* on *Achievement in Physics, Chemistry and Physical Science* reveal that only *Self-Esteem*, *Attitude towards Science* and *Attitude towards Academic Work* have significant main effect on *Achievement*. This result suggests that variation in *Achievement in Physical Science* is dependent on variations in *Attitude* and *Self-Esteem* of the students. Moreover, post hoc comparison also reveal that three identical groups formed on the basis of *Self-Esteem*, *Attitude towards Science* and

Attitude towards Academic Work differ significantly in mean *Achievement in Physics, Chemistry and Physical Science* – especially in all the extreme group-pair comparisons. This result may be interpreted as one's level of *Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* may determine his / her level of *Achievement in Physical Science*.

Sex by *School type* interaction is found significant in *Achievement in Physics, Chemistry and Physical Science*. But this interaction is found different in different levels of *Attitude towards Science*. Gender difference exists in *Single-sex* schools. Gender difference widens from less – favourable to favourable *Attitude towards Science* and *Attitude towards Academic Work* and low to high *Self-Esteem* group. No gender difference is noticed in *Coeducational* schools. Boys show higher mean achievement than girls in *Single-sex* schools whereas girls show higher mean achievement in *Coeducational* schools. This is true in different levels of *Self-Esteem* and attitudes. The differences in the performance of boys and girls in *Single-sex* schools and *Coeducational* schools is in contradiction to earlier studies before 1980. Whereas studies of Marsh (1989), Kahle and Lakes (1983) highlighted the differential performance of boys and girls. Greenfield (1997) do not support the inequality of performance of boys and girls in science classroom – after analysing a number of studies of more than ten years in different institutions. The better performance of girls in *Coeducational* schools may due to the active participation of girls in a competitive science class, initiated by better teacher – student interaction related to each gender, lesser sex-stereotyping and a conducive classroom learning environment. Boys' superiority in *Single-sex* schools may be due to different dominating personality characteristics of males and females or differences in the perception of classroom experiences or differences in the approach or style of learning or differences in the teacher – student interaction or absence of disruptive classroom settings. These factors have to be further explored by well-designed studies. The findings of the present study are in consistent with

the findings and implications reported by American Association of University Women (1998) that there is no evidence that single-sex education in general is better than coeducation for girls.

The fact that the five variables selected, *Sex* and *School type* are capable of discriminating High – ; Average – ; and Low – Achievers in Physics, Chemistry and Physical science (total) to a certain extent. Among the variables, Attitudes show better efficiency.

The role of *Classroom Learning Environment* especially the different dimensions namely Physical and material factor, Psycho-social factor and Educational factor in determining the development of *Self-Esteem* and *Attitudes* may have to be probed deeper to have a better understanding of differential performance of boys and girls in *Single-sex* and *Coeducational* schools.

SUMMARY, FINDINGS AND SUGGESTIONS

Suchitra K. “Classroom learning environment and select affective variables in relation to achievement in physical science of students of single - sex and coeducational secondary schools ” Thesis. Department of Education, University of Calicut, 2004

SUMMARY, FINDINGS AND SUGGESTIONS

- **Study in retrospect**
 - **Variables Of the Study**
 - **Objectives**
 - **Methodology**
 - **Major Findings**
 - **Tenability of Hypotheses**
 - **Suggestions for Improving Educational Practice**
 - **Suggestions for Further Research**
-

CHAPTER V

SUMMARY, FINDINGS AND SUGGESTIONS

This chapter deals with the summary of the various phases in the process of the present investigation, major findings of the study, educational implications and suggestions for further study.

5.1 STUDY IN RETROSPECT

The present study as stated earlier was intended to examine whether *Classroom Learning Environment* and select five affective variables have differential influence on *Achievement in Physical Science* of boys and girls in *Single-sex* and *Coeducational* secondary schools. The study was hence stated as “**CLASSROOM LEARNING ENVIRONMENT AND SELECT AFFECTIVE VARIABLES IN RELATION TO ACHIEVEMENT IN PHYSICAL SCIENCE OF STUDENTS OF SINGLE – SEX AND COEDUCATIONAL SECONDARY SCHOOLS**”

5.2 VARIABLES OF THE STUDY

The variables selected for the study were the following:

5.2.1 Independent Variables

Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and *Attitude towards Academic Work* were treated as independent variables.

5.2.2 Criterion Variables

Achievement in Physics, Achievement in Chemistry and *Achievement in Physical Science* (total) were treated as criterion variables.

5.2.3 Basal Variables

In this study *Sex* and *School type* based on sex enrolment (*Single-sex* and *Coeducational* schools) were treated as basal variables.

5.3 OBJECTIVES

The present study was designed with the following objectives:

- (i) To study the main effect of each of the five select independent variables on *Achievement in Physics* of boys and girls of *Single – Sex* and *Coeducational* secondary schools.
- (ii) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Physics*.
- (iii) To study the main effect of each of the five select independent variables on *Achievement in Chemistry* of boys and girls of *Single – sex* and *Coeducational* secondary schools.
- (iv) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Chemistry*.
- (v) To study the main effect of each of the five select independent variables on *Achievement in Physical Science* (total) of boys and girls of *Single – sex* and *Coeducational* secondary schools.
- (vi) To study the interaction effect of each of the five select independent variables, *Sex* and *School type* on *Achievement in Physical Science* (total).
- (vii) To predict High –; Average –; and Low–Achievers in Physics using the variables *Sex* of the subjects, *Type of institutions* based on sex enrolment and five select independent variables.
- (viii) To predict High –; Average –; and Low–Achievers in Chemistry using the variables *Sex* of subjects, *Type of institutions* based on sex enrolment and five select independent variables.
- (ix) To predict High –; Average –; and Low – Achievers in Physical Science using the variables *Sex* of subjects, *Type of institutions* based on sex enrolment and five select independent variables.

5.4 METHODOLOGY

The methodology of the present investigation is described below:

5.4.1 Sample

The study was conducted on a sample of 946 students studying in class IX of the secondary schools of Thiruvananthapuram, Malappuram and Kozhikode districts of Kerala State. The sample for the study was selected using proportionate stratified sampling technique giving due representation to sex, locale, instructional efficiency and type of management of schools.

5.4.2 Tools

The tools used for collecting the needed data for the study were the following:

- i) Scale of Classroom Learning Environment (Usha and Suchitra, 2002)
- ii) Scale of Achievement Motivation (Pillai and Salim Kumar, 1994)
- iii) Self-Esteem Inventory (Battle, 2000)
- iv) Scale of Attitude towards Science (Pillai, K.S., 1980)
- v) Scale of Attitude towards Academic Work (Usha and Suchitra, 2002)
- vi) Test of Achievement in Physical Science (Usha and Suchitra, 2002)

5.4.3 Statistical Techniques Used

- i) Three-way ANOVA with $3 \times 2 \times 2$ factorial design
- ii) Scheffé Test of Multiple Comparison
- iii) Test of significance of difference between means
- iv) Discriminant Function Analysis (Tacqu, 1997).

5.5 MAJOR FINDINGS

The major findings of the study are presented below.

5.5.1 Main Effect of Each of the Five Select Independent Variables, Sex and School Type on Achievement in Physical Science

5.5.1.1 Main Effect of Classroom Learning Environment, Sex and School type on Achievement in Physical Science

No significant main effect of *Classroom Learning Environment* on *Achievement in Physics, Chemistry and Physical Science* (total) was noticed. But main effect of *Sex* on *Achievement in Physics* ($F = 19.69$) and *Achievement in Physical Science* ($F = 11.86$) and main effect of *School type* on *Achievement in Physics* (7.28), *Achievement in Chemistry* (23.47) and *Achievement in Physical Science* (17.01) were found to be significant.

5.5.1.2 Main Effect of Achievement Motivation, Sex and School Type on Achievement in Physical Science

No significant main effect of *Achievement Motivation* on *Achievement in Physics, Chemistry and Physical Science* (total) was noticed. But significant main effect of *Sex* on *Achievement in Physics* ($F = 25.20$) and *Achievement in Physical Science* ($F = 13.70$) and main effect of *School type* on *Achievement in Physics* ($F = 7.69$), *Achievement in Chemistry* ($F = 26.49$) and *Achievement in Physical Science* ($F = 18.74$) were found to exist.

5.5.1.3 Main Effect of Self-Esteem, Sex and School Type on Achievement in Physical Science

Significant main effect of *Self-Esteem* on *Achievement in Physics* ($F = 12.83$), *Achievement in Chemistry* ($F = 12.10$) and *Achievement in Physical Science* ($F = 14.83$) was found to exist. The main effect of *Sex* on *Achievement in Physics* ($F = 19.76$) and *Achievement in Physical Science* ($F = 10.82$) and main effect of *School type* on *Achievement in Physics* ($F = 8.33$), *Achievement in Chemistry* ($F = 26.82$) and *Achievement in*

Physical Science ($F = 19.53$) were found to be significant well beyond 0.01 level.

5.5.1.4 Main Effect of Attitude towards Science, Sex and School Type on Achievement in Physical Science

Significant main effect of *Attitude towards Science* on *Achievement in Physics* ($F = 94.96$), *Chemistry* ($F = 64.75$) and *Physical Science* ($F = 96.69$) was found to exist. The main effect of *Sex* on *Achievement in Physics* ($F = 44.75$), *Chemistry* ($F = 12.19$) and *Physical Science* ($F = 31.48$) and the main effect of *School type* on *Achievement in Physics* ($F = 11.50$), *Chemistry* ($F = 26.64$) and *Physical Science* ($F = 22.78$) were found to be significant well beyond 0.01 level.

5.5.1.5 Main Effect of Attitude towards Academic Work, Sex and School Type on Achievement in Physical Science

Significant main effect of *Attitude towards Academic Work* on *Achievement in Physics* ($F = 28.81$), *Chemistry* ($F = 17.08$) and *Physical Science* ($F = 26.83$) was found to exist. The main effect of *Sex* on *Achievement in Physics* ($F = 30.77$), *Chemistry* ($F = 8.82$) and *Physical Science* ($F = 21.53$) and main effect of *School type* on *Achievement in Physics* ($F = 14.79$), *Chemistry* ($F = 30.67$) and *Physical Science* ($F = 26.60$) were found to be significant well beyond 0.01 level.

5.5.2 Interaction Effect of Each of the Five Select Independent Variables, Sex and School Type on Achievement in Physical Science

5.5.2.1 Interaction Effect of Classroom Learning Environment, Sex and School Type on Achievement in Physical Science

- (i) The first order interaction of *Classroom Learning Environment* \times *Sex* on *Achievement in Physics*, *Chemistry* and *Physical Science* was found to be not significant.

- (ii) The first order interaction of *Classroom Learning Environment* × *School type* was found to be significant on *Achievement in Physics* only ($F = 3.28$; $p < 0.05$).
- (iii) The first order interaction of *Sex* × *School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be significant well beyond 0.01 level.
- (iv) The second order interaction of *Classroom Learning Environment* × *Sex* × *School type* on *Achievement in Physics, Chemistry and Physical Science* was found not significant even at 0.05 level.

5.5.2.2 Interaction Effect of Achievement Motivation, Sex and School Type on Achievement in Physical Science

- (i) The first order interaction of *Achievement Motivation* × *Sex* on *Achievement in Physics, Chemistry and Physical Science* was found to be not significant.
- (ii) The first order interaction of *Achievement Motivation* × *School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be not significant.
- (iii) The first order interaction of *Sex* × *School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be significant well beyond 0.01 level.
- (iv) The second order interaction of *Achievement Motivation* × *Sex* × *School type* on *Achievement in Physics* was found to be significant beyond 0.01 level ($F = 5.55$). No significant second order interaction effect on *Achievement in Chemistry* or *Achievement in Physical Science* was noticed.

5.5.2.3 Interaction Effect of Self-Esteem, Sex and School Type on Achievement in Physical Science

- (i) No significant first order interaction effect of either *Self-Esteem* × *Sex* or *Self-Esteem* × *School type* on *Achievement in Physics, Chemistry*

and *Physical Science* was noticed: the obtained F-value being less than the critical limit.

- (ii) The first order interaction of *Sex × School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be significant well beyond 0.01 level.
- (iii) No second order interaction (*Self-Esteem × Sex × School type*) on *Achievement in Physics, Chemistry and Physical Science* was noticed.

5.5.2.4 Interaction Effect of Attitude towards Science, Sex and School Type on Achievement in Physical Science

- (i) No significant first order interaction effect of either *Attitude towards Science × Sex* or *Attitude towards Science × School type* on *Achievement in Physics, Chemistry and Physical Science* was noticed: the obtained F-value being less than the critical limit.
- (ii) The first order interaction of *Sex × School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be significant well beyond 0.01 level.
- (iii) The second order interaction of *Attitude towards Science × Sex × School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be significant at 0.05 level.

5.5.2.5 Interaction Effect of Attitude towards Academic Work, Sex and School type on Achievement in Physical Science

- (i) No significant first order interaction effect of either *Attitude towards Academic Work × Sex* or *Attitude towards Academic Work × School type* on *Achievement in Physics, Chemistry and Physical Science* was noticed: the obtained F-value being less than the critical limit.
- (ii) The first order interaction of *Sex × School type* on *Achievement in Physics, Chemistry and Physical Science* was found to be significant well beyond 0.01 level.

- (iii) No second order interaction (*Attitude towards Academic Work* × *Sex* × *School type*) on *Achievement in Physics, Chemistry and Physical Science* was noticed.

5.5.3 Group Differences in Achievement in Physical Science

Group difference in *Achievement in Physical Science* was studied wherever significant effect of those independent variables on *Achievement in Physical Science* [*Achievement in Physics, Chemistry and Physical science* (total)] were noticed. Of the five independent variables, three variables, namely, *Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* were found to have significant main effect on *Achievement in Physics, Achievement in Chemistry and Achievement in Physical Science*. Moreover, significant first order interaction of *Sex* × *School type* on *Achievement in Physics, Chemistry and Physical Science* were also noticed. Hence, Mean Difference in *Achievement in Physical Science* was studied for (i) Groups formed on the basis of *Self-Esteem, Attitude towards Science* and *Attitude towards Academic Work* and (ii) Groups formed on the basis of *Sex, School type* and each of the five select independent variables. The findings are summarised and presented below:

1. Difference in Achievement in Physical Science among High – ; Average – ; and Low – Self-Esteem Groups

Results of multiple comparison using Scheffé test of three identical groups formed on the basis of *Self-Esteem* of the subjects (boys, girls, single-sex schools, coeducational schools and total sample) with respect to mean *Achievement in Physics, Chemistry and Physical Science* reveal the following:

Criterion Variables	Group pairs	Level of Significance of F-value				
		Boys	Girls	Single-sex	Coeducational	Total
Achievement in Physics	HSE – ASE	H.S	N.S	H.S	N.S	H.S
	HSE – LSE	H.S	H.S	H.S	H.S	H.S
	ASE – LSE	N.S	N.S	N.S	N.S	N.S
Achievement in Chemistry	HSE – ASE	H.S	H.S	H.S	S	H.S
	HSE – LSE	H.S	H.S	H.S	H.S	H.S
	ASE – LSE	N.S	N.S	N.S	N.S	N.S
Achievement in Physical Science	HSE – ASE	H.S	S	H.S	S	H.S
	HSE – LSE	H.S	H.S	H.S	H.S	H.S
	ASE – LSE	N.S	N.S	N.S	N.S	N.S

Note: N.S – Not Significant HSE – High – Self-Esteem Group
 S – Significant at 0.05 level ASE – Average–Self-Esteem Group
 H.S – Significant at 0.01 LSE – Low – Self-Esteem Group

It is revealed from the summary of results that significant mean difference exist in eight out of fifteen comparisons in *Achievement in Physics*, ten out of fifteen comparisons in *Achievement in Chemistry* and ten out of fifteen in *Achievement in Physical Science*. Here, extreme groups (HSE – LSE) show significant difference in all the fifteen comparisons.

2. Difference in Achievement in Physical among Favourable – ; Moderately Favourable – ; and Less – Favourable – Attitude towards Science Groups

Results of the Scheffé test of multiple comparison with regard to mean *Achievement in Physics*, *Chemistry* and *Physical Science* of students grouped on the basis of *Attitude towards Science* (three levels) in the total sample and four sub samples are presented below:

Criterion Variables	Group pairs	Level of Significance of F-value				
		Boys	Girls	Single-sex	Coeducational	Total
Achievement in Physics	F-ATS – M-ATS	H.S	H.S	H.S	H.S	H.S
	F-ATS – L-ATS	H.S	H.S	H.S	H.S	H.S
	M-ATS – L-ATS	H.S	H.S	S	H.S	H.S
Achievement in Chemistry	F-ATS – M-ATS	H.S	H.S	H.S	H.S	H.S
	F-ATS – L-ATS	H.S	H.S	H.S	H.S	H.S
	M-ATS – L-ATS	H.S	H.S	H.S	H.S	H.S
Achievement in Physical Science	F-ATS – M-ATS	H.S	H.S	H.S	H.S	H.S
	F-ATS – L-ATS	H.S	H.S	H.S	H.S	H.S
	M-ATS – L-ATS	H.S	H.S	H.S	H.S	H.S

Note: S – Significant at 0.05 level

H.S – Significant at 0.0 level

F-ATS – Favourable – Attitude towards Science Group

M-ATS – Moderately – Favourable Attitude towards Science Group

L-ATS – Less–Favourable Attitude towards Science Group

The results reveal that all the forty-five group pair comparisons are found to be significantly different in the mean scores.

3. Difference in Achievement in Physical Science among Favourable – ; Moderately – Favourable – ; and Less – Favourable Attitude towards Academic Works Groups

Results of multiple comparison using Scheffé test of three identical groups formed on the basis of *Attitude towards Academic Work* of the subjects (boys, girls, single-sex schools, coeducational schools and total sample) with respect to mean *Achievement in Physics, Chemistry and Physical Science* are presented below.

Criterion Variables	Group pairs	Level of Significance of F-value				
		Boys	Girls	Single-sex	Coeducational	Total
Achievement in Physics	F-ATA – M-ATA	N.S	N.S	N.S	N.S	N.S
	F-ATA – L-ATA	H.S	H.S	H.S	H.S	H.S
	M-ATA – L-ATA	H.S	H.S	H.S	H.S	H.S
Achievement in Chemistry	F-ATA – M-ATA	H.S	N.S	N.S	H.S	H.S
	F-ATA – L-ATA	H.S	H.S	H.S	H.S	H.S
	M-ATA – L-ATA	H.S	H.S	H.S	H.S	H.S
Achievement in Physical Science	F-ATA – M-ATA	N.S	N.S	N.S	S	N.S
	F-ATA – L-ATA	H.S	H.S	H.S	H.S	H.S
	M-ATA – L-ATA	H.S	H.S	H.S	H.S	H.S

Note: N.S – Not Significant; S – Significant at 0.05 level

H.S – Significant at 0.0 level

F-ATA – Favourable – Attitude towards Academic Work Group

M-ATA – Moderately – Favourable Attitude towards Academic Work Group

L-ATA – Less-Favourable Attitude towards Academic Work Group

The results reveal that ten out of fifteen group-pair comparisons show significant mean difference in *Achievement in Physics*, thirteen out of fifteen show significant mean difference in *Achievement in Chemistry* and eleven out of fifteen show significant mean difference in *Achievement in Physical Science*. Extreme group-pairs (F-ATA – L-ATA) show significant difference in all the fifteen comparisons.

4. Difference in Mean Scores of Achievement in Physical Science between Boys and Girls of Single-sex Schools

Results obtained for the test of significant difference between mean *Achievement in Physical Science* of boys and girls of three-levels of independent variables in *Single-sex schools* are presented below:

Sl.No.	Variables	Group Pairs	Sex difference in mean scores Level of significance of t-value		
			Achievement in Physics	Achievement in Chemistry	Achievement in Physical science
1.	Classroom Learning Environment (CLE)	L – CLE	S	S	S
		M – CLE	H.S	H.S	H.S
		F – CLE	H.S	H.S	H.S
2.	Achievement Motivation (AM)	L – AM	H.S	S	H.S
		A – AM	H.S	H.S	H.S
		H – AM	S	H.S	H.S
3.	Self-Esteem (SE)	L – SE	H.S	S	H.S
		A – SE	H.S	H.S	H.S
		H – SE	H.S	H.S	H.S
4.	Attitude towards Science (ATS)	L – ATS	H.S	H.S	H.S
		M – ATS	H.S	H.S	H.S
		F – ATS	H.S	H.S	H.S
5.	Attitude towards Academic Work (ATA)	L – ATA	H.S	H.S	H.S
		M – ATA	H.S	H.S	H.S
		F – ATA	H.S	H.S	H.S

Note: N.S – Not Significant; S – Significant at 0.05 level;

H.S – Significant at 0.0 level

L – Less - Favourable / Low; M – Moderately – Favourable; H – High

A – Average; F – Favourable

The results reveal that significant sex difference exist in all the fifteen comparisons in *Achievement in Physics*, *Achievement in Chemistry* and *Achievement in Physical Science*. High means are associated with boys.

5. Difference in Mean Scores of Achievement in Physical Science between Boys and Girls of Coeducational Schools

Results obtained for the test of significant difference between mean *Achievement in Physical Science* of boys and girls of three levels of independent variables in *Coeducational* schools are presented below.

Sl.No.	Variables	Group Pairs	Sex difference in mean scores Level of significance of t-value		
			Achievement in Physics	Achievement in Chemistry	Achievement in Physical science
1.	Classroom Learning Environment (CLE)	L – CLE	N.S	H.S	H.S
		M – CLE	N.S	S	N.S
		F – CLE	N.S	N.S	N.S
2.	Achievement Motivation (AM)	L – AM	S	H.S	H.S
		A – AM	N.S	H.S	N.S
		H – AM	N.S	N.S	N.S
3.	Self-Esteem (SE)	L – SE	N.S	H.S	N.S
		A – SE	N.S	S	N.S
		H – SE	N.S	H.S	N.S
4.	Attitude towards Science (ATS)	L – ATS	S	N.S	S
		M – ATS	N.S	S	N.S
		F – ATS	N.S	H.S	S
5.	Attitude towards Academic Work (ATA)	L – ATA	N.S	N.S	N.S
		M – ATA	N.S	S	N.S
		F – ATA	N.S	S	N.S

Note: N.S – Not Significant; S – Significant at 0.05 level

H.S – Significant at 0.0 level

L – Less - Favourable / Low; M – Moderately – Favourable; H – High

A – Average; F – Favourable

The results reveal that significant sex difference exists in eleven out of fifteen comparisons in *Achievement in Chemistry*: High means being associated with girls.

But for *Achievement in Physics*, only in two out of fifteen comparisons and for *Achievement in Physical Science*, four out of fifteen comparisons show significant difference.

6. Difference in Mean Scores of Achievement in Physical Science between Boys of Single-sex Schools and Coeducational Schools

The mean scores of *Achievement in Physical Science* of boys of three levels of independent variables in *Single-sex schools* and *Coeducational schools* were compared. The results are summarised below:

SI.No.	Variables	Group Pairs	School type difference in mean scores of boys Level of significance of t-value		
			Achievement in Physics	Achievement in Chemistry	Achievement in Physical science
1.	Classroom Learning Environment (CLE)	L – CLE	S	S	S
		M – CLE	S	N.S	N.S
		F – CLE	N.S	N.S	N.S
2.	Achievement Motivation (AM)	L – AM	H.S	N.S	N.S
		A – AM	H.S	H.S	H.S
		H – AM	N.S	N.S	N.S
3.	Self-Esteem (SE)	L – SE	N.S	N.S	N.S
		A – SE	N.S	N.S	N.S
		H – SE	N.S	N.S	S
4.	Attitude towards Science (ATS)	L – ATS	N.S	N.S	N.S
		M – ATS	N.S	N.S	N.S
		F – ATS	S	N.S	S
5.	Attitude towards Academic Work (ATA)	L – ATA	N.S	N.S	N.S
		M – ATA	N.S	N.S	N.S
		F – ATA	N.S	N.S	N.S

Note: N.S – Not Significant; S – Significant at 0.05 level

H.S – Significant at 0.0 level

L – Less - Favourable / Low; M – Moderately – Favourable; H – High

A – Average; F – Favourable

The results reveal that only five out of fifteen comparisons for *Achievement in Physics*; two out of fifteen comparisons in *Achievement in Chemistry* and four out of fifteen comparisons in *Achievement in Physical*

Science were found to be significant. High means are seen associated with boys of *Single-sex* schools.

7. Difference in Mean Scores of Achievement in Physical Science between Girls of Single-sex Schools and Coeducational Schools

The mean scores of *Achievement in Physical Science* of girls of three levels of independent variables of *Single-sex schools* and *Coeducational schools* were compared. The results are summarised below.

SI.No.	Variables	Group Pairs	School type difference in mean scores of girls Level of significance of t-value		
			Achievement in Physics	Achievement in Chemistry	Achievement in Physical science
1.	Classroom Learning Environment (CLE)	L – CLE	N.S	H.S	S
		M – CLE	H.S	H.S	H.S
		F – CLE	H.S	H.S	H.S
2.	Achievement Motivation (AM)	L – AM	H.S	H.S	H.S
		A – AM	H.S	H.S	H.S
		H – AM	H.S	H.S	H.S
3.	Self-Esteem (SE)	L – SE	H.S	H.S	H.S
		A – SE	H.S	H.S	H.S
		H – SE	S	H.S	H.S
4.	Attitude towards Science (ATS)	L – ATS	S	H.S	H.S
		M – ATS	H.S	H.S	H.S
		F – ATS	H.S	H.S	H.S
5.	Attitude towards Academic Work (ATA)	L – ATA	S	H.S	H.S
		M – ATA	H.S	H.S	H.S
		F – ATA	H.S	H.S	H.S

Note: N.S – Not Significant; S – Significant at 0.05 level

H.S – Significant at 0.0 level

L – Less - Favourable / Low; M – Moderately – Favourable; H – High

A – Average; F – Favourable

The results obtained show that in *Achievement in Physics* fourteen out of fifteen comparisons, and in both *Achievement in Chemistry* and *Achievement in Physical Science*, all the comparisons were found to be significant. High means are seen associated with girls of *Coeducational schools*.

5.5.4 Effectiveness of the Significant Predictors in Predicting Group Membership Namely Low – ; Average –; and High – Achievers in Physical Science

Effectiveness of seven predictors namely, *Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science, Attitude towards Academic Work, Sex and School type* in predicting group membership such as Low – ; Average – ; and High – Achievers in Physics, Chemistry and Physical Science were estimated using Discriminant Function Analysis by direct method. The results are summarised and presented below.

5.5.4.1 Efficiency of Predicting Group Membership of Low – ; Average –; and High Achievers in Physics

The major findings are:

1. The two discriminant functions in terms of standardised discriminant functions for the seven significant predictors namely,

$$\begin{aligned}
 D_1 &= -0.18 Z_1 + 0.25 Z_2 - 0.25 Z_3 + 0.84 Z_4 \\
 &\quad + 0.24 Z_5 - 0.39 Z_6 + 0.35 Z_7 \quad \text{and} \\
 D_2 &= -0.03 Z_1 - 0.11 Z_2 + 0.37 Z_3 - 0.55 Z_4 \\
 &\quad + 0.70 Z_5 - 0.53 Z_6 + 0.31 Z_7
 \end{aligned}$$

are effective enough to discriminate significantly with the three groups of differential achievements with a success rate of 53.28 per cent for correct classification.

2. The coefficient of effectiveness of First functions for discriminating High – Achievers from Average – ; and Low – Achievers in Physics is 95.40 and

the coefficient of effectiveness of Function -2 for discriminating Low – Achievers from Average – ; and High – Achievers in Physics is 4.60.

5.5.4.2 Efficiency of Predicting Group Membership of Low – ; Average –; and High Achievers in Chemistry

The major findings are:

1. The two discriminant functions in terms of standardised discriminant functions for the seven significant predictors namely

$$D_1 = -0.03 Z_1 + 0.17 Z_2 - 0.21 Z_3 + 0.88 Z_4 + 0.15 Z_5 - 0.14 Z_6 + 0.42 Z_7 \quad \text{and}$$

$$D_2 = 0.28 Z_1 + 0.09 Z_2 + 0.49 Z_3 + 0.05 Z_4 + 0.06 Z_5 - 0.47 Z_6 - 0.43 Z_7$$

are efficient enough to discriminate significantly the three groups of differential achievers with a success rate of 53.28 per cent for correct classification.

2. The coefficient of effectiveness of the First function for discriminating High – Achievers from Average – and Low – Achievers in Chemistry is 94.65 and the coefficient of effectiveness of Function 2 for discriminating Low – Achievers from Average – and High – Achievers in Chemistry is 5.35.

5.5.4.3 Efficiency of Predicting Group Membership of Low – ; Average –; and High Achievers in Physical Science

The major findings are:

- (1) The two discriminant functions in terms of standardised discriminant functions for the seven significant predictors namely,

$$D_1 = -0.11 Z_1 + 0.28 Z_2 - 0.27 Z_3 + 0.86 Z_4 + 0.19 Z_5 - 0.28 Z_6 + 0.32 Z_7$$

$$D_2 = 0.04 Z_1 - 0.18 Z_2 - 0.51 Z_3 + 0.17 Z_4 - 0.12 Z_5 + 0.69 Z_6 + 0.18 Z_7$$

are efficient enough to discriminate significantly the three groups of differential achievers with a success rate of 52.43 per cent for correct classification.

- (2) The coefficient of effectiveness of the First function for discriminating High – Achievers from Average – and Low – Achievers in Physical Science is 94.37 and the coefficient of effectiveness of Function 2 for discriminating Low – Achievers from Average – ; and High – Achievers in Physical Science is 5.63.

5.6 TENABILITY OF HYPOTHESES

The tenability of the nine hypotheses set for the study was examined in the light of the findings. The study showed that most of the hypotheses set for the study are substantiated.

Hypothesis (i) assumed that “the main effect of each of the five select independent variables namely, *Classroom Learning Environment; Achievement Motivation; Self-Esteem; Attitude towards Science and Attitude towards Academic Work and Sex and School type on Achievement in Physics* of secondary school students will be significant”. This hypothesis is mostly substantiated in view of the fact that three out of the five independent variables selected, Sex of the subjects and School type based on sex enrolment have significant main effect on Achievement in Physics.

Hypothesis (ii) assumed that “the interaction effect of each of the five independent variables *Sex and School type on Achievement in Physics* will be significant”. This hypothesis is only partially substantiated by the study. Of the five three-way ANOVA computed, significant first order interaction on Achievement in Physics was found for all the Sex × School type interactions and Classroom Learning Environment × Sex interaction. Second order interaction of Achievement Motivation × Sex × School type was also found to be significant. All other first order and second order interactions are not significant.

Hypothesis (iii) assumed that “The main effect of each of the five select independent variables namely, *Classroom Learning Environment; Achievement Motivation; Self-Esteem; Attitude towards Science and Attitude towards Academic Work and Sex and School type on Achievement in*

Chemistry of secondary school students will be significant". This hypothesis is mostly substantiated. Three out of five independent variables selected and School type have significant main effect on Achievement in Chemistry. Besides, Sex of the subjects have independent effect on Achievement in two out of five ANOVA computed.

Hypothesis (iv) assumed that "the interaction effect of each of the five independent variables, Sex and School type on Achievement in Chemistry will be significant". This hypothesis is substantiated only to a low extent. Of the five three-way ANOVA computed, first order interaction was found to be significant only for all the five Sex \times School type interactions. Second order interaction of Attitude towards Science \times Sex \times School type was found to be significant. All other ten first order interactions and four second order interactions do not have significant effect on Achievement in Chemistry.

Hypothesis (v) assumed that "the main effect of five select independent variables namely, Classroom Learning Environment; Achievement Motivation; Self-Esteem; Attitude towards Science; and Attitude towards Academic Work and Sex and School type on Achievement in Physical Science (total) of secondary school students will be significant". This hypothesis is mostly substantiated in view of the fact that three out of five independent variables selected, Sex of the subjects and School type have significant main effect on Achievement in Physical Science.

Hypothesis (vi) assumed that "the interaction effect of each of the five independent variables, Sex and School type on Achievement in Physical Science (total) will be significant". This hypothesis is substantiated only to a low extent. Of the five three-way ANOVA computed, first order interaction was found to be significant only for all the five Sex \times School type interactions. Second order interaction of Attitude towards Science \times Sex \times School type was found to be significant. All other ten first order interactions and four second order interactions do not have significant effect on Achievement in Physical Science.

Hypothesis (vii) assumed that “High –; Average –; and Low– Achievers in Physics can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work*”. This hypothesis is substantiated to a great extent. Two discriminant functions were formulated using seven predictor variables. These two functions were found to be efficient enough to discriminate significantly High –; Average –; and Low – Achievers in Physics with a success rate of 53.28 per cent for correct classification.

Hypothesis (viii) assumed that “High –; Average –; and Low – Achievers in Chemistry can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work*”. This hypothesis is substantiated to a great extent. Two discriminant functions were formulated using seven predictor variables. These two functions were found to be efficient enough to discriminate significantly High –; Average –; and Low – Achievers in Chemistry with a success rate of 53.28 per cent for correct classification.

Hypothesis (ix) assumed that “High –; Average –; and Low – Achievers in Physical Science can be significantly discriminated by means of select set of independent variables namely, *Sex, School type, Classroom Learning Environment, Achievement Motivation, Self-Esteem, Attitude towards Science and Attitude towards Academic Work*”. This hypothesis is substantiated to a great extent. Two discriminant functions were formulated using seven predictor variables. These two functions were found to be efficient enough to discriminate significantly High –; Average –; and Low – Achievers in Physical Science with a success rate of 52.43 per cent for correct classification.

5.7 SUGGESTIONS FOR IMPROVING EDUCATIONAL PRACTICE

The present study has helped to locate those variables from among the select variables which have significant single and joint effect on Achievement in Physical Science. The variables which have main effect on Achievement in Physics, Chemistry and Physical Science are: (i) Self-Esteem, (ii) Attitude towards Science and (iii) Attitude towards Academic Work. In order to explore differential effect of the School type based on sex enrolment, Sex of the subjects along with the select variables on Achievement in Physical Science, three-way ANOVA were computed. The combined effect of Sex and School type on Achievement in Physics, Chemistry and Physical Science was found to be very prominent. The combined effect of Attitude towards Science, Sex and School type on Achievement in Physical Science was also worth mentioning here in this study. Based upon these findings, differences in Achievement in Physical Science of comparable groups categorised on the basis of differing levels of each of the independent variables, Sex and School type were attempted. The results of these group-pair comparisons reveal that (i) The total sample and sub samples (boys, girls, students of Single-sex and Coeducational schools) of three nearly identical levels of Self-Esteem, Attitude towards Science and Attitude towards Academic Work differ significantly in Achievement in Physics, Chemistry and Physical Science. Similarly, consistent sex – difference in achievement were noticed in Single – sex schools. High means are associated with boys. In Coeducational schools, significant sex – difference were noticed only in a few cases, especially in Achievement in Chemistry. When School type differences in mean achievement in Physical Science were examined, performance of boys is almost similar whereas girls' performance in science is seen superior in Coeducational schools. It is worthwhile to consider how the findings of the study will affect the existing educational practice in relation to Achievement in Physical Science teaching at the school level. The following are some of the guidelines suggested:

- (1) Since extreme group pairs namely High – Self-Esteem – Low – self-Esteem Groups, Favourable – Attitude towards Science – Less Favourable – Attitude towards Science Groups and Favourable – Attitude towards Academic Work – Less Favourable – Attitude towards Academic Work Groups significantly differ in Achievement in Physical Science in the total sample, Boys, Girls, Single-sex schools and Coeducational Schools and total sample, special programme may be arranged to boost their Self-Esteem and to create favourable attitudes. In classroom settings, sex-stereotype learning tasks and learning patterns may be avoided. Classroom environment may be made more comfortable and gratifying for both boys and girls in Coeducational setting, appropriate learning styles can be provided for developing positive Self-Esteem.
- (2) The study reveal that sex-difference in Achievement in Physical Science exist in favour of boys in Single-sex schools. But boys and girls perform almost similar in Coeducational schools. Girls in Coeducational schools were found to perform better than girls in Single-sex schools. This result warrant for differential academic programmes for enhancing Achievement in Physical Science of boys and girls in Single-sex and Coeducational schools. Some of the programmes which can be considered useful are the following:

Occasional single-sex programmes (all girls / all boys classes) can be provided in Coeducational schools which may be beneficial to boys. Innovative teaching such as the new models of teaching and utilising modern information technology can be adopted to ensure gender equity.
- (3) In order to minimise gender inequality, science learning activities may be directed to create positive attitude towards science and science learning tasks, to reduce science anxiety especially in Physics learning anxiety, to avoid science gender stereotyping, to develop similar perceptions in science career expectations, to enhance indoor

as well as outdoor active participation in small group learning situations, to promote doing science and explorative activities, to rotate regularly managerial and leadership roles, to minimise gender biased classroom activities by teachers and the like. Encourage student participation in curricular and co-curricular activities but never demand achievement beyond their abilities which will hinder a favourable attitude towards science and academic work. Abundant opportunities for group work, group discussions and group study should be provided without any sex bias. A healthy and conducive environment of the classroom may enhance better learning.

- (4) The select seven predictor variables namely, sex, school type, classroom learning environment, achievement motivation, self-esteem, attitude towards science and attitude towards academic work could discriminate between High-, Average- and Low-achievers in physics, chemistry and physical science. The two functions obtained in all the cases were efficient enough to discriminate significantly between High-, Average – and Low – achievers. So it is revealed that these seven variables could be used to identify a discriminant score (based on Fisher coefficient) which is helpful in classifying school pupils into High-; Average- and Low- achievers. Based on that proper teaching-learning strategies can be formulated. It is possible to adopt (i) models of teaching such as 'Direct Instructional Model' in the class to help Low-achievers to attain mastery; (ii) need based programmes such as computer-assisted instruction, suitable teaching-learning packages, individualised modules of learning and the like. Based on these, proper academic and vocational guidance also have to be provided in the class.

5.8 SUGGESTIONS FOR FURTHER RESEARCH

The findings of the present study can further be extended by future researchers on the lines suggested below.

1. A factor comparison of students of single-sex and coeducational schools using a wide range of cognitive and affective variables can be attempted.
2. Impact of school type, gender of the students and gender of the teachers on students' achievement and attitude towards science in secondary schools can be studied.
3. A comparison of perceived classroom learning environment and preferred learning environment especially in science learning context in single-sex and coeducational schools can be studied.
4. The study can be replicated using the component dimensions of classroom learning environment, achievement motivation and self-esteem.
5. A longitudinal study of personality characteristics and career success of women received in coeducational and single-sex schooling may be attempted.

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APPENDICES

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF CLASS ROOM LEARNING ENVIRONMENT

(Draft Form)

DR. USHA .P AND SUCHITRA. K

നിർദ്ദേശങ്ങൾ

താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകൾ നിങ്ങളുടെ ക്ലാസ്സു പഠനവുമായി ബന്ധപ്പെട്ടവയാണ്. ഓരോ പ്രസ്താവനയ്ക്കും മൂന്നുവീതം പ്രതികരണങ്ങൾ കൊടുത്തിട്ടുണ്ട്.

- (1) എല്ലായ്പ്പോഴും ഉണ്ട് (2) ചിലപ്പോൾ മാത്രം ഉണ്ട് (3) ഒരിക്കലുമില്ല

ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ച്, അതിൽ പറയുന്ന കാര്യങ്ങൾ നിങ്ങളെ സംബന്ധിച്ചിടത്തോളം എത്രമാത്രം ശരിയാണെന്ന് തീരുമാനിക്കുക. ആ പ്രതികരണമാണ് തന്നിരിക്കുന്ന ഉത്തരക്കലടലാസ്സിൽ രേഖപ്പെടുത്തേണ്ടത്.

തന്നിരിക്കുന്ന ഉത്തരക്കലടലാസ്സിൽ അതാത് പ്രസ്താവനകളുടെ നമ്പറിന് എതിരെ നിങ്ങളുടെ പ്രതികരണത്തിന് ചുവടെയുള്ള കോളത്തിൽ X ചിഹ്നം രേഖപ്പെടുത്തുക. നിങ്ങളുടെ പ്രതികരണം രേഖപ്പെടുത്താനുള്ള ക്രമനമ്പർ തെറ്റിപ്പോകാതിരിക്കാൻ ശ്രദ്ധിക്കുക.

ചോദ്യക്കലടലാസ്സിൽ ഒന്നും രേഖപ്പെടുത്തരുത്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്തുവാൻ ശ്രദ്ധിക്കണം.

ഉദാ: പഠനസൗകര്യത്തിനായി ക്ലാസ്സിലെ ബഞ്ചും ഡസ്കും ഇടയ്ക്കിടെ മാറ്റി ക്രമീകരിക്കാറുണ്ട്.

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| എല്ലായ്പ്പോഴും ഉണ്ട് | ചിലപ്പോൾ മാത്രം ഉണ്ട് | ഒരിക്കലുമില്ല |
| ○ | ⊗ | ○ |

1. പഠന സൗകര്യത്തിനായി ക്ലാസ്സിലെ ബഞ്ചും ഡസ്കും ഇടയ്ക്കിടെ മാറ്റി ക്രമീകരിക്കാറുണ്ട്.
2. ക്ലാസ്സിൽ വിദ്യാർത്ഥികളും അധ്യാപകനും തമ്മിൽ കാണാനും ഇടപഴകാനും സാധിക്കുന്ന രീതിയിലാണ് ക്ലാസ്സിലെ ഫർണിച്ചർ ക്രമീകരിച്ചിട്ടുള്ളത്.
3. വിദ്യാർത്ഥികളുടെ പഠനപുരോഗതിക്കനുസരിച്ച് ക്ലാസ്സിൽ അവർ ഇരിക്കേണ്ട സ്ഥലം ക്രമീകരിക്കാൻ അധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.
4. ക്ലാസ്സിലെ ഫർണിച്ചറിനും പഠനോപകരണങ്ങൾക്കും കുറവുണ്ടെങ്കിൽ അവയുടെ ക്രമീകരണം വഴി പഠനത്തിനുള്ള തടസ്സം നീക്കാറുണ്ട്.
5. പഠനപ്രവർത്തനങ്ങൾക്ക് ക്ലാസ്സ്മുറിക്ക് പുറത്തുള്ള ശബ്ദം ശല്യമാകാറുണ്ട്.
6. ക്ലാസ്സിലെ സ്ഥലപരിമിതിക്കനുസരിച്ച് അധ്യാപന രീതിയിൽ ഉചിതമായ മാറ്റങ്ങൾ വരുത്താൻ അധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.

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7. സയൻസ് പഠിക്കുന്നതിന് അനുവദിച്ചിരിക്കുന്ന ക്ലാസ്സ് സമയം വിദ്യാർത്ഥികളുടെ ഉത്തരവാദിത്വത്തോടും സഹകരണത്തോടും കൂടി പരമാവധി പ്രയോജനപ്പെടുത്താനുണ്ട്.
8. പഠനത്തിൽ പിന്നോക്കമായ വിദ്യാർത്ഥികളെ സഹായിക്കാൻ അധ്യാപകൻ സമയം കണ്ടെത്താനുണ്ട്.
9. ഉചിതമായ ഗൃഹപാഠം നൽകുന്നതുവഴി അധ്യാപന സമയം ലാഭിക്കാനും വിദ്യാർത്ഥികളുടെ പഠനസമയം കൂട്ടാനും ഉപകരിക്കുന്നുണ്ട്.
10. ക്ലാസ്സിൽവിവിധ പഠന പ്രവർത്തനങ്ങൾ തടസ്സമില്ലാതെ നടത്താൻ ആവശ്യമായ വായു സഞ്ചാരവും വെളിച്ചവും ലഭിക്കാനുള്ള ക്രമീകരണം ഉണ്ട്.
11. ലഭ്യമായ ഫർണിച്ചറും പഠന സാമഗ്രികളും മനോഹരമായും പരമാവധി പ്രയോജനപ്പെടുത്താവുന്ന രീതിയിലും ക്രമീകരിക്കാനുണ്ട്.
12. ക്ലാസ്സിൽ ഞെങ്ങിഞ്ഞെരുങ്ങിയിരുന്ന് പഠിക്കേണ്ടി വരാനുണ്ട്.
13. ക്ലാസ്സിൽ കൃത്യമായും വിജയകരമായും പഠനപ്രവർത്തനങ്ങൾ ചെയ്തു തീർക്കാൻ അധ്യാപകൻ പ്രത്യേകം നിഷ്കർഷിക്കാനുണ്ട്.
14. വിവിധതരം ശാസ്ത്ര പ്രവർത്തനങ്ങൾക്കായി പഠനസാമഗ്രികൾ സംഘടിപ്പിച്ച് ക്രമീകരിക്കാനുണ്ട്.
15. പഠന പ്രവർത്തനങ്ങൾ ചിട്ടയോടും അച്ചടക്കത്തോടും കൂടി നടത്താൻ വിദ്യാർത്ഥികളും അധ്യാപകരും ഒരുപോലെ ശ്രദ്ധിക്കാനുണ്ട്.
16. ക്ലാസ്സിൽ ബഹളം വരുന്നവരെയും പഠനത്തിൽ ശ്രദ്ധ ഇല്ലാത്തവരെയും അധ്യാപകൻ തന്ത്രപൂർവ്വം പഠനപ്രവർത്തനങ്ങളിലേക്ക് നയിക്കാനുണ്ട്.
17. കുട്ടികളുടെ വ്യത്യസ്ത കഴിവിനനുസരിച്ചുള്ള പ്രവർത്തനങ്ങൾ ക്ലാസ്സിൽ അവലംബിക്കാനുണ്ട്.
18. വിദ്യാർത്ഥികളുടെ ആവശ്യങ്ങൾ മനസ്സിലാക്കി അവരോട് പെരുമാറാൻ അധ്യാപകൻ ശ്രദ്ധിക്കാനുണ്ട്.
19. പാഠ്യഭാഗങ്ങൾ വേഗത്തിൽ ലക്ഷ്യബോധത്തോടെ പഠിക്കാൻ ഗ്രൂപ്പ് പഠനരീതി അവലംബിക്കാനുണ്ട്.
20. പഠന പ്രവർത്തനങ്ങൾ വിജയകരമായി ചെയ്തു തീർക്കാൻ മറ്റ് കുട്ടികളോട് മത്സരിക്കാനുണ്ട്.
21. പഠനത്തിൽ മിടുക്കരായ കുട്ടികളെ ക്ലാസ്സിൽ വച്ചുതന്നെ അഭിനന്ദിക്കാനുണ്ട്.
22. ഓരോ കുട്ടിയേയും പരമാവധി കഴിവുപയോഗിച്ച് പഠന പുരോഗതി കൈവരുത്താൻ അധ്യാപകൻ ഉത്സാഹിപ്പിക്കാനുണ്ട്.
23. പഠനത്തിൽ പിന്നോക്കമായ കുട്ടികളെ പരസ്യമായി കുറ്റപ്പെടുത്താറില്ല.
24. കുട്ടികൾ തമ്മിൽ തമ്മിൽ പഠനകാര്യങ്ങൾ ചർച്ച ചെയ്യാൻ അധ്യാപകൻ പ്രോത്സാഹിപ്പിക്കാനുണ്ട്.
25. കുട്ടികളുടെ അഭിപ്രായം അധ്യാപകൻ ശ്രദ്ധാപൂർവ്വം കേൾക്കാനുണ്ട്.
26. പഠനകാര്യത്തിലും പാഠ്യേതര പ്രവർത്തനങ്ങളിലും കുട്ടിയുടെ ആശയം കണക്കിലെടുക്കാനുണ്ട്.
27. ശാസ്ത്രപഠന കാര്യത്തിൽ നേരിയ ആശങ്ക തോന്നാനുണ്ട്.
28. പഠനം തൃപ്തികരമായും വേഗത്തിലും ആക്കാൻ അധ്യാപകൻ കൃത്യമായ നിബന്ധനകൾ അനുശാസിക്കാനുണ്ട്.

29. ക്ലാസ്സിലെ എല്ലാ കുട്ടികളും ഒരേ സമയം ഒരേ പഠന പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടുകയാണ് പതിവ്.
30. വിദ്യാർത്ഥികൾക്ക് ക്ലാസ്സിൽ സംശയം ഉന്നയിക്കാനോ ആശയം അവതരിപ്പിക്കാനോ അവസരം ലഭിക്കാറില്ല.
31. പാഠ്യപ്രവർത്തനങ്ങളിൽ അധ്യാപകരെ സഹായിക്കാൻ വിദ്യാർത്ഥികൾക്ക് അവസരം നൽകാറുണ്ട്.
32. ഓരോ കുട്ടിയുടേയും പഠനനിലവാരം അവരെ ബോധ്യപ്പെടുത്താൻ അധ്യാപകൻ ഇടയ്ക്കിടെ ശ്രമിക്കാറുണ്ട്.
33. സയൻസ് ക്ലബ്ബുകൾ, കിസ്സുകൾ തുടങ്ങിയ പാഠ്യേതര പ്രവർത്തനങ്ങൾക്ക് പാഠ്യവിഷയത്തോടൊപ്പം പ്രാധാന്യം നൽകാറുണ്ട്.
34. പാഠ്യേതര പ്രവർത്തനങ്ങൾക്ക് പരമാവധി കുട്ടികളെ പങ്കെടുപ്പിക്കാറുണ്ട്.
35. ശാസ്ത്രപാഠഭാഗങ്ങൾ നിത്യജീവിതത്തോടും ശാസ്ത്ര പുരോഗതിയോടും ബന്ധപ്പെടുത്തി പഠിപ്പിക്കാൻ അധ്യാപകൻ ശ്രമിക്കാറുണ്ട്.
36. ശാസ്ത്രത്തിലെ അടിസ്ഥാന തത്വങ്ങൾ മനസ്സിലാക്കി തരുവാൻ അധ്യാപകൻ കൂടുതൽ സമയം ചെലവഴിക്കാറുണ്ട്.
37. പഠിപ്പിക്കുമ്പോൾ അധ്യാപകൻ ഞങ്ങളെ ഓരോരുത്തരേയും ശ്രദ്ധിക്കുന്നതുപോലെ തോന്നാറുണ്ട്.
38. പാഠഭാഗങ്ങൾക്കനുസരിച്ച് ഉചിതമായ പഠനോപകരണങ്ങൾ ഉപയോഗിച്ച് അധ്യാപകൻ പഠിപ്പിക്കാറുണ്ട്.
39. ശാസ്ത്ര പാഠങ്ങൾക്കാവശ്യമായ ചാർട്ടുകൾ, ലഘുവായ മോഡലുകൾ തുടങ്ങിയ പഠന സഹായികൾ ഉണ്ടാക്കാൻ കുട്ടികളെ പരിശീലിപ്പിക്കാറുണ്ട്.
40. പഠിപ്പിച്ചു കൊണ്ടിരിക്കുന്നതിനോടൊപ്പം തന്നെ അധ്യാപകൻ സയൻസിൽ ആവശ്യാനുസരണം പരീക്ഷണങ്ങളും കാണിച്ചുതരാറുണ്ട്.
41. പരീക്ഷണങ്ങൾ സ്വയം ചെയ്യുന്നതിനുള്ള അവസരങ്ങൾ അധ്യാപകൻ കുട്ടികൾക്ക് നൽകാറുണ്ട്.
42. അധ്യാപകന്റെ അഭാവത്തിലും മറ്റ് ക്ലാസ്സുകൾക്ക് ശല്യമാവാതെ മുൻകൂട്ടി തന്നിട്ടുള്ള പഠനപ്രവർത്തനങ്ങളിൽ കുട്ടികൾ ഏർപ്പെടാറുണ്ട്.
43. ശാസ്ത്രപ്രവർത്തനങ്ങൾ രസകരമായി ചെയ്ത് തീർക്കാൻ കഴിയുന്നു.
44. വിരസമായ പാഠ്യപ്രവർത്തനങ്ങളിൽ ഏർപ്പെടേണ്ടിവരാറുണ്ട്.
45. സാധാരണമല്ലാത്തതോ, പുതിയതോ ആയ ആശയങ്ങൾ പഠനപ്രവർത്തനങ്ങളിൽ പ്രകടിപ്പിക്കാൻ അധ്യാപകനെ അനുവദിക്കാറുണ്ട്.
46. ക്ലാസ്സിൽ കുട്ടികൾ നിശബ്ദരായി, കേൾവിക്കാരായി ഇരിക്കുന്നത് അധ്യാപകൻ നിരുത്സാഹപ്പെടുത്താറുണ്ട്.
47. സയൻസ് ക്ലാസ്സിലെ പഠനം എനിക്ക് സന്തോഷകരമായ അനുഭവം തന്നെയാണ്.
48. പരീക്ഷയിലെ മാർക്കും റാങ്കും ഒരു പ്രശ്നമായി എന്നെ അലട്ടാറില്ല.
49. ഓരോ കുട്ടിക്കും വിജയസാധ്യതയുള്ള പഠനപ്രവർത്തനങ്ങൾ നൽകാൻ അധ്യാപകൻ ശ്രമിക്കാറുണ്ട്.
50. സയൻസ് ടീച്ചർ കുട്ടികളെ കുറ്റപ്പെടുത്താറുണ്ട്.
51. വിദ്യാർത്ഥികൾ കൃത്യസമയത്ത് ക്ലാസ്സിൽ ഹാജരാകാൻ അധ്യാപകൻ നിഷ്കർഷിക്കാറുണ്ട്.

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- 52. അധ്യാപകൻ കുട്ടികളോട് സൗഹാർദ്ദപൂർവ്വം പെരുമാറാറുണ്ട്.
- 53. എല്ലാ കുട്ടികളും തമ്മിൽ തമ്മിൽ അടുത്ത് ഇടപഴകാൻ അവസരം ലഭിക്കാറുണ്ട്.
- 54. പഠനപ്രവർത്തനങ്ങളിൽ വ്യക്തികൾ തമ്മിലുള്ള മത്സരം പ്രോത്സാഹിപ്പിക്കാറില്ല.
- 55. കുട്ടികൾ തമ്മിൽ പലകാര്യങ്ങൾക്കും വഴക്കിടാറുണ്ട്.
- 56. ക്ലാസ്സിലെ ചില കുട്ടികൾ മറ്റ് കുട്ടികളോട് കൂട്ടം കൂടാൻ താത്പര്യം കാണിക്കാറില്ല.
- 57. ക്ലാസ്സിലെ കുട്ടികളുടെ ബഹളം കാരണം പഠനം തടസ്സപ്പെടാറുണ്ട്.
- 58. ചുരുക്കം ചില കുട്ടികൾ കാരണം ക്ലാസ്സിൽ ലഹളയോ സമരമോ ഉണ്ടാവാറുണ്ട്.
- 59. അധ്യാപകനും കുട്ടികളും ഒത്ത് ചേർന്ന് പഠനകാര്യങ്ങളും പാഠ്യേതര പ്രവർത്തനങ്ങളും ചിട്ടയോടെ പ്രവർത്തനക്ഷമം ആക്കാറുണ്ട്.
- 60. ക്ലാസ്സിൽ മര്യാദയില്ലാതെ പെരുമാറുന്ന കുട്ടികളെ അധ്യാപകൻ നിശ്ചയ ദാർഢ്യത്തോടെ കൈകാര്യം ചെയ്യാറുണ്ട്.
- 61. വഴക്കുണ്ടാക്കുന്ന കുട്ടികളെ മറ്റ് കുട്ടികളും അധ്യാപകരും അവഗണിക്കുകയോ ഒറ്റപ്പെടുത്തുകയോ ചെയ്യാറുണ്ട്.
- 62. ചെറിയഗ്രൂപ്പുകളായി തിരിച്ച് പഠന പ്രവർത്തനങ്ങൾ നടത്തുന്നതുകൊണ്ട് കുട്ടികളിൽ ആത്മവിശ്വാസം കൂടുതലാണ്.
- 63. പഠനത്തിൽ പിന്നോക്കമായ കുട്ടികളെ മിടുക്കരായ സഹപാഠികൾ സഹായിക്കാൻ ശ്രമിക്കാറില്ല.
- 64. വിദ്യാർത്ഥികളെ പഠനഗ്രൂപ്പുകളായി തിരിച്ച് ഓരോ ഗ്രൂപ്പിനും പഠനപ്രവർത്തനങ്ങൾ നൽകാറുണ്ട്.
- 65. വിദ്യാർത്ഥികളെ ഗ്രൂപ്പ് തിരിച്ച് കിസ് തുടങ്ങിയ മത്സരങ്ങൾ നടത്താറുണ്ട്.
- 66. സയൻസ് എക്സിബിഷൻ, ക്ലബ്ബ്, പഠനയാത്ര എന്നിവ സംഘടിപ്പിക്കുമ്പോൾ ഗ്രൂപ്പായി തിരിച്ച് പ്രത്യേകം ചുമതലകൾ ഏൽപ്പിക്കാറുണ്ട്.
- 67. കുട്ടികളുടെ പഠനം, ഗൃഹപാഠം എന്നീ കാര്യങ്ങളിൽ ശ്രദ്ധിക്കാൻ അധ്യാപകനോടൊപ്പം, തെരഞ്ഞെടുക്കപ്പെട്ട ക്ലാസ്സ് ലീഡർമാരെയും ചുമതലപ്പെടുത്താറുണ്ട്.
- 68. കുട്ടികൾക്കിടയിലുണ്ടാകാറുള്ള അഭിപ്രായവ്യത്യാസങ്ങൾ അവർ തന്നെ പറഞ്ഞ് ഒതുക്കാറുണ്ട്.
- 69. കുട്ടികൾ പരസ്പരം സഹായിക്കാനുള്ള മനസ്ഥിതി അധ്യാപകൻ അവരിൽ വളർത്തി എടുക്കാറുണ്ട്.
- 70. പഠനത്തിലും പാഠ്യേതര പ്രവർത്തനങ്ങളിലും മുൻപിലെത്താൻ കുട്ടികൾ ഒത്തൊരുമിച്ച് പ്രവർത്തിക്കാറുണ്ട്.
- 71. അധ്യാപകന്റേയോ ചില കുട്ടികളുടേയോ പെരുമാറ്റംകൊണ്ട് ക്ലാസ്സിൽ പിരിമുറുക്കം (Tension) അനുഭവപ്പെടാറുണ്ട്.
- 72. കാര്യങ്ങൾ സ്വന്തമായി ചെയ്തുതീർക്കാനുള്ള പ്രാപ്തി ക്ലാസ്സിലെ പ്രവർത്തനങ്ങൾ വഴി ലഭിക്കാറുണ്ട്.
- 73. ചില കുട്ടികളെ പ്രത്യേക പ്രാധാന്യത്തോടെയാണ് അധ്യാപകർ കാണാറുള്ളത്.
- 74. മാധ്യമങ്ങളിൽ നിന്നും ലഭിക്കുന്ന വിജ്ഞാനപ്രദമായ കാര്യങ്ങൾ ക്ലാസ്സിൽ ചർച്ച ചെയ്യാറുണ്ട്.
- 75. ഗൃഹപാഠം സ്വയം ചെയ്യാതെ സഹപാഠികളുടെ പുസ്തകം നോക്കി എഴുതിയാൽ സമയം ലാഭിക്കാം.

7. സയൻസ് പഠിക്കുന്നതിന് അനുവദിച്ചിരിക്കുന്ന ക്ലാസ്സ് സമയം വിദ്യാർത്ഥികളുടെ ഉത്തരവാദിത്വത്തോടും സഹകരണത്തോടും കൂടി പരമാവധി പ്രയോജനപ്പെടുത്താനുണ്ട്.
8. പഠനത്തിൽ പിന്നോക്കമായ വിദ്യാർത്ഥികളെ സഹായിക്കാൻ അധ്യാപകൻ സമയം കണ്ടെത്താനുണ്ട്.
9. ഉചിതമായ ഗൃഹപാഠം നൽകുന്നതുവഴി അധ്യാപന സമയം ലാഭിക്കാനും വിദ്യാർത്ഥികളുടെ പഠനസമയം കൂട്ടാനും ഉപകരിക്കുന്നുണ്ട്.
10. ക്ലാസ്സിൽ വിവിധ പഠന പ്രവർത്തനങ്ങൾ തടസ്സമില്ലാതെ നടത്താൻ ആവശ്യമായ വായു സഞ്ചാരവും വെളിച്ചവും ലഭിക്കാനുള്ള ക്രമീകരണം ഉണ്ട്.
11. ലഭ്യമായ ഫർണിച്ചറും പഠന സാമഗ്രികളും മനോഹരമായും പരമാവധി പ്രയോജനപ്പെടുത്താവുന്ന രീതിയിലും ക്രമീകരിക്കാനുണ്ട്.
12. ക്ലാസ്സിൽ ഞെങ്ങിഞ്ഞെരുങ്ങിയിരുന്ന് പഠിക്കേണ്ടി വരാനുണ്ട്.
13. ക്ലാസ്സിൽ കൃത്യമായും വിജയകരമായും പഠന പ്രവർത്തനങ്ങൾ ചെയ്തു തീർക്കാൻ അധ്യാപകൻ പ്രത്യേകം നിഷ്കർഷിക്കാനുണ്ട്.
14. വിവിധതരം ശാസ്ത്ര പ്രവർത്തനങ്ങൾക്കായി പഠനസാമഗ്രികൾ സംഘടിപ്പിച്ച് ക്രമീകരിക്കാനുണ്ട്.
15. പഠന പ്രവർത്തനങ്ങൾ ചിട്ടയോടും അച്ചടക്കത്തോടും കൂടി നടത്താൻ വിദ്യാർത്ഥികളും അധ്യാപകരും ഒരുപോലെ ശ്രദ്ധിക്കാനുണ്ട്.
16. ക്ലാസ്സിൽ ബഹളം വരുന്നവരേയും പഠനത്തിൽ ശ്രദ്ധ ഇല്ലാത്തവരേയും അധ്യാപകൻ തന്ത്രപൂർവ്വം പഠനപ്രവർത്തനങ്ങളിലേക്ക് നയിക്കാനുണ്ട്.
17. കുട്ടികളുടെ വ്യത്യസ്ത കഴിവിനനുസരിച്ചുള്ള പ്രവർത്തനങ്ങൾ ക്ലാസ്സിൽ അവലംബിക്കാനുണ്ട്.
18. വിദ്യാർത്ഥികളുടെ ആവശ്യങ്ങൾ മനസ്സിലാക്കി അവരോട് പെരുമാറാൻ അധ്യാപകൻ ശ്രദ്ധിക്കാനുണ്ട്.
19. പാഠ്യഭാഗങ്ങൾ വേഗത്തിൽ ലക്ഷ്യബോധത്തോടെ പഠിക്കാൻ ഗ്രൂപ്പ് പഠനരീതി അവലംബിക്കാനുണ്ട്.
20. പഠനത്തിൽ മിടുക്കരായ കുട്ടികളെ ക്ലാസ്സിൽ വച്ചുതന്നെ അഭിനന്ദിക്കാനുണ്ട്.
21. ഓരോ കുട്ടിയേയും പരമാവധി കഴിവുപയോഗിച്ച് പഠന പുരോഗതി കൈവരുത്താൻ അധ്യാപകൻ ഉത്സാഹിപ്പിക്കാനുണ്ട്.
22. കുട്ടികൾ തമ്മിൽ തമ്മിൽ പഠനകാര്യങ്ങൾ ചർച്ച ചെയ്യാൻ അധ്യാപകൻ പ്രോത്സാഹിപ്പിക്കാനുണ്ട്.
23. കുട്ടികളുടെ അഭിപ്രായം അധ്യാപകൻ ശ്രദ്ധാപൂർവ്വം കേൾക്കാനുണ്ട്.
24. പഠനകാര്യത്തിലും പാഠ്യേതര പ്രവർത്തനങ്ങളിലും കുട്ടിയുടെ ആശയം കണക്കിലെടുക്കാനുണ്ട്.
25. ശാസ്ത്രപഠന കാര്യത്തിൽ നേരിയ ആശങ്ക തോന്നാനുണ്ട്
26. പഠനം തൃപ്തികരമായും വേഗത്തിലും ആക്കാൻ അധ്യാപകൻ കൃത്യമായ നിബന്ധനകൾ അനുശാസിക്കാനുണ്ട്.
27. പാഠ്യപ്രവർത്തനങ്ങളിൽ അധ്യാപകരെ സഹായിക്കാൻ വിദ്യാർത്ഥികൾക്ക് അവസരം നൽകാനുണ്ട്.
28. ഓരോ കുട്ടിയുടേയും പഠനനിലവാരം അവരെ ബോധ്യപ്പെടുത്താൻ അധ്യാപകൻ ഇടയ്ക്കിടെ ശ്രമിക്കാനുണ്ട്.

- 29. സയൻസ് ക്ലബ്ബുകൾ, ക്ലബ്ബുകൾ തുടങ്ങിയ പാഠ്യേതര പ്രവർത്തനങ്ങൾക്ക് പാഠ്യവിഷയത്തോടൊപ്പം പ്രാധാന്യം നൽകാറുണ്ട്.
- 30. പാഠ്യേതര പ്രവർത്തനങ്ങൾക്ക് പരമാവധി കുട്ടികളെ പങ്കെടുപ്പിക്കാറുണ്ട്.
- 31. ശാസ്ത്രപാഠഭാഗങ്ങൾ നിത്യജീവിതത്തോടും ശാസ്ത്ര പുരോഗതിയോടും ബന്ധപ്പെടുത്തി പഠിപ്പിക്കാൻ അധ്യാപകൻ ശ്രമിക്കാറുണ്ട്.
- 32. ശാസ്ത്രത്തിലെ അടിസ്ഥാന തത്വങ്ങൾ മനസ്സിലാക്കി തരുവാൻ അധ്യാപകൻ കൂടുതൽ സമയം ചെലവഴിക്കാറുണ്ട്.
- 33. പഠിപ്പിക്കുമ്പോൾ അധ്യാപകൻ ഞങ്ങളെ ഓരോരുത്തരേയും ശ്രദ്ധിക്കുന്നതുപോലെ തോന്നാറുണ്ട്.
- 34. പാഠഭാഗങ്ങൾക്കനുസരിച്ച് ഉചിതമായ പഠനോപകരണങ്ങൾ ഉപയോഗിച്ച് അധ്യാപകൻ പഠിപ്പിക്കാറുണ്ട്.
- 35. ശാസ്ത്ര പാഠങ്ങൾക്കാവശ്യമായ ചാർട്ടുകൾ, ലഘുവായ മോഡലുകൾ തുടങ്ങിയ പഠനസഹായികൾ ഉണ്ടാക്കാൻ കുട്ടികളെ പരിശീലിപ്പിക്കാറുണ്ട്.
- 36. പഠിപ്പിച്ചു കൊണ്ടിരിക്കുന്നതിനോടൊപ്പം തന്നെ അധ്യാപകൻ സയൻസിൽ ആവശ്യാനുസരണം പരീക്ഷണങ്ങളും കാണിച്ചുതരാറുണ്ട്.
- 37. പരീക്ഷണങ്ങൾ സ്വയം ചെയ്യുന്നതിനുള്ള അവസരങ്ങൾ അധ്യാപകൻ കുട്ടികൾക്ക് നൽകാറുണ്ട്.
- 38. അധ്യാപകന്റെ അഭാവത്തിലും മറ്റ് ക്ലബ്ബുകൾക്ക് ശല്യമാവാതെ മുൻകൂട്ടി തന്നിട്ടുള്ള പഠനപ്രവർത്തനങ്ങളിൽ കുട്ടികൾ ഏർപ്പെടാറുണ്ട്.
- 39. ശാസ്ത്രപ്രവർത്തനങ്ങൾ രസകരമായി ചെയ്ത് തീർക്കാൻ കഴിയുന്നു.
- 40. വിരസമായ പാഠ്യപ്രവർത്തനങ്ങളിൽ ഏർപ്പെടേണ്ടിവരാറുണ്ട്.
- 41. ക്ലബ്ബിൽ കുട്ടികൾ നിശബ്ദരായി, കേൾവിക്കാരായി ഇരിക്കുന്നത് അധ്യാപകൻ നിരുത്സാഹപ്പെടുത്താറുണ്ട്.
- 42. സയൻസ് ക്ലബ്ബിലെ പഠനം എനിക്ക് സന്തോഷകരമായ അനുഭവം തന്നെയാണ്.
- 43. പരീക്ഷയിലെ മാർക്കും റാങ്കും ഒരു പ്രശ്നമായി എന്നെ അലട്ടാറില്ല.
- 44. ഓരോ കുട്ടിക്കും വിജയസാധ്യതയുള്ള പഠനപ്രവർത്തനങ്ങൾ നൽകാൻ അധ്യാപകൻ ശ്രദ്ധിക്കാറുണ്ട്.
- 45. വിദ്യാർത്ഥികൾ കൃത്യസമയത്ത് ക്ലബ്ബിൽ ഹാജരാകാൻ അധ്യാപകൻ നിഷ്കർഷിക്കാറുണ്ട്.
- 46. അധ്യാപകൻ കുട്ടികളോട് സൗഹാർദ്ദപൂർവ്വം പെരുമാറാറുണ്ട്.
- 47. എല്ലാ കുട്ടികളും തമ്മിൽ തമ്മിൽ അടുത്ത് ഇടപഴകാൻ അവസരം ലഭിക്കാറുണ്ട്.
- 48. കുട്ടികൾ തമ്മിൽ പല കാര്യങ്ങൾക്കും വഴക്കിടാറുണ്ട്.
- 49. ക്ലബ്ബിലെ ചില കുട്ടികൾ മറ്റ് കുട്ടികളോട് കൂട്ടം കൂടാൻ താത്പര്യം കാണിക്കാറില്ല.
- 50. ക്ലബ്ബിലെ കുട്ടികളുടെ ബഹളം കാരണം പഠനം തടസ്സപ്പെടാറുണ്ട്.
- 51. ചുരുക്കം ചില കുട്ടികൾ കാരണം ക്ലബ്ബിൽ ലഹളയോ സമരമോ ഉണ്ടാവാറുണ്ട്.
- 52. അധ്യാപകനും കുട്ടികളും ഒത്ത് ചേർന്ന് പഠനകാര്യങ്ങളും പാഠ്യേതര പ്രവർത്തനങ്ങളും ചിട്ടയോടെ പ്രവർത്തനക്ഷമം ആക്കാറുണ്ട്.
- 53. ക്ലബ്ബിൽ മര്യാദയില്ലാതെ പെരുമാറുന്ന കുട്ടികളെ അധ്യാപകൻ നിശ്ചയ ദാർഢ്യത്തോടെ കൈകാര്യം ചെയ്യാറുണ്ട്.

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- 54. ചെറിയ ഗ്രൂപ്പുകളായി തിരിച്ച് പഠനപ്രവർത്തനങ്ങൾ നടത്തുന്നതു കൊണ്ട് കുട്ടികളിൽ ആത്മാവിശ്വാസം കൂടുതലാണ്.
- 55. വിദ്യാർത്ഥികളെ പഠനഗ്രൂപ്പുകളായി തിരിച്ച് ഓരോ ഗ്രൂപ്പിനും പഠനപ്രവർത്തനങ്ങൾ നൽകാറുണ്ട്.
- 56. വിദ്യാർത്ഥികളെ ഗ്രൂപ്പ് തിരിച്ച് കിസ് തുടങ്ങിയ മത്സരങ്ങൾ നടത്താറുണ്ട്.
- 57. സയൻസ് എക്സിബിഷൻ, ക്ലബ്ബ്, പഠനയാത്ര എന്നിവ സംഘടിപ്പിക്കുമ്പോൾ ഗ്രൂപ്പായി തിരിച്ച് പ്രത്യേക ചുമതലകൾ ഏൽപ്പിക്കാറുണ്ട്.
- 58. കുട്ടികളുടെ പഠനം, ഗൃഹപാഠം എന്നീ കാര്യങ്ങളിൽ ശ്രദ്ധിക്കാൻ അധ്യാപകനോടൊപ്പം, തെരഞ്ഞെടുക്കപ്പെട്ട ക്ലാസ്സ് ലീഡർമാരെയും ചുമതലപ്പെടുത്താറുണ്ട്.
- 59. കുട്ടികൾക്കിടയിലുണ്ടാകാറുള്ള അഭിപ്രായവ്യത്യാസങ്ങൾ അവർ തന്നെ പറഞ്ഞ് ഒതുക്കാറുണ്ട്.
- 60. കുട്ടികൾ പരസ്പരം സഹായിക്കാനുള്ള മനസ്ഥിതി അധ്യാപകൻ അവരിൽ വളർത്തി എടുക്കാറുണ്ട്.
- 61. പഠനത്തിലും പാഠ്യേതരപ്രവർത്തനങ്ങളിലും മുൻപിലെത്താൻ കുട്ടികൾ ഒത്തൊരുമിച്ച് പ്രവർത്തിക്കാറുണ്ട്.
- 62. അധ്യാപകന്റേയോ ചില കുട്ടികളുടേയോ പെരുമാറ്റം കൊണ്ട് ക്ലാസ്സിൽ പിരിമുറുക്കം (Tension) അനുഭവപ്പെടാറുണ്ട്.
- 63. കാര്യങ്ങൾ സ്വന്തമായി ചെയ്തുതീർക്കാനുള്ള പ്രാപ്തി ക്ലാസ്സിലെ പ്രവർത്തനങ്ങൾ വഴി ലഭിക്കാറുണ്ട്.
- 64. ചിലകുട്ടികളെ പ്രത്യേക പ്രാധാന്യത്തോടെയാണ് അധ്യാപകർ കാണാറുള്ളത്.
- 65. മാധ്യമങ്ങളിൽ നിന്നും ലഭിക്കുന്ന വിജ്ഞാനപ്രദമായ കാര്യങ്ങൾ ക്ലാസ്സിൽ ചർച്ച ചെയ്യാറുണ്ട്.
- 66. ഗൃഹപാഠം സ്വയം ചെയ്യാതെ സഹപാഠികളുടെ പുസ്തകം നോക്കി എഴുതിയാൽ സമയം ലാഭിക്കാം.

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UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF CLASSROOM LEARNING ENVIRONMENT
(FINAL SCALE)
Dr. P. USHA and SUCHITRA K.

Instructions

The following statements are associated with your studies in the classroom. For the statements, 3 responses marked 'Always', 'Sometimes' and 'Never' are given. Read carefully the 66 statements. Decide how far each statement is true regarding your classroom studies. Record your responses in the separate response sheet given to you by marking 'x' mark in the circle for each statement.

1. Benches and desks in the classroom are rearranged periodically for the purpose of successful learning.
2. The furniture in the classrooms are arranged in such a way that the teacher and the students can see and communicate one another.
3. The teacher takes care to arrange the seats of the students according to their progress of study.
4. If the classroom furniture and teaching learning aids are not sufficient, the hindrance to learning is removed by suitable arrangement of the same.
5. The noises outside the classroom is a nuisance for learning activities.
6. The teacher tries to make suitable changes in the method of teaching according to the space limitations of the class.
7. The time allotted for learning science is utilised fully with the responsibility and co-operation of the students.
8. The teacher finds time to assist the students who are slow learners.
9. By giving adequate home works, the time for class teaching can be saved so that the students get more time for learning.
10. The classroom is arranged in such a way that there is sufficient light and ventilation for carrying out successful learning activities.

11. The available furniture and learning aids in the classroom are arranged in beautiful manner and for their utmost utility.
12. Sometimes students are forced to sit in congested classrooms.
13. The teacher instructs the students to do their work systematically and successfully.
14. The learning devices are organised and arranged for the purpose of various scientific activities.
15. The teacher and the students take care to do the learning activities systematically and in a disciplined manner.
16. Inattentive and troublesome students in the class are cleverly directed to learning activities by the teacher.
17. Teacher arranges suitable learning activities according to the ability levels of the students.
18. The teacher takes care to deal with the students according to their needs.
19. Group learning is encouraged for a successful and purposeful learning.
20. The bright students are congratulated in the class itself.
21. Teacher encourages the students to use their maximum ability for their progress in learning.
22. Teacher encourages the students to discuss the lessons among themselves in the class.
23. Teacher pays attention to the opinion of the students.
24. The ideas of the students regarding curricular as well as co-curricular activities are considered by the teacher.
25. There is a slight anxiety in the learning of science.
26. Teacher insists to follow specific rules for the success of learning in time.
27. Students get opportunity to assist the teacher in teaching activities.
28. The teacher makes the students aware of their standard of learning periodically.
29. Importance is given for co-curricular activities such as Science Clubs and Quiz along with curricular activities.
30. Students are encouraged to participate in co-curricular activities.
31. The teacher tries to teach science subjects by relating to daily life and progress of science.

32. The teacher spends more time to make the students understand the basic principles of science.
33. It is felt that the teacher pays attention to each and everyone of us during teaching.
34. Teacher uses appropriate teaching devices for the lessons during teaching.
35. Students are given training in making charts and models in science.
36. Teacher demonstrates appropriate experiments in science classes.
37. Students are given opportunities for doing the experiments themselves.
38. Students engage in learning activities without disturbing the other classes even in the absence of their teacher.
39. Science activities in the class could be completed interestingly.
40. Sometimes students have to engage in uninteresting learning activities also.
41. Teacher discourages the students to be passive listeners.
42. Learning science in the class is a pleasant experience for me.
43. The rank and marks in the examination does not worry me any way.
44. Teacher tries to give learning activities in which each student can succeed.
45. Teacher insists the students to attend the class in time.
46. Teacher has a friendly approach to the students.
47. All the students get opportunity to interact with one another.
48. Students quarrel for many things.
49. Some students in the class do not like to mingle with others.
50. Sometimes learning is obstructed due to the unruly behaviour of the students.
51. Because of the misbehaviour of a few students, class work will be disrupted.
52. Both the curricular and co-curricular activities are systematically and efficiently conducted by the cooperative effort of teacher and students.
53. Students who behave indecently in the class will be handled strictly by the teachers.
54. Students have more confidence in learning activities when they work in small groups.
55. Students are divided into small groups and each group is given learning activities.
56. Students are divided into groups and Quiz competitions are conducted.

57. When Science Exhibition, Clubs, study tours etc. are conducted, the students are divided into groups and each group is entrusted with certain responsibilities.
58. To attend the classroom learning tasks, home assignments and the like, select students are also entrusted to share the responsibility along with the teacher.
59. The difference of opinion among the students are amicably settled by themselves.
60. Mutual help in all endeavours is encouraged among students.
61. Students work together to come first in both the curricular and co-curricular activities.
62. Occasionally certain behaviour of the teacher or the students creates tension in the class.
63. The nature of doing the learning tasks in the class help students to be more self-dependent.
64. Teacher pays undue attention to certain students in the class.
65. Informative topics available in the media are discussed in the class.
66. Time can be saved by doing the homework by copying from the books of the peers.



UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF CLASS ROOM LEARNING ENVIRONMENT

RESPONSE SHEET

വിദ്യാർത്ഥിയുടെ പേര് ക്ലാസ്സ് ക്ലാസ്സ് നമ്പർ
സ്കൂളിന്റെ പേര് ആൺകുട്ടി/പെൺകുട്ടി വയസ്സ്

Sl. No.	എല്ലായ്പ്പോഴും ഉണ്ട്	ചിലപ്പോൾ ഉണ്ട്	ഒരിക്കലും ഇല്ല	Sl. No.	എല്ലായ്പ്പോഴും ഉണ്ട്	ചിലപ്പോൾ ഉണ്ട്	ഒരിക്കലും ഇല്ല
1	→ ○ _____	○ _____	○ _____	34	→ ○ _____	○ _____	○ _____
2	→ ○ _____	○ _____	○ _____	35	→ ○ _____	○ _____	○ _____
3	→ ○ _____	○ _____	○ _____	36	→ ○ _____	○ _____	○ _____
4	→ ○ _____	○ _____	○ _____	37	→ ○ _____	○ _____	○ _____
5	→ ○ _____	○ _____	○ _____	38	→ ○ _____	○ _____	○ _____
6	→ ○ _____	○ _____	○ _____	39	→ ○ _____	○ _____	○ _____
7	→ ○ _____	○ _____	○ _____	40	→ ○ _____	○ _____	○ _____
8	→ ○ _____	○ _____	○ _____	41	→ ○ _____	○ _____	○ _____
9	→ ○ _____	○ _____	○ _____	42	→ ○ _____	○ _____	○ _____
10	→ ○ _____	○ _____	○ _____	43	→ ○ _____	○ _____	○ _____
11	→ ○ _____	○ _____	○ _____	44	→ ○ _____	○ _____	○ _____
12	→ ○ _____	○ _____	○ _____	45	→ ○ _____	○ _____	○ _____
13	→ ○ _____	○ _____	○ _____	46	→ ○ _____	○ _____	○ _____
14	→ ○ _____	○ _____	○ _____	47	→ ○ _____	○ _____	○ _____
15	→ ○ _____	○ _____	○ _____	48	→ ○ _____	○ _____	○ _____
16	→ ○ _____	○ _____	○ _____	49	→ ○ _____	○ _____	○ _____
17	→ ○ _____	○ _____	○ _____	50	→ ○ _____	○ _____	○ _____
18	→ ○ _____	○ _____	○ _____	51	→ ○ _____	○ _____	○ _____
19	→ ○ _____	○ _____	○ _____	52	→ ○ _____	○ _____	○ _____
20	→ ○ _____	○ _____	○ _____	53	→ ○ _____	○ _____	○ _____
21	→ ○ _____	○ _____	○ _____	54	→ ○ _____	○ _____	○ _____
22	→ ○ _____	○ _____	○ _____	55	→ ○ _____	○ _____	○ _____
23	→ ○ _____	○ _____	○ _____	56	→ ○ _____	○ _____	○ _____
24	→ ○ _____	○ _____	○ _____	57	→ ○ _____	○ _____	○ _____
25	→ ○ _____	○ _____	○ _____	58	→ ○ _____	○ _____	○ _____
26	→ ○ _____	○ _____	○ _____	59	→ ○ _____	○ _____	○ _____
27	→ ○ _____	○ _____	○ _____	60	→ ○ _____	○ _____	○ _____
28	→ ○ _____	○ _____	○ _____	61	→ ○ _____	○ _____	○ _____
29	→ ○ _____	○ _____	○ _____	62	→ ○ _____	○ _____	○ _____
30	→ ○ _____	○ _____	○ _____	63	→ ○ _____	○ _____	○ _____
31	→ ○ _____	○ _____	○ _____	64	→ ○ _____	○ _____	○ _____
32	→ ○ _____	○ _____	○ _____	65	→ ○ _____	○ _____	○ _____
33	→ ○ _____	○ _____	○ _____	66	→ ○ _____	○ _____	○ _____

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ACHIEVEMENT MOTIVATION
Dr. KAMALA S. PILLAI & SALIMKUMAR.
(Final Scale)

Instructions

Read carefully the statements given below. For each statement three responses 'A', 'B' and 'C' are possible and these denotes Yes, Undecided and No respectively. Separate sheet is provided for recording your responses. Mark your response with the symbol 'x' below the circle of your response (A, B, C) for each statement. Try to mark your response to each and every statement.

1. I like to avoid those lessons which I find difficult to study.
2. I would try to utilise maximum of my ability for doing any work.
3. I usually study the lessons taught each day, that day itself.
4. I have the feeling that I am lazy.
5. I often put off things I know I should do today.
6. I like hard work.
7. I used to do very little work which I can do.
8. I would spend more time in studying difficult lessons.
9. I find satisfaction in doing well in my studies.
10. I like to mingle with others, who are good at studies like me.
11. Each time I try to score more marks than my previous examinations.
12. I find satisfaction when I do a work in a befitting manner.
13. I get satisfaction in doing a work better than my earlier work even if I don't outperform others.
14. I would be able to complete my studies very well.
15. I like to present my activities which others can consider as models.
16. I want to become a person admired by others.
17. I want others to come to me for clearing their doubts.
18. I like to be admired of my abilities.
19. I want others to consider my opinions of great value.

20. I dislike being the centre of attention.
21. I like to take my own decisions.
22. I want to mingle with important persons in the community.
23. I like others to appreciate my good activities.
24. Even if I top in my class studies always I like to continue my studies.
25. I try harder to win the top positions when I am in competition with others.
26. I judge my performance on whether I do better than others rather than just getting a good result.
27. It is important to me to perform better than others on a task.
28. I would study my lessons so that I get the top rank in my class.
29. It gives me pleasure in doing things which I am sure to win.
30. If there is tough competition, my performance will be better.
31. I never neglect opportunities of better performance in my studies.
32. I don't mind working hard while others are having fun.
33. There is continuous effort behind the success of my accomplishments in studies.
34. I could study well as I am getting more recognition.
35. The most important thing about studies is the accomplishment.
36. I usually get the trophies and prizes for studies.
37. There is satisfaction in work involving technical knowledge and skill.
38. I find satisfaction in studying materials which require high intellectual ability and skill.
39. I feel like giving up a work which I am unable to do correctly.
40. I feel doubt about my learning style whether it will help to attain the goal.
41. I think I am able to study better than anybody else.
42. In all study matters, my opinions always come first.
43. I used to take initiative in discussing study matters with my classmates.
44. I would enjoy having authority over my classmates.
45. If given the chance I would become a good leader.
46. My classmates take notice of what I say.
47. I usually think I am the leader of my group.
48. I enjoy taking initiative in what my classmates should do and get things done.
49. When we plan an activity I would like to direct it myself rather than someone else taking the lead.
50. I like to give direction to my classmates and get things going accordingly.



UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ACHIEVEMENT MOTIVATION

RESPONSE SHEET

വിദ്യാർത്ഥിയുടെ പേര് ക്ലാസ്സ് ക്ലാസ്സ് നമ്പർ
സ്കൂളിന്റെ പേര് ആൺകുട്ടി/പെൺകുട്ടി വയസ്സ്

Sl. No.	അതെ A	തീർച്ചയില്ല B	അല്ല C	Sl. No.	അതെ A	തീർച്ചയില്ല B	അല്ല C
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	26	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	27	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	28	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	29	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	30	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	31	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	32	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	33	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	34	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	35	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	36	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	37	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	38	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	39	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	40	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	41	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	42	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	43	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	44	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	45	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	46	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	47	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	48	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	49	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	50	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SELF-ESTEEM INVENTORY (Battle, 2000)

1. Do you have only a few friends?
2. Are you happy most of the time?
3. Are you comfortable telling your parents about your problems?
4. Can you do things as well as others?
5. Do you like everyone you know?
6. Do you spend most of your free time alone?
7. Do you trust your family?
8. Do most people like you?
9. Do you often feel like quitting school?
10. Have you ever taken anything that didn't belong to you?
11. Are you as intelligent as most people?
12. Do you argue often with your family?
13. Do you feel you are as important as most people?
14. Are you easily depressed?
15. Are you satisfied with your school work?
16. Do you feel like you have enough freedom at home?
17. Would you change many things about yourself if you could?
18. Do you always tell the truth?
19. Do you have a good relationship with your mother?
20. Are you as nice looking as most people?
21. Do you usually quit when your school work is too hard?
22. Are you usually tense or anxious?
23. Do you gossip at times?
24. Do you often feel that you are no good at all?
25. Are you as strong and healthy as most people are?
26. Do you enjoy learning?
27. Do you have a good relationship with your father?
28. Is it difficult for you to express your views and feelings?
29. Do you ever get angry?
30. Do you often feel ashamed of yourself?
31. Are you pretty good about doing homework on time?
32. Are other people generally more successful than you are?
33. Are you doing as well in school as you would like to do?
34. Do you feel uneasy most of the time without knowing why?

35. Do you feel that you are as happy as others are?
36. Are you ever shy?
37. Are you a failure?
38. Are you popular with other people your age?
39. Is it hard for you to meet new people?
40. Do you ever lie?
41. Are you often upset about something?
42. Do most people respect your views?
43. Are people your age smarter than you are?
44. Are you uncomfortable in groups of people?
45. Do you worry more than most people do?
46. Are you as happy as most people?
47. Do the people in your family have quick tempers?
48. Are you ever sad?
49. Is it hard for you to find the energy to do things?
50. Do you feel as though your friends have a lot of confidence in you?
51. Do you feel that you are not good enough?
52. Do your parents understand how you feel?
53. Are you doing the best school work that you can?
54. Do people like your ideas?
55. Do your parents think that you are a failure?
56. Is it hard for you to give yourself credit when you do a good job?
57. Do you have trouble talking to other people?
58. Are you a failure at school?
59. Do your parents love you?
60. Are you proud of your schoolwork?
61. Do you often get upset when you are at home?
62. Are you a hard worker at school?
63. Do you find it hard to make up your mind and stick to it?
64. Do you like yourself very much?
65. Do you have friends you can confide in?
66. In school, do you do as little work as you can get by with?
67. Do you feel as though your family trusts you?

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

Adopted Version

SELF ESTEEM INVENTORY (Battle, 2000)

DR. USHA .P AND SUCHITRA. K

നിർദ്ദേശങ്ങൾ

1. നിങ്ങൾ നിങ്ങളെ എത്രത്തോളം അംഗീകരിക്കുന്നു എന്ന് മനസ്സിലാക്കാനുള്ള ഒരു ചോദ്യാവലിയാണ് ഇത്. ഈ ചോദ്യാവലിയിൽ 67 ചോദ്യങ്ങൾ ഉൾപ്പെടുത്തിയിട്ടുണ്ട്
2. നിങ്ങളുടെ പ്രതികരണം രേഖപ്പെടുത്താൻ Response Sheet പ്രത്യേകം തന്നിട്ടുണ്ട്. ഇതിൽ ഓരോ ചോദ്യനമ്പരിനും എതിരെ 'Yes', 'No' എന്ന് കൊടുത്തിട്ടുണ്ട്.
3. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിലെ ആശയം നിങ്ങളെ സംബന്ധിച്ച് ശരിയാണോ അല്ലയോ എന്ന് തീരുമാനിക്കുക. ശരിയാണെങ്കിൽ Response Sheet ൽ ചോദ്യനമ്പരിന് എതിരെ 'Yes' നു മുകളിലും ശരിയല്ലെങ്കിൽ No ന് മുകളിലും 'X' ചിഹ്നം ഇടുക.
4. എല്ലാ ചോദ്യങ്ങൾക്കും ക്രമനമ്പർ തെറ്റാതെ പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കുക.

1. നിങ്ങളുടെ സ്നേഹിതരുടെ എണ്ണം വളരെ കുറവാണോ?
2. മിക്ക സമയവും നിങ്ങൾ ഉല്ലാസവൻ / ഉല്ലാസവതി ആണോ?
3. നിങ്ങളുടെ പ്രശ്നങ്ങൾ നിങ്ങളുടെ അച്ഛനമ്മമാരോട് സൗകര്യമായി പറയാൻ കഴിയുമോ?
4. മറ്റുള്ളവർക്ക് ചെയ്യാൻ കഴിയുന്നതുപോലെ കാര്യങ്ങൾ നന്നായി ചെയ്യാൻ നിങ്ങൾക്കും കഴിയാറുണ്ടോ?
5. നിങ്ങൾക്ക് പരിചയമുള്ളവരെല്ലാം നിങ്ങൾക്ക് ഇഷ്ടമാണോ ?
6. നിങ്ങളുടെ ഒഴിവുസമയം മിക്കവാറും നിങ്ങൾ ഏകാന്തമായി കഴിച്ചുകൂട്ടുകയാണോ?
7. നിങ്ങളുടെ കുടുംബാംഗങ്ങളെ നിങ്ങൾക്ക് വിശ്വാസമാണോ?
8. മിക്കവാറും എല്ലാപേർക്കും നിങ്ങളെ ഇഷ്ടം ആണോ?
9. സ്കൂൾ പഠനം ഉപേക്ഷിക്കുവാൻ പലപ്പോഴും തോന്നാറുണ്ടോ?
10. നിങ്ങളുടേത് അല്ലാത്ത ഏതെങ്കിലും സാധനം നിങ്ങൾ എപ്പോഴെങ്കിലും എടുത്തിട്ടുണ്ടോ?
11. മറ്റുപലരേയും പോലെ നിങ്ങൾക്ക് ബുദ്ധിസാമാർത്ഥ്യം ഉണ്ടോ?
12. നിങ്ങൾ കുടുംബാംഗങ്ങളുമായി വാദപ്രതിവാദം നടത്താറുണ്ടോ?
13. മറ്റു പലരേയും പോലെ നിങ്ങളും ഒരു പ്രധാനവ്യക്തിയാണെന്ന് തോന്നാറുണ്ടോ?

14. നിങ്ങൾ വളരെ എളുപ്പത്തിൽ നിരാശരാകാറുണ്ടോ?
15. നിങ്ങളുടെ സ്കൂൾപഠന പ്രവർത്തനങ്ങളിൽ നിങ്ങൾക്ക് സംതൃപ്തി ഉണ്ടോ?
16. നിങ്ങൾക്ക് ആവശ്യമുള്ളത്ര സ്വാതന്ത്ര്യം വീട്ടിൽ നിന്ന് ലഭിക്കുന്നുണ്ടോ?
17. നിങ്ങളെ സംബന്ധിക്കുന്ന പല കാര്യങ്ങളിലും മാറ്റം വരുത്തുവാൻ നിങ്ങൾ ശ്രമിക്കാറുണ്ടോ?
18. നിങ്ങൾ എല്ലായ്പ്പോഴും സത്യം പറയാറുണ്ടോ?
19. നിങ്ങളുടെ അമ്മയുമായി നിങ്ങൾക്ക് നല്ല സൗഹൃദബന്ധം ഉണ്ടോ?
20. നിങ്ങളെ കണ്ടാൽ മറ്റു പലരേയും പോലെശാലിനത ഉണ്ടെന്നു തോന്നാറുണ്ടോ?
21. നിങ്ങളുടെ സ്കൂൾ പഠനപ്രവർത്തനങ്ങൾ പ്രയാസമാകുമ്പോൾ അവ നിർത്തിവയ്ക്കാറുണ്ടോ?
22. നിങ്ങൾക്ക് പതിവായി ഉത്കണ്ഠയോ, മനസ്സിനു പിരിമുറുക്കമോ (Tension) അനുഭവപ്പെടാറുണ്ടോ?
23. ചിലപ്പോഴെങ്കിലും നിങ്ങൾ വിടുവാക്ക് (gossip) പറഞ്ഞിരിക്കാറുണ്ടോ?
24. നിങ്ങളെക്കൊണ്ട് ഒന്നിനും കൊള്ളുകയില്ലെന്ന് പലപ്പോഴും തോന്നാറുണ്ടോ?
25. മറ്റു പലരേയും പോലെ നിങ്ങൾക്ക് കരുത്തും ആരോഗ്യവും ഉണ്ടോ?
26. പഠനം നിങ്ങൾക്ക് ആനന്ദപ്രദായകം ആകാറുണ്ടോ?
27. നിങ്ങളുടെ പിതാവുമായുള്ള നിങ്ങളുടെ ബന്ധം സൗഹൃദപരമാണോ?
28. നിങ്ങളുടെ അഭിപ്രായവും വികാരവും പ്രകടിപ്പിക്കുവാൻ നിങ്ങൾക്ക് ബുദ്ധിമുട്ടുണ്ടോ?
29. നിങ്ങൾക്ക് എപ്പോഴും ദേഷ്യം വരാറുണ്ടോ?
30. നിങ്ങളെ പറ്റി പലപ്പോഴും സ്വയം ലജ്ജ തോന്നാറുണ്ടോ?
31. ഗൃഹപാഠം കൃത്യസമയത്തിനുള്ളിൽ ചെയ്തുതീർക്കാൻ നിങ്ങൾക്ക് മിടുകുണ്ടോ?
32. നിങ്ങളെക്കാൾ വിജയ സാധ്യത കൂടുതൽ ഉള്ളത് സാധാരണയായി മറ്റു പലർക്കും ആണോ?
33. നിങ്ങൾ ഉദ്ദേശിക്കുന്ന രീതിയിൽ സ്കൂളിലെ പ്രവർത്തനങ്ങൾ നിർവഹിക്കാൻ നിങ്ങൾക്ക് സാധിക്കാറുണ്ടോ?
34. നിങ്ങൾക്ക് പലപ്പോഴും അകാരണമായ മനോവിഷമം അനുഭവപ്പെടാറുണ്ടോ?
35. മറ്റുള്ളവർക്ക് ഉള്ളതുപോലെ സന്തോഷം തനിക്കും ഉണ്ടെന്നു തോന്നാറുണ്ടോ?
36. നിങ്ങൾ സദാ ലജ്ജാശീലൻ/ലജ്ജാശീല ആണോ?
37. നിങ്ങൾ ഒരു പരാജയമാണെന്ന് തോന്നാറുണ്ടോ?
38. നിങ്ങളുടെ സതീർത്ഥ്യരുടെ ഇടയിൽ നിങ്ങൾ സുസമ്മതനായ വ്യക്തിയാണോ?
39. പുതിയ ആളുകളെ പരിചയപ്പെടാൻ ബുദ്ധിമുട്ടുണ്ടോ?
40. നിങ്ങൾ എപ്പോഴെങ്കിലും കള്ളം പറയാറുണ്ടോ?
41. എന്തെന്ന് അറിയാത്ത ഒരു ഉത്കണ്ഠ പലപ്പോഴും നിങ്ങളെ അലട്ടാറുണ്ടോ?
42. നിങ്ങളുടെ അഭിപ്രായങ്ങൾ മിക്കപേരും പരിഗണിക്കാറുണ്ടോ?
43. നിങ്ങളുടെ സമപ്രായക്കാർ നിങ്ങളെക്കാൾ കാര്യക്ഷമത (Smart) ഉള്ളവരാണോ?
44. ആൾക്കൂട്ടത്തിൽ നിങ്ങൾ പരുങ്ങാറുണ്ടോ?

- 45. മറ്റുള്ളവരെക്കാൾ കൂടുതലായി നിങ്ങൾക്ക് അകാരണമായ ഉത്കണ്ഠ തോന്നാറുണ്ടോ?
- 46. മിക്ക ആളുകളെയും പോലെ നിങ്ങളും സന്തുഷ്ടരാണോ?
- 47. നിങ്ങളുടെ കുടുംബാംഗങ്ങൾ പെട്ടെന്ന് കോപിക്കുന്ന പ്രകൃതക്കാരാണോ?
- 48. നിങ്ങൾ എപ്പോഴും ദുഃഖിക്കാറുണ്ടോ?
- 49. കാര്യങ്ങൾ നടത്താനുള്ള ശക്തി ആർജ്ജിക്കാൻ നിങ്ങൾക്ക് ബുദ്ധിമുട്ട് അനുഭവപ്പെടാറുണ്ടോ?
- 50. നിങ്ങളുടെ സുഹൃത്തുക്കൾക്ക് നിങ്ങളെ വലിയ വിശ്വാസമാണെന്ന് തോന്നാറുണ്ടോ?
- 51. ഞാൻ അത്ര നല്ലതല്ല എന്ന തോന്നൽ നിങ്ങൾക്കുണ്ടാകാറുണ്ടോ?
- 52. അച്ഛനമ്മമാർ നിങ്ങളുടെ വികാരം മനസ്സിലാക്കാറുണ്ടോ?
- 53. നിങ്ങളുടെ സ്കൂൾ പഠനപ്രവർത്തനങ്ങൾ പരമാവധി നന്നായി ചെയ്തു തീർക്കാൻ നിങ്ങൾ ശ്രമിക്കാറുണ്ടോ?
- 54. നിങ്ങളുടെ ആശയങ്ങൾ മറ്റുള്ളവർക്ക് ഇഷ്ടപ്പെടുന്നുണ്ടോ?
- 55. നിങ്ങൾ ഒരു പരാജയമാണെന്ന് നിങ്ങളുടെ അച്ഛനമ്മമാർ കരുതാറുണ്ടോ?
- 56. നിങ്ങൾ ഒരു നല്ലകാര്യം ചെയ്താൽ സ്വയം അംഗീകരിക്കാൻ നിങ്ങൾക്ക് പ്രയാസമുണ്ടോ?
- 57. മറ്റു ആളുകളോട് സംസാരിക്കുവാൻ നിങ്ങൾക്ക് ബുദ്ധിമുട്ടുണ്ടോ?
- 58. സ്കൂളിൽ നിങ്ങളൊരു പരാജയം ആണോ?
- 59. നിങ്ങളുടെ അച്ഛനമ്മമാർക്ക് നിങ്ങളെ ഇഷ്ടമാണോ?
- 60. നിങ്ങളുടെ സ്കൂൾ പഠനപ്രവർത്തനങ്ങളിൽ നിങ്ങൾക്ക് അഭിമാനം തോന്നാറുണ്ടോ?
- 61. സ്വന്തം വീട്ടിൽ നിങ്ങൾക്ക് പലപ്പോഴും തിരിച്ചടി ഉണ്ടാകാറുണ്ടോ?
- 62. സ്കൂൾ പ്രവർത്തനങ്ങൾക്കായി നിങ്ങൾ കഠിനമായി പ്രയത്നിക്കാറുണ്ടോ?
- 63. സ്വയം തീരുമാനം എടുക്കാനും അതിൽ തന്നെ ഉറച്ചു നിൽക്കാനും നിങ്ങൾക്ക് ബുദ്ധിമുട്ട് ഉണ്ടാകാറുണ്ടോ?
- 64. നിങ്ങൾക്ക് നിങ്ങളെ തന്നെ തൃപ്തി ആണോ?
- 65. നിങ്ങൾക്ക് വിശ്വസ്തരായ സുഹൃത്തുക്കൾ ഉണ്ടോ?
- 66. സ്കൂൾ പ്രവർത്തനങ്ങൾ കഴിയുന്നതും കുറച്ചു പ്രയത്നം കൊണ്ട് കാര്യം നേടാൻ നിങ്ങൾ ശ്രമിക്കാറുണ്ടോ?
- 67. നിങ്ങളുടെ കുടുംബത്തിന് നിങ്ങളിൽ വിശ്വാസം ഉണ്ടെന്ന് തോന്നാറുണ്ടോ?

G



UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SELF ESTEEM INVENTORY

RESPONSE SHEET

വിദ്യാർത്ഥിയുടെ പേര് ക്ലാസ്സ് ക്ലാസ്സ് നമ്പർ
സ്കൂളിന്റെ പേര് ആൺകുട്ടി/പെൺകുട്ടി വയസ്സ്

Sl. No.			Sl. No.		
1	Yes	No	35	Yes	No
2	Yes	No	36	Yes	No
3	Yes	No	37	Yes	No
4	Yes	No	38	Yes	No
5	Yes	No	39	Yes	No
6	Yes	No	40	Yes	No
7	Yes	No	41	Yes	No
8	Yes	No	42	Yes	No
9	Yes	No	43	Yes	No
10	Yes	No	44	Yes	No
11	Yes	No	45	Yes	No
12	Yes	No	46	Yes	No
13	Yes	No	47	Yes	No
14	Yes	No	48	Yes	No
15	Yes	No	49	Yes	No
16	Yes	No	50	Yes	No
17	Yes	No	51	Yes	No
18	Yes	No	52	Yes	No
19	Yes	No	53	Yes	No
20	Yes	No	54	Yes	No
21	Yes	No	55	Yes	No
22	Yes	No	56	Yes	No
23	Yes	No	57	Yes	No
24	Yes	No	58	Yes	No
25	Yes	No	59	Yes	No
26	Yes	No	60	Yes	No
27	Yes	No	61	Yes	No
28	Yes	No	62	Yes	No
29	Yes	No	63	Yes	No
30	Yes	No	64	Yes	No
31	Yes	No	65	Yes	No
32	Yes	No	66	Yes	No
33	Yes	No	67	Yes	No
34	Yes	No			

**UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ATTITUDE TOWARDS SCIENCE
KAMALA S. PILLAI**

1. Scientific ideas and theories will remain as ultimate truths without any change.
2. The major problem of science is to make decisions such as to continue or not nuclear experiment, space experiments and the like.
3. Science contributes new knowledge and at the same time corrects its own mistakes.
4. Everyman has equal right to enjoy the benefits of scientific discoveries.
5. Science grows and changes with time.
6. When religious ideas contradict new scientific information, it is better to accept religious ideas.
7. Science is a way of action.
8. Science may be viewed as a way of thinking.
9. Science is beneficial only to the rich.
10. The growth and progress of humanities mainly due to the contributions of science.
11. Science is for science sake; not for the society.
12. The average man does not benefit from scientific advances.
13. The existing moral standards are explained better by the new contributions of science.
14. Science has upset the existing social system.
15. Mutual dependence of science and technology enhances technological development.
16. As science advances man becomes spiritually poor.
17. Without science progress of humanity would have been slow.
18. To unfold the secrets of nature is one of the functions of science.
19. The discoveries of a scientist should be judged on the basis of his past reputation and fame.
20. Scientists who attempt to go abroad and work there should be discouraged.

21. Scholarships for learning science should be distributed equally between boys and girls.
22. Potentialities of women for scientific endeavour should be capitalised.
23. National scholarship programme for training scientists should be limited to the scientists of India.
24. The new discoveries of science are the monopoly of the nations concerned.
25. To make scientific theories perfect scientists of different nations should exchange their theories and ideas.
26. Communication among scientists is not necessary for the growth of science.
27. Science should be developed only in accordance with the society's needs.
28. Freedom of investigation in science should be controlled for the welfare of the Nations.
29. Individual's freedom for research is of utmost importance in sciences.
30. A nation should control scientific investigations directly.
31. Science and authoritarianism will not go together.
32. Scientific advances depend on how much freedom for action and thought is given to scientists.
33. Science had done more harm than good.
34. Science is not needed for cultural progress.
35. It is not right to give up scientific endeavour because it does not bring forth material benefit to man.
36. Modern science and its inventions are responsible for man's personal discontent and disappointment.
37. Time saved from mechanisation can be utilised for more creative works.
38. Man would have continued to be an uncultured race in the absence of scientific development.
39. Mechanisation due to advances in science and technology results in unemployment problems.
40. In the long run man's lot will be improved by scientific knowledge.



UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ATTITUDE TOWARDS SCIENCE

RESPONSE SHEET

Sl. No.	പരിപൂർണ്ണമായി യോജിക്കുന്നു A	യോജിക്കുന്നു B	നിഷ്പക്ഷം C	വിയോജിക്കുന്നു D	ശക്തിയായി വിയോജിക്കുന്നു E
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF ATTITUDE TOWARDS ACADEMIC WORK

(Draft Form)

DR. USHA .P AND SUCHITRA. K

നിർദ്ദേശങ്ങൾ

താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകൾ നിങ്ങളുടെ പഠന പ്രവർത്തനങ്ങളോടുള്ള മനോഭാവം എന്താണെന്ന് അറിയാൻ ഉദ്ദേശിച്ചിട്ടുള്ളവയാണ്.

ഓരോ പ്രസ്താവനയും വായിച്ച ശേഷം അതിനെക്കുറിച്ചുള്ള നിങ്ങളുടെ പ്രതികരണം 'യോജിക്കുന്നു', 'നിഷ്പക്ഷം', 'വിയോജിക്കുന്നു' എന്ന രീതിയിലാണ് രേഖപ്പെടുത്തേണ്ടത്.

ഇതിനായി പ്രസ്താവനകളുടെ ക്രമനമ്പരകൾക്കെതിരെ A (യോജിക്കുന്നു), B (നിഷ്പക്ഷം), C (വിയോജിക്കുന്നു) എന്ന് സൂചിപ്പിച്ചുകൊണ്ട് മൂന്ന് വൃത്തങ്ങളിൽ പ്രത്യേക Response Sheet ഉം നിങ്ങൾക്ക് തരുന്നുണ്ട്.

ഓരോ പ്രസ്താവനക്കുമെതിരെ നിങ്ങളുടെ പ്രതികരണം യോജിക്കുന്നു എന്നാണെങ്കിൽ A എന്ന വൃത്തത്തിലും, നിഷ്പക്ഷമാണെങ്കിൽ B എന്ന വൃത്തത്തിലും, വിയോജിക്കുന്നു എന്നാണെങ്കിൽ C എന്ന വൃത്തത്തിലും 'X' അടയാളമിടുക.

ഉദാ: ക്ലാസ്സു പരീക്ഷ ആയാൽപ്പോലും പരീക്ഷയിൽ തോൽക്കുമ്പോൾ വലിയ വിഷമം തോന്നാറുണ്ട്.

A

B

C

ഈ ഉദാഹരണത്തിൽ A എന്ന കോളത്തിലുള്ള വൃത്തത്തിലാണ് അടയാളം ഇട്ടിരിക്കുന്നത്. ഉത്തരം എഴുതുന്ന ആൾ ഈ പ്രസ്താവനയോട് യോജിക്കുന്നു എന്നതാണ് ഇത് സൂചിപ്പിക്കുന്നത്.

എല്ലാപ്രസ്താവനകൾക്കും മുകളിൽ നിർദ്ദേശിച്ചിരിക്കുന്നതുപോലെ നിങ്ങളുടെ പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കുക.

-
1. ക്ലാസ്സു പരീക്ഷ ആയാൽപ്പോലും പരീക്ഷയിൽ തോൽക്കുമ്പോൾ വലിയ വിഷമം തോന്നാറുണ്ട്.
 2. ഇന്നത്തെ സ്കൂൾ വിദ്യാഭ്യാസം, സിലബസ് അനുസരിച്ചുള്ള പഠനത്തിന് അമിതമായ പ്രാധാന്യം നൽകുന്നു.
 3. എല്ലാ ദിവസവും അധ്യാപകൻ തലേ ദിവസത്തെ പാഠങ്ങളിൽ നിന്നും ചോദ്യങ്ങൾ ചോദിക്കുന്നത് പഠനം ഹൃദിസ്തമാക്കാൻ സഹായിക്കുന്നു.

4. കളിയിൽ തോറ്റാൽ ക്ലാസ്സിലെ പാഠം പഠിക്കാൻ ഉത്സാഹം തോന്നുകയില്ല.
5. പഠിക്കാനുള്ള കാലം ശരിയായ രീതിയിൽ പ്രയോജനപ്പെടുത്തിയില്ലെങ്കിൽ പിന്നീട് ദുഃഖി ക്കേണ്ടി വരും.
6. പകൽ സമയം മിക്കവാറും ക്ലാസ്സ് പഠനത്തിന് ചെലവഴിച്ചശേഷം വീട്ടിലും അതേപോലെ പഠിക്കണമെന്നു പറയുന്നത് സങ്കടമാണ്.
7. അവധി ദിവസങ്ങളിലും ക്ലാസ്സ് പ്രവർത്തിച്ചാൽ പഠിപ്പിച്ചു തീർത്ത ഭാഗങ്ങൾ പഠിച്ചുറപ്പി ക്കാൻ സാധിക്കാതെ വരും.
8. എല്ലാ പാഠഭാഗങ്ങളും അദ്ധ്യാപകൻ ക്ലാസ്സിൽ നേരിട്ട് പഠിപ്പിക്കണമെന്നില്ല. സ്വന്തമായി പഠിക്കാൻ വേണ്ട മാർഗ്ഗ നിർദ്ദേശം തന്നാലും മതി.
9. സ്കൂളിൽ നിന്നും പഠിക്കുന്ന പാഠങ്ങൾ നിത്യജീവിതത്തിൽ ഒരു തൊഴിൽ ചെയ്യാൻ ഉപ കരിക്കുന്നില്ല.
10. ഏതു പ്രതികൂല സാഹചര്യം ഉണ്ടായാലും സ്കൂൾ പഠനം നിർത്താൻ ആഗ്രഹിക്കു ന്നില്ല.
12. ശാസ്ത്രപഠനത്തിൽ ആൺകുട്ടികളും പെൺകുട്ടികളും ഒരേ നിലവാരം പുലർത്താറുണ്ട്.
13. ശാസ്ത്രപഠനത്തിൽ ക്ലാസ്സുമുറിക്ക് പുറത്തുള്ള പഠന പ്രവർത്തനങ്ങൾ ബുദ്ധിമുട്ട് ഉണ്ടാക്കാം.
14. ആൺകുട്ടികളും പെൺകുട്ടികളും ഒരുമിച്ച് ശാസ്ത്രവിഷയങ്ങൾ പഠിക്കുകയാണെങ്കിൽ പാഠങ്ങൾ കൂടുതൽ ഹൃദിസ്തമാക്കാമായിരുന്നു.
15. സുഹൃത്തുക്കളുമായി ഒരുമിച്ചിരുന്ന് പഠിക്കുമ്പോൾ വേഗത്തിൽ പഠിച്ചു തീർക്കാൻ കഴിയും.
16. പഠനത്തിൽ മിടുക്കരായ കുട്ടികളുടെ പഠനരീതി അനുകരിക്കാവുന്നതാണ്.
17. എത്ര ബുദ്ധിമുട്ടി പഠിച്ചാലും ഭാഗ്യം ഇല്ലെങ്കിൽ വിജയിക്കാൻ സാധ്യമല്ല എന്ന് തോന്നാ റുണ്ട്.
18. ശിക്ഷണ നടപടികളെ പേടിച്ച് പാഠങ്ങൾ പഠിക്കുന്നത്.
19. ഏൽപ്പിക്കുന്ന പാഠ്യപ്രവർത്തനങ്ങൾ സ്വന്തം കഴിവ് ഉപയോഗിച്ച് തനിയെ ചെയ്ത് തീർക്കുന്നതാണ് ഉത്തമം.
20. കൃത്യമായി ക്ലാസ്സിൽ ഹാജരായി പഠന പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടാത്ത കുട്ടികൾക്ക് നഷ്ടപ്പെടുന്നതെന്താണെന്ന് അവർക്കറിയില്ല.
21. എത്ര വിഷമമേറിയ പാഠമായാലും കഴിവതും പരസഹായം കൂടാതെ പഠിക്കാൻ ശ്രമി ക്കേണ്ടതാണ്.
22. പഠനത്തിൽ അതീവ ശ്രദ്ധ ചെലുത്തുന്ന ഒരു കുട്ടിക്ക് വിദ്യാർത്ഥി ജീവിതത്തിലെ രസ കരമായ പല അനുഭവങ്ങളും നഷ്ടമാകുന്നു.
23. വീട്ടിൽ വച്ച് പഠിക്കാൻ സൗകര്യം ലഭിക്കാത്തവർക്ക് സ്കൂളിൽ വെച്ചു തന്നെ പഠിക്കാൻ പരമാവധി സൗകര്യം നൽകണം.
24. ഇടക്കിടെ പരീക്ഷ നടത്തിയാൽ പഠനം വിരസമാകുകയേ ഉള്ളൂ.
25. ഏതെങ്കിലും ഒരു തൊഴിൽ ലഭിക്കുകയാണെങ്കിൽ സ്കൂൾ പഠനം നിർത്തിപോകാനും എനിക്ക് മടിയില്ല.
26. മുൻകൂട്ടി നിശ്ചയിക്കാത്ത അവധികൾ വരുന്നതുകൊണ്ട് സ്കൂളിൽ നിന്ന് കിട്ടുന്ന പഠനാ വസരം പരമാവധി പ്രയോജനപ്പെടുത്തണം.
27. ഇലക്ട്രോണിക് മാധ്യമങ്ങളിലൂടെയുള്ള വിനോദങ്ങളിൽ ഏർപ്പെടുന്ന വിദ്യാർത്ഥി വില യേറിയ പഠന സമയം പാഴാക്കിക്കളയുകയാണ് ചെയ്യുന്നത്.

- 28. നൂതന പഠന സൗകര്യമുള്ള ഇന്നത്തെ തലമുറയിലെ വിദ്യാർത്ഥികൾക്ക് സ്കൂൾ വിഷയങ്ങൾ പഠിക്കുന്നതിന് ഇപ്പോൾ ഉള്ളതിലും കുറച്ച് സാധ്യമായ ദിവസങ്ങൾ മതിയാകും.
- 29. മറ്റുള്ളവർ നിർബന്ധിക്കുന്നതുകൊണ്ടാണ് ഞാൻ പഠിക്കുന്നത്.
- 30. ഓരോ ദിവസവും മുൻകൂട്ടി നിശ്ചയിച്ച പ്രകാരം പാഠഭാഗം പഠിച്ചു തീർക്കുന്നതാണ് ഉത്തമം.
- 31. പഠിക്കാൻ ബുദ്ധിമുട്ടുള്ള പാഠഭാഗങ്ങൾ ആദ്യം പഠിച്ചു ഉറപ്പിക്കേണ്ടതാണ് (ദ്യുവമാക്കേണ്ടതാണ്).
- 32. ഓരോ ദിവസവും ക്ലാസ്സിൽ പഠിപ്പിക്കുന്ന പാഠഭാഗങ്ങൾ അന്നന്നു പഠിച്ചു തീർക്കണമെന്ന് അധ്യാപകൻ നിർബന്ധിക്കുമെങ്കിലും ക്ലാസ്സ് വിജയത്തിന് അങ്ങനെ ചെയ്തേ തീരൂ എന്നില്ല.
- 33. ക്ലാസ്സിലെ പാഠങ്ങൾ പഠിക്കാൻ എനിക്ക് രസം തോന്നാറില്ല.
- 34. പാഠ്യവിഷയങ്ങൾക്ക് ഇന്ന് കൽപ്പിക്കുന്നിടത്തോളം പ്രാധാന്യം കൊടുക്കേണ്ടതില്ല.
- 35. പാഠ്യ വിഷയങ്ങൾ പഠിക്കുന്നതിനേക്കാൾ പാഠ്യേതര പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടുന്നതാണ് രസകരം.
- 36. സമരങ്ങളിൽ പങ്കെടുത്ത് പഠന സന്ദർഭങ്ങൾ നഷ്ടപ്പെടുത്തുന്ന പ്രവണത വിദ്യാർത്ഥികൾ ഉപേക്ഷിക്കേണ്ടതാണ്.
- 37. ഇപ്പോഴുള്ളതിൽ കൂടുതൽ അവധി ദിവസങ്ങൾ വിദ്യാർത്ഥികൾക്ക് കൊടുക്കേണ്ടതില്ല.
- 38. സ്കൂളിൽ ഇപ്പോഴുള്ള പഠനസമയം ക്ലാസ്സുമുറിയിലുള്ള പഠനം, പാഠ്യേതര പ്രവർത്തനം, വിനോദം, അഭ്യാസം ചെയ്യുക എന്നിവക്കായി പുനർക്രമീകരിക്കേണ്ടതാണ്.
- 39. വിദ്യാർത്ഥികൾ ക്ലാസ്സിൽ എല്ലാ ദിവസവും ഹാജരാകാൻ നിർബന്ധിക്കേണ്ടതാണ്.
- 40. മുൻപാഠങ്ങൾ പഠിക്കാതെ ക്ലാസ്സിൽ വരുന്ന കുട്ടികളെ ശിക്ഷിച്ചു പഠിപ്പിക്കണം.
- 41. ക്ലാസ്സിൽ അധ്യാപനത്തിന് ഇടക്ക് ലഭിക്കുന്ന വേളകൾ അഭ്യാസം ചെയ്യാനോ, ലൈബ്രറി പുസ്തകങ്ങൾ വായിക്കാനോ പ്രയോജനപ്പെടുത്തുന്ന കുട്ടികളെ അവഗണിക്കണം.
- 42. പഠനകാലം കഴിയുന്നതുവരെ മറ്റ് കാര്യങ്ങളിൽ ഇടപെടാതെ പഠിത്തത്തിൽ തന്നെ ശ്രദ്ധ പതിപ്പിക്കണം.
- 43. നല്ല മാർക്കു വാങ്ങുവാൻ ഏതു രീതി അവലംബിക്കുന്നതും തെറ്റല്ല.
- 44. പഠനകാര്യത്തിൽ കർക്കശമായ രീതി (Strict) അധ്യാപകർ അനുശാസിച്ചാൽ വിജയ സാധ്യത കൂടും.
- 45. പഠന സംബന്ധമായ കാര്യങ്ങൾ (Tasks) ചെയ്ത് തീർത്തതിനുശേഷം മറ്റു കാര്യങ്ങൾ ഏറ്റെടുത്ത് ചെയ്യുന്നതാണ് ശരി.

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ATTITUDE TOWARDS ACADEMIC WORK

DR. USHA .P AND SUCHITRA .K

നിർദ്ദേശങ്ങൾ

താഴെകൊടുത്തിരിക്കുന്ന പ്രസ്താവനകൾ നിങ്ങളുടെ പഠന പ്രവർത്തനങ്ങളോടുള്ള മനോഭാവം എന്താണെന്ന് അറിയാൻ ഉദ്ദേശിച്ചിട്ടുള്ളവയാണ്.

ഓരോ പ്രസ്താവനയും വായിച്ചശേഷം അതിനെക്കുറിച്ചുള്ള നിങ്ങളുടെ പ്രതികരണം 'യോജിക്കുന്നു', 'നിഷ്പക്ഷം', 'വിയോജിക്കുന്നു' എന്ന രീതിയിലാണ് രേഖപ്പെടുത്തേണ്ടത്.

ഇതിനായി പ്രസ്താവനകളുടെ ക്രമനമ്പരകൾക്കെതിരെ A (യോജിക്കുന്നു), B (നിഷ്പക്ഷം), C (വിയോജിക്കുന്നു) എന്ന് സൂചിപ്പിച്ചുകൊണ്ട് മൂന്ന് വൃത്തങ്ങളിൽ പ്രത്യേക Response Sheet ഉം നിങ്ങൾക്ക് തരുന്നുണ്ട്

ഓരോ പ്രസ്താവനക്കുമെതിരെ നിങ്ങളുടെ പ്രതികരണം യോജിക്കുന്നു എന്നാണെങ്കിൽ A എന്ന വൃത്തത്തിലും നിഷ്പക്ഷമാണെങ്കിൽ B എന്ന വൃത്തത്തിലും , വിയോജിക്കുന്നു എന്നാണെങ്കിൽ C എന്ന വൃത്തത്തിലും X അടയാളമിടുക.

ഉദാ : ക്ലാസ്സു പരീക്ഷ ആയാൽപ്പോലും പരീക്ഷയിൽ തോൽക്കുമ്പോൾ വലിയ വിഷമം തോന്നാറുണ്ട്.



ഈ ഉദാഹരണത്തിൽ A എന്ന കോളത്തിലുള്ള വൃത്തത്തിലാണ് അടയാളം ഇട്ടിരിക്കുന്നത്. ഉത്തരം എഴുതുന്ന ആൾ ഈ പ്രസ്താവനയോട് യോജിക്കുന്നു എന്നതാണ് ഇത് സൂചിപ്പിക്കുന്നത്.

എല്ലാ പ്രസ്താവനകൾക്കും മുകളിൽ നിർദ്ദേശിച്ചിരിക്കുന്നതുപോലെ നിങ്ങളുടെ പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കുക.

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1. ഇന്നത്തെ സ്കൂൾ വിദ്യാഭ്യാസം, സിലബസ് അനുസരിച്ചുള്ള പഠനത്തിന് അമിതമായ പ്രാധാന്യം നൽകുന്നു.
 2. എല്ലാ ദിവസവും അദ്ധ്യാപകൻ തലേ ദിവസത്തെ പാഠങ്ങളിൽ നിന്നും ചോദ്യങ്ങൾ ചോദിക്കുന്നത് പാഠം ഹൃദിസ്തമാക്കാൻ സഹായിക്കുന്നു.
 3. കളിയിൽ തോറ്റാൽ ക്ലാസ്സിലെ പാഠം പഠിക്കാൻ ഉത്സാഹം തോന്നുകയില്ല
 4. പഠിക്കാനുള്ള കാലം ശരിയായ രീതിയിൽ പ്രയോജനപ്പെടുത്തിയില്ലെങ്കിൽ പിന്നീട് ദുഃഖിക്കേണ്ടിവരും.
 5. പകൽ സമയം മിക്കവാറും ക്ലാസ്സ് പഠനത്തിന് ചെലവഴിച്ച ശേഷം വീട്ടിലും അതേപോലെ പഠിക്കണമെന്നു പറയുന്നത് സങ്കടമാണ്.
 6. സ്കൂളിൽ നിന്നും പഠിക്കുന്ന പാഠങ്ങൾ നിത്യജീവിതത്തിൽ ഒരു തൊഴിൽ ചെയ്യാൻ ഉപകരിക്കുന്നില്ല.

7. പഠിക്കാൻ മറ്റ് സാഹചര്യം ഉണ്ടെങ്കിൽ ക്ലാസ്സിൽ നിശ്ചിത ശതമാനം ഹാജർ വേണമെന്ന് നിർബന്ധിക്കേണ്ടതില്ല.
8. സുഹൃത്തുക്കളുമായി ഒരുമിച്ചിരുന്ന് പഠിക്കുമ്പോൾ വേഗത്തിൽ പഠിച്ചു തീർക്കാൻ കഴിയും
9. പഠനത്തിൽ മിടുക്കരായ കുട്ടികളുടെ പഠനരീതി അനുകരിക്കാവുന്നതാണ്.
10. എത്ര ബുദ്ധിമുട്ടി പഠിച്ചാലും ഭാഗ്യം ഇല്ലെങ്കിൽ വിജയിക്കാൻ സാധ്യമല്ല എന്ന് തോന്നാറുണ്ട്
11. ശിക്ഷണ നടപടികളെ പേടിച്ചാണ് പാഠങ്ങൾ പഠിക്കുന്നത്
12. ഏൽപ്പിക്കുന്ന പാഠ്യപ്രവർത്തനങ്ങൾ സ്വന്തം കഴിവ് ഉപയോഗിച്ച് തനിയെ ചെയ്ത് തീർക്കുന്നതാണ് ഉത്തമം
13. കൃത്യമായി ക്ലാസ്സിൽ ഹാജരായി പഠനപ്രവർത്തനങ്ങളിൽ ഏർപ്പെടാത്ത കുട്ടികൾക്ക് നഷ്ടപ്പെടുന്നതെന്താണെന്ന് അവർക്കറിയില്ല.
14. പഠനത്തിൽ അതീവ ശ്രദ്ധ ചെലുത്തുന്ന ഒരു കുട്ടിക്ക് വിദ്യാർത്ഥി ജീവിതത്തിലെ രസകരമായ പല അനുഭവങ്ങളും നഷ്ടമാകുന്നു.
15. ഇടക്കിടെ പരീക്ഷ നടത്തിയാൽ പഠനം വിരസമാകുകയേ ഉള്ളൂ
16. ഏതെങ്കിലും ഒരു തൊഴിൽ ലഭിക്കുകയാണെങ്കിൽ സ്കൂൾ പഠനം നിർത്തി പോകാനും എനിക്ക് മടിയില്ല
17. മുൻകൂട്ടി നിശ്ചയിക്കാത്ത അവധികൾ വരുന്നതുകൊണ്ട് സ്കൂളിൽ നിന്ന് കിട്ടുന്ന പഠനാവസരം പരമാവധി പ്രയോജനപ്പെടുത്തണം
18. ഇലക്ട്രോണിക് മാധ്യമങ്ങളിലൂടെയുള്ള വിനോദങ്ങളിൽ ഏർപ്പെടുന്ന വിദ്യാർത്ഥി വിലയേറിയ പഠനസമയം പാഴാക്കിക്കളയുകയാണ് ചെയ്യുന്നത്
19. മറ്റുള്ളവർ നിർബന്ധിക്കുന്നതുകൊണ്ടാണ് ഞാൻ പഠിക്കുന്നത്
20. പഠിക്കാൻ ബുദ്ധിമുട്ടുള്ള പാഠഭാഗങ്ങൾ ആദ്യം പഠിച്ചു ഉറപ്പിക്കേണ്ടതാണ്.
21. ഓരോ ദിവസവും ക്ലാസ്സിൽ പഠിപ്പിക്കുന്ന പാഠഭാഗങ്ങൾ അന്നന്നു പഠിച്ചു തീർക്കണമെന്ന് അധ്യാപകൻ നിർബന്ധിക്കുമെങ്കിലും ക്ലാസ്സ് വിജയത്തിന് അങ്ങനെ ചെയ്തേ തീരൂ എന്നില്ല.
22. പാഠ്യവിഷയങ്ങൾക്ക് ഇന്ന് കൽപ്പിക്കുന്നിടത്തോളം പ്രാധാന്യം കൊടുക്കേണ്ടതില്ല
23. സമരങ്ങളിൽ പങ്കെടുത്ത് പഠന സന്ദർഭങ്ങൾ നഷ്ടപ്പെടുത്തുന്ന പ്രവണത വിദ്യാർത്ഥികൾ ഉപേക്ഷിക്കേണ്ടതാണ്
24. ഇപ്പോഴുള്ളതിൽ കൂടുതൽ അവധി ദിവസങ്ങൾ വിദ്യാർത്ഥികൾക്ക് കൊടുക്കേണ്ടതില്ല.
25. വിദ്യാർത്ഥികൾ ക്ലാസ്സിൽ എല്ലാദിവസവും ഹാജരാകാൻ നിർബന്ധിക്കേണ്ടതാണ്
26. മുൻപാഠങ്ങൾ പഠിക്കാതെ ക്ലാസ്സിൽവരുന്ന കുട്ടികളെ ശിക്ഷിച്ചു പഠിപ്പിക്കണം
27. ക്ലാസ്സിൽ അധ്യാപനത്തിന് ഇടക്ക് ലഭിക്കുന്ന വേളകൾ അഭ്യാസം ചെയ്യാനോ, ലൈബ്രറി പുസ്തകങ്ങൾ വായിക്കാനോ പ്രയോജനപ്പെടുത്തുന്ന കുട്ടികളെ അവഗണിക്കണം
28. പഠനകാലം കഴിയുന്നതുവരെ മറ്റ് കാര്യങ്ങളിൽ ഇടപെടാതെ പഠിത്തത്തിൽ തന്നെ ശ്രദ്ധ പതിപ്പിക്കണം
29. നല്ല മാർക്കു വാങ്ങുവാൻ ഏതു രീതി അവലംബിക്കുന്നതും തെറ്റല്ല
30. പഠനകാര്യത്തിൽ കർക്കശമായി രീതി (Strict) അധ്യാപകർ അനുശാസിച്ചാൽ വിജയസാധ്യത കൂടും

SCALE OF ATTITUDE TOWARDS ACADEMIC WORK
(Approximate English Translation)

1. Undue emphasis is given for syllabus – based learning in the present school education.
2. Asking questions from the previous day's lessons enable me to comprehend the lessons.
3. I will not be in a mood to study if I lose in games.
4. If you do not utilise the opportunity for studies properly now, you will regret later.
5. To be insisted to study at house even after spending whole day for class study will be sad.
6. What is learned from school may not help for a job in actual life.
7. If other facilities are available for studies, compulsory attendance in class need not be insisted.
8. Learning becomes faster when combined study with friends is adopted.
9. Learning strategies of able students can be imitated.
10. Even if you work hard, you may not succeed unless you are not lucky enough.
11. Fear of punishment makes one to study class lessons.
12. It is better to carry out and complete the assigned learning task according to one's own ability.
13. Children may not be aware of what they are losing if they fail to attend classes regularly and take up learning tasks.
14. Student who concentrate utmost may be denied of many interesting experiences in life.
15. Frequent examinations make study uninteresting.
16. If I get a job, I do not mind discontinuing studies.

17. Since there are many undeclared holidays in these days, it is better to use the learning opportunities from school to the maximum extent.
18. A student engaged in games through electronic media may be wasting his / her valuable time for studies.
19. I am studying because others compel me to do so.
20. It is better to learn thoroughly difficult lessons at first.
21. Even if class teacher insists that each day's lesson must be learned on that day itself, success in the class may not depend on that practice.
22. Much importance need not be given for the present day school subjects.
23. Students should abandon the tendency to lose the opportunity for studying by taking part in strikes.
24. It is not necessary to give more holidays than given at present.
25. Compulsory attendance in the class regularly need not be insisted.
26. Students who come to the class without studying the previous day's lessons need to be punished.
27. Students who work on assignments, read additional book from library during interval time may be neglected.
28. It is better to concentrate in class studies without engaging in non-academic activities till the period of school education is over.
29. In order to get grades in the class, there is no harm in adopting any means.
30. If teachers adopt strict measures in studies of their student, the result will be more successful.

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ATTITUDE TOWARDS ACADEMIC WORK

RESPONSE SHEET

വിദ്യാർത്ഥിയുടെ പേര് ക്ലാസ്സ് ക്ലാസ്സ് നമ്പർ
സ്കൂളിന്റെ പേര് ആൺകുട്ടി/പെൺകുട്ടി വയസ്സ്

Sl. No.	യോജിക്കുന്നു A	നിഷ്പക്ഷം B	വിയോജിക്കുന്നു C		യോജിക്കുന്നു A	നിഷ്പക്ഷം B	വിയോജിക്കുന്നു C
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	16	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	17	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	18	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	19	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	21	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	22	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	23	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	24	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	25	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	26	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	27	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	28	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	29	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	30	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. വാവലുകൾ അവയുടെ സഞ്ചാരപഥത്തിലുള്ള തടസ്സം മനസ്സിലാക്കുന്നത് എങ്ങനെ?
 - A. കാഴ്ചശക്തി കൊണ്ട്
 - B. സ്പർശന ശക്തികൊണ്ട്
 - C. സൂപ്പർസോണിക് തരംഗങ്ങളുടെ സഹായത്താൽ
 - D. അൾട്രാ സോണിക് തരംഗങ്ങളുടെ സഹായത്താൽ
4. താഴെകൊടുത്തിരിക്കുന്നവയിൽ വൈദ്യുത ചാലകം ഏത് ?
 - A. പ്ലാസ്റ്റിക്
 - B. അലൂമിനിയം
 - C. റബ്ബർ
 - D. വജ്രം
5. ഒരു കാന്തത്തിന്റെ രണ്ടുഗ്രന്ഥങ്ങൾക്കു പറയുന്ന പേരെന്ത്?
 - A. പോസിറ്റീവും നെഗറ്റീവും
 - B. നീലയും ചുവപ്പും
 - C. ആനോഡും കാഥോഡും
 - D. ഉത്തരധ്രുവവും , ദക്ഷിണധ്രുവവും.
6. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ചലനാത്മകത കൂടുതലുള്ള ദ്രാവകം ഏത് ?
 - A. തേൻ
 - B. മെർക്കുറി
 - C. മണ്ണെണ്ണ
 - D. ആവണക്കെണ്ണ
7. പ്രതിബിംബത്തെ സംബന്ധിച്ച താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ കോൺവെക്സ് ലെൻസിന് ബാധകമായത് ഏത് ?
 - A. എല്ലായ്പ്പോഴും വലുത്
 - B. എല്ലായ്പ്പോഴും ചെറുത്
 - C. എല്ലായ്പ്പോഴും യഥാർത്ഥം
 - D. ചിലപ്പോൾ യഥാർത്ഥവും ചിലപ്പോൾ മിഥ്യയും
8. അബ്സല്യൂട്ട് സീറോ സൂചിപ്പിക്കുന്ന ഊഷ്മാവ് എത്ര?
 - A. 0°C
 - B. 100°C
 - C. -273°C
 - D. 273°C
9. ഒരേയിനം തന്മാത്രകൾ തമ്മിലുള്ള ആകർഷണ ബലമേത് ?
 - A. പ്രതലബലം
 - B. കൊഹിഷൻ ബലം
 - C. അഡ്ഹിഷൻ ബലം
 - D. വിസ്കസ് ബലം
10. ശക്തിയേറിയ സ്ഥിരകാന്തങ്ങൾ നിർമ്മിക്കുന്നതിന് ഉപയോഗിക്കുന്ന പദാർത്ഥമേത് ?
 - A. നിക്രോം
 - B. ഡുറാലൂമിൻ
 - C. ടങ്സ്റ്റൺ
 - D. അൽനിക്കോ
11. കുതിരപ്പുറത്തിരിക്കുന്ന ഒരു സവാരിക്കാരൻ കുതിര പെട്ടെന്ന് മുന്നോട്ട് ഓടുമ്പോൾ പിന്നിലേക്ക് ചായുന്നു. ഇതിന് കാരണമെന്ത്?
 - A. ശരീരത്തിന്റെ താഴ്ഭാഗം ജഡത്വത്തിൽ തുടരുകയും മുകൾഭാഗം ചലിക്കുകയും ചെയ്യുന്നതിനാൽ
 - B. ശരീരത്തിന്റെ മുകൾഭാഗം ജഡത്വത്തിൽ തുടരുകയും താഴ്ഭാഗം ചലിക്കുകയും ചെയ്യുന്നതിനാൽ
 - C. ശരീരത്തിന്റെ മുകൾഭാഗം ചലനജഡത്വത്തിൽ തുടരുകയും താഴ്ഭാഗം നിൽക്കുകയും ചെയ്യുന്നതിനാൽ
 - D. ശരീരത്തിന്റെ താഴ്ഭാഗം ചലനജഡത്വത്തിൽ തുടരുകയും മുകൾഭാഗം നിൽക്കുകയും ചെയ്യുന്നതിനാൽ
12. ഗുരുത്വാകർഷണ സ്ഥിരാങ്കത്തിന്റെ മൂല്യം എത്രയാണ്?
 - A. $6.67 \times 10^{-11} \text{ Nm}^2 \text{ x kg}^{-2}$
 - B. $6.67 \times 10 \text{ Nm}^2 \text{ x kg}^{-2}$
 - C. $6.67 \times 10^{11} \text{ Nm}^2 \text{ x kg}^{-2}$
 - D. $6.07 \times 10^{-11} \text{ Nm}^2 \text{ x kg}^{-2}$
13. ഭൂമിയുടെ കേന്ദ്രത്തിൽ ഒരു വസ്തുവിന്റെ ഭാരം എന്തായിരിക്കും?
 - A. പൂജ്യം
 - B. വസ്തുവിന്റെ യഥാർത്ഥ ഭാരം
 - C. വസ്തുവിന്റെ യഥാർത്ഥ ഭാരത്തേക്കാൾ കുറവ്
 - D. വസ്തുവിന്റെ യഥാർത്ഥ ഭാരത്തേക്കാൾ കൂടുതൽ

14. ഒരു യൂണിറ്റ് മാസ് പദാർത്ഥം അവസ്ഥാ പരിവർത്തനം നടക്കുമ്പോൾ സ്വീകരിക്കുന്ന താപപരിമാണത്തെ എന്തുവിളിക്കും ?

A. ലീനതാപം	B. തിളനില
C. ബാഷ്പീകരണ ലീനതാപം	D. വിശിഷ്ട താപധാരിത

15. കറന്റ് അളക്കുന്നതിനുള്ള ഉപകരണം ഏത്?

A. അമ്മീറ്റർ	B. റിയോസ്റ്റാറ്റ്
C. പ്രതിരോധ പേടകം	D. വോൾട്ട് മീറ്റർ

16. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ അനുപ്രസ്ത തരംഗമല്ലാത്തത് ഏത് ?

A. ജലതരംഗം	B. സ്പ്രിംഗിലെ തരംഗം
C. ശബ്ദതരംഗം	D. പ്രകാശ തരംഗം

17. ഒരു ലെൻസിന്റെ പവർ +4 ഡയോപ്റ്റർ ആണ്. അതിന്റെ ഫോക്കസ് ദൂരം +25 സെ.മീ. ഇത് ഏതു തരം ലെൻസ് ആണ്?

A. സംവ്രജന ലെൻസ്	B. പ്ലെയിൻ ഗ്ലാസ്സ്
C. വിവ്രജന ലെൻസ്	D. കട്ട് ഗ്ലാസ്സ്

18. താഴെകൊടുത്തിരിക്കുന്നവയിൽ വിദ്യുത് രോധി ഏത്?

A. കാർബൺ	B. അയൺ
C. റബ്ബർ	D. ചെമ്പ്

19. ഏറ്റവും ഉയരത്തിൽ എത്തുമ്പോൾ ഒരു കല്ലിന്റെ സ്ഥാനികോർജ്ജം എത്രയായിരിക്കും?

A. $3 \times 10^8 \text{m/sec}^2$	B. $3.28 \times 10^8 \text{m/sec}^2$
C. 0	D. 0.25

20. ജലത്തിന്റെ വിശിഷ്ടതാപധാരിത എത്ര?

A. $4.18 \times 10^3 \text{J/Kg}^\circ\text{C}$	B. $0.24 \times 10^3 \text{J/Kg}^\circ\text{C}$
C. $0.48 \times 10^3 \text{J/kg}^\circ\text{C}$	D. $0.50 \times 10^3 \text{J/K}^\circ\text{C}$

21. ഒരേ ഊഷ്മാവിലും മർദ്ദത്തിലും സ്ഥിതി ചെയ്യുന്ന എല്ലാ വാതകങ്ങളുടേയും തുല്യവ്യാപ്തത്തിൽ കാണുന്ന തന്മാത്രകളുടെ എണ്ണം തുല്യമായിരിക്കും. ഇത് ഏത് നിയമമാണ്?

A. ബോയിൽ നിയമം	B. അവഗാഡ്രോ നിയമം
C. ഓം നിയമം	D. ചാൾസ് നിയമം

22. ഒരു കാറിന് ഏറ്റവും കൂടുതൽ ഘർഷണം അനുഭവപ്പെടുന്നത് താഴെ കൊടുത്തിരിക്കുന്ന ഏത് സാഹചര്യത്തിലാണ്?

A. കാർ സഞ്ചരിക്കാൻ ആരംഭിക്കുമ്പോൾ
B. കാർ സമവേഗതയിൽ സഞ്ചരിക്കുമ്പോൾ
C. കാർ അതിവേഗത്തിൽ സഞ്ചരിക്കുമ്പോൾ
D. കാർ സമതരണത്തിൽ സഞ്ചരിക്കുമ്പോൾ

23. ഭൂമദ്ധ്യരേഖയിൽ ഒരു വസ്തുവിന്റെ ഭാരം 5 കി.ലോ. ആ വസ്തുവിന്റെ ഉത്തരധ്രുവത്തിൽ ഉള്ള ഭാരം താഴെകൊടുത്തിരിക്കുന്നവയിൽ ഏതാണ്?

A. $< 5 \text{ kg}$	B. $> 5 \text{ Kg}$
C. 25 kg	D. 0

24. മനുഷ്യ ശരീരത്തിന്റെ ഊഷ്മാവ് 37°C ആണ്. കെൽവിൻ സ്കെയിൽ പ്രകാരം ഇതെത്രയായിരിക്കും?

A. 37 K	B. 100 K
C. 236 K	D. 310 K

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25. ന്യൂട്ടന്റെ രണ്ടാം ചലനനിയമം ഏത് പ്രതിഭാസത്തെ കുറിക്കുന്നു?

A. ത്വരണം	B. ബലം
C. ആക്കം	D. മർദ്ദം
26. ഒരു പ്രകാശരശ്മി വായുവിൽ നിന്ന് ഗ്ലാസിലേക്ക് പ്രവേശിക്കുന്നു. പതനകോൺ വർദ്ധിപ്പിക്കുമ്പോൾ അപവർത്തനകോണിന് എന്ത്മാറ്റം സംഭവിക്കുന്നു?

A. കുറയുന്നു	B. കൂടുന്നു
C. വ്യത്യാസം വരുന്നില്ല	D. കുറയുകയോ കൂടുകയോ ചെയ്യുന്നു
27. ഒരു വസ്തുവിന്റെ മാസ് 'm' ഉം പ്രവേഗം 'V'യും ആയിരുന്നാൽ അതിന്റെ ആക്കം എത്ര?

A. mV	B. mV ²
C. m/v	D. m/V ²
28. ഒരാൾക്ക് പത്തു മീറ്റർ ചുറ്റളവിലുള്ള വസ്തുക്കൾ മാത്രമേ കാണാൻ കഴിയുന്നുള്ളൂ. ദൂരെയുള്ള വസ്തുക്കളെ കാണാൻ അയാൾ ഏതുതരം ഗ്ലാസ്സ് ഉപയോഗിക്കണം?

A. സംവ്രജന ലെൻസ്	B. പ്ലെയിൻ ഗ്ലാസ്സ്
C. വിവ്രജന ലെൻസ്	D. കട്ട് ഗ്ലാസ്സ്
29. 100 കി.ഗ്രാം പിണ്ഡമുള്ള ഒരു വസ്തു നിശ്ചലമായി ഇരിക്കുന്നു. അതിന്റെ ആക്കം എത്ര?

A. 0	B. 100 Kgm/S ²
C. 50 Kgm/S ²	D. 25 Kgm/S ²
30. ചന്ദ്രനിൽ ഒരു വസ്തുവിന്റെ ഭാരം 50 കി.ഗ്രാം ആണ്. ഭൂമിയിൽ ആ വസ്തുവിന്റെ ഭാരം എത്രയായിരിക്കും?

A. 0	B. 50 kg
C. 100 kg	D. 300 Kg
31. താഴെകൊടുത്തിരിക്കുന്നവയിൽ പ്രതലബലത്തെക്കുറിച്ച് തെറ്റായ പ്രസ്താവന ഏത് ?

A. പ്രതലബലം ദ്രാവകങ്ങളെ സംബന്ധിച്ചുള്ളതാണ്
B. ദ്രാവകോപരിതലങ്ങൾക്ക് വിസ്തീർണ്ണം കുറഞ്ഞിരിക്കാൻ വേണ്ടി ഉളവാക്കുന്ന ബലമാണ്.
C. തന്മാത്രകൾ തമ്മിലുള്ള ബലംകൊണ്ടാണ് ഇതുണ്ടാകുന്നത്.
D. പ്രതലബലം കടുത്തോറും കേശികതവുമു കൂടിക്കൊണ്ടിരിക്കും.
32. ദ്രവ്യവും ഊർജ്ജവും തമ്മിലുള്ള ബന്ധം കാണിക്കുന്ന ഐൻസ്റ്റീനിന്റെ പ്രസിദ്ധമായ സമവാക്യം ഏത്?

A. $E = \frac{1}{2} MV^2$	B. $E = MC^2$
C. $E = \frac{1}{2} MC^2$	D. $E = MV^2$
33. അന്തരീക്ഷത്തിൽ നിന്ന് ഭൂമിയിലേക്ക് നിർബാധം പതിക്കുന്ന ഒരു വസ്തുവിന്റെ ത്വരണം എത്ര?

A. 0.98m/s ²	B. 9.8m/s ²
C. 98m/s ²	D. 0m/s ²
34. വേഗത്തിൽ ഓടിക്കൊണ്ടിരിക്കുന്ന ഒരു ബസ് പെട്ടെന്ന് ബ്രേക്കിട്ടാൽ, അതിൽ നിൽക്കുന്ന യാത്രക്കാർ മുമ്പോട്ടു വീഴാൻ പോകുന്നു എന്തുകൊണ്ട്?

A. ചലനജഡത്വം	B. ഘർഷണം
C. ആക്കം	D. അഭികേന്ദ്രബലം

- 35. താഴെകൊടുത്തിരിക്കുന്നവയിൽ കേശികതത്തിന് ഉദാഹരണമേത്?
 - A. ഒരു ബ്ലോട്ടിങ്ങ് പേപ്പർ മഷി ഒപ്പിയെടുക്കുന്നു.
 - B. കറൻസി നോട്ട് എണ്ണി തിട്ടപ്പെടുത്തുമ്പോൾ വിരൽതുമ്പിൽ ജലാംശം പുരട്ടുന്നു.
 - C. വസ്ത്രം അലക്കാൻ സോപ്പ് ഉപയോഗിക്കുന്നു.
 - D. ഷോക്കേറ്റവരുടെ ശരീരം അമർത്തി തിരുമ്മുന്നു.
- 36. ഒരു വസ്തുവിനെ നിരക്കി മാറ്റുന്നതിനേക്കാൾ എളുപ്പം ഉരുട്ടി മാറ്റുന്നതാണ്. കാരണമെന്ത്?
 - A. ഉരുട്ടി മാറ്റുമ്പോൾ ഘർഷണം തീരെ അനുഭവപ്പെടുന്നില്ല
 - B. നിരങ്ങൽ ഘർഷണം ഉരുളൽ ഘർഷണത്തേക്കാൾ കുറവാണ്
 - C. നിരങ്ങൽ ഘർഷണം ഉരുളൽ ഘർഷണത്തേക്കാൾ കൂടുതലാണ്
 - D. പ്രതലം മിനുസമായതുകൊണ്ട് എളുപ്പം ഉരുട്ടിമാറ്റാം
- 37. താരണം എന്നാൽ എന്ത്?
 - A. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന വേഗത
 - B. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന സ്ഥാനാന്തരം
 - C. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന പ്രവേഗമാറ്റം
 - D. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന പ്രവേഗം
- 38. ജലത്തിന് മെർക്കുറിയേക്കാൾ വേഗത്തിൽ ഒരു കഷണം തൂണിയെ നനക്കുവാൻ സാധിക്കുന്നു. ഇതിനു കാരണം?
 - A. ജലം സംയുക്തവും മെർക്കുറി മൂലകവുമാണ്
 - B. ജലത്തിന് മെർക്കുറിയേക്കാൾ സാന്ദ്രത കുറവാണ്
 - C. ജലത്തിന്റെ പ്രതലബലം മെർക്കുറിയേക്കാൾ വളരെ കുറവാണ്
 - D. ജലത്തിന് മെർക്കുറിയേക്കാൾ ചലനാത്മകത വളരെ കൂടുതലാണ്
- 39. റോക്കറ്റുകൾ പ്രവർത്തിക്കുന്നത് താഴെപറയുന്ന ഏത് നിയമത്തെ ആസ്പദമാക്കിയാണ്?
 - A. ഒരു വസ്തുവിനുണ്ടാകുന്ന താരണം അതിൽ പ്രയോഗിക്കപ്പെടുന്ന ബലത്തിന് ക്രമമായ അനുപാതത്തിലാണ്.
 - B. ഒരു വസ്തുവിനുണ്ടാകുന്ന താരണം അതിന്റെ പിണ്ഡത്തിന് വിപരീത അനുപാതത്തിലാണ്
 - C. അസന്തുലിതമായ ബലത്തിന് വിധേയമാകുന്നതുവരെ ഒരു വസ്തു സ്ഥിതിയിലോ നേർരേഖാ ചലനത്തിലോ തുടരുന്നതാണ്.
 - D. ഏതൊരു പ്രവർത്തനത്തിനും തുല്യവും വിപരീതവുമായ പ്രതിപ്രവർത്തനമുണ്ട്.
- 40. ഒരു ചെമ്പുകഷണവും ഒരു ഗ്ലാസ്സ് കഷണവും ഒരേ ജാലയിൽ തുല്യസമയം ചൂടാക്കിയതിനു ശേഷം തൊട്ടുനോക്കിയാൽ
 - A. ചെമ്പിന്റെ ഉഷ്മാവ് കൂടിയിരിക്കും
 - B. ഗ്ലാസ്സിന്റെ ഉഷ്മാവ് കൂടിയിരിക്കും
 - C. രണ്ടും ഒരേ ഉഷ്മാവിൽ ആയിരിക്കും
 - D. ചെമ്പിന് കൂടുതൽ തണുപ്പ് തോന്നും.
- 41. വായുശൂന്യമാക്കിയ ഒരു ഗ്ലാസ്സ് കുഴലിലൂടെ ഒരു ചെമ്പു നാണയവും ഒരു പക്ഷിത്തുവലും ഒരേ സമയം താഴേക്കിട്ടാൽ ആദ്യം എത്തുന്നത് ഏതായിരിക്കും?
 - A. പക്ഷിത്തുവൽ
 - B. ചെമ്പുനാണയം
 - C. രണ്ടും എത്തുന്നില്ല
 - D. രണ്ടും ഒരേ സമയത്ത് എത്തുന്നു.
- 42. ഒരാൾ 5 സെക്കന്റിൽ 50 മീറ്റർ ഓടുന്നുവെങ്കിൽ അയാളുടെ വേഗത എത്ര?
 - A. 250 ms
 - B. 45 m/s
 - C. 10 m/s
 - D. 55 m/s

- 43. ഒരു റബ്ബർ ദണ്ഡ് കമ്പിളിയുമായി ഉരസുമ്പോൾ റബ്ബറിന് നെഗറ്റീവ് ചാർജ്ജ് ലഭിക്കുന്നത് എന്തുകൊണ്ട്?
 - A. ഇലക്ട്രോണുകൾ കമ്പിളിയിൽ നിന്ന് റബ്ബറിലേക്ക് മാറ്റപ്പെടുന്നു.
 - B. ഇലക്ട്രോണുകൾ റബ്ബറിൽ നിന്ന് കമ്പിളിയിലേക്ക് മാറ്റപ്പെടുന്നു.
 - C. പ്രോട്ടോണുകൾ കമ്പിളിയിൽ നിന്ന് റബ്ബറിലേക്ക് മാറ്റപ്പെടുന്നു.
 - D. പ്രോട്ടോണുകൾ റബ്ബറിൽ നിന്ന് കമ്പിളിയിലേക്ക് മാറ്റപ്പെടുന്നു.
- 44. മുഴുവനായും വെള്ളം നിറച്ച ഒരു ജാറിന്റെ ഭാരം 700 ഗ്രാം ആണ്. ഇതിലേക്ക് 100 ഗ്രാം ഭാരമുള്ള വസ്തു പൂർണ്ണമായും മുങ്ങിക്കിടക്കുന്ന വിധത്തിൽ ഇടുന്നു. വസ്തു ഇട്ടതിനു ശേഷം വെള്ളം നിറച്ച ആ ജാറിന്റെ ഭാരം എത്ര ആയിരിക്കും?
 - A. 100 g
 - B. 500 g
 - C. 700 g
 - D. 800 g
- 45. ചന്ദ്രനിൽ ഒരുവൻ സ്പേസനം നടന്നാൽ ആ ശബ്ദം നമുക്ക് കേൾക്കാൻ കഴിയുന്നില്ല. കാരണമെന്ത്?
 - A. സഞ്ചരിക്കാൻ മാധ്യമം ഇല്ലാത്തതിനാൽ ശബ്ദം കേൾക്കാൻ കഴിയുന്നില്ല.
 - B. അൾട്രാസോണിക് ശബ്ദമായതുകൊണ്ട് കേൾക്കാൻ കഴിയുന്നില്ല.
 - C. ഇൻഫ്രാസോണിക് ശബ്ദമായതുകൊണ്ട് കേൾക്കാൻ കഴിയുന്നില്ല.
 - D. വൈദ്യുതകാന്തിക തരംഗങ്ങളായതിനാൽ കേൾക്കാൻ കഴിയുന്നില്ല.
- 46. വാട്ടർ റിസർവോയർ ഏറ്റവും ഉയരം കൂടിയ സ്ഥലത്ത് വളരെ ഉയരത്തിൽ സ്ഥാപിക്കുന്നു. കാരണമെന്ത്?
 - A. ഉയർന്ന സ്ഥലത്ത് ജലം വളരെ പരിശുദ്ധമായിരിക്കും
 - B. ഉയർന്ന സ്ഥലത്ത് വെള്ളത്തിന് നല്ല തണുപ്പായിരിക്കും
 - C. ഉയർന്ന സ്ഥലത്ത് വെള്ളം ശേഖരിച്ചാൽ എല്ലായിടത്തും വെള്ളം എത്തിക്കാൻ വേണ്ട മർദ്ദം ലഭിക്കുന്നു.
 - D. ഉയർന്ന സ്ഥലത്ത് നിന്ന് പൈപ്പ് ലൈനുകൾ നാനാഭാഗത്തേക്കും ഇടുവാൻ സൗകര്യമായിരിക്കും
- 47. ഒരു ബീക്കറിലെ ജലത്തിൽ കിടക്കുന്ന ഐസ് കഷണം ഉരുകിത്തീരുമ്പോൾ ബീക്കറിലെ ജലനിരപ്പിന് എന്ത് സംഭവിക്കുന്നു?
 - A. ജലനിരപ്പ് ഉയരുന്നു
 - B. ജലനിരപ്പ് താഴുന്നു
 - C. ജലനിരപ്പ് മാറ്റമില്ലാതെ നിൽക്കുന്നു
 - D. ജലനിരപ്പ് ആദ്യം വർദ്ധിക്കുന്നു. ഉടൻതന്നെ കുറയുകയും ചെയ്യുന്നു
- 48. ജലത്തുള്ളികൾ ഗോളാകൃതി പ്രാപിക്കാൻ കാരണമെന്ത്?
 - A. പ്രതലബലം
 - B. അഡ്ഹീഷൻ ബലം
 - C. കൊഹീഷൻ ബലം
 - D. ആന്തരിക മർദ്ദം
- 49. ചൂടുകാലത്ത് മൺകുജയിലെ വെള്ളം തണുത്തതായിരിക്കും കാരണമെന്ത്?
 - A. മൺകുജയിലെ ചെറുസൂഷിരങ്ങളിലൂടെ വെള്ളം ഉററി ബാഷ്പീകരിച്ചുകൊണ്ടിരിക്കും.
 - B. കളിമൺ കുജ താപവാഹിയല്ലാത്തതുകൊണ്ട് വെള്ളം ചൂടു പിടിക്കുന്നില്ല.
 - C. കളിമൺകുജ അതിനകത്തുള്ള ജലത്തിന്റെ താപം പുറത്തെ അന്തരീക്ഷത്തിലേക്ക് പ്രസരിച്ചുകളയുന്നു.
 - D. മൺകുജ ജലത്തിലെ താപം ആഗിരണം ചെയ്യുന്നു.
- 50. പകുതി ഭാഗം ജലവും പകുതി ഭാഗം വെളിച്ചെണ്ണയും നിറച്ചിരിക്കുന്ന ഒരു ഗ്ലാസ് ബീക്കറിൽ ഒരു ചുവന്ന പെൻസിലിന്റെ കുറച്ചുഭാഗം ദ്രാവകത്തിനു മുകളിൽ നിൽക്കത്തക്കവണ്ണം മുക്കിവെച്ചിരിക്കുന്നു. ബീക്കറിലെ വശത്ത്കൂടി നോക്കിയാൽ പെൻസിൽ കാണപ്പെടുന്നത് എങ്ങനെ
 - A. നിവർന്നു കാണുന്നു
 - B. രണ്ടുസ്ഥലങ്ങളിൽ വളവു കാണുന്നു
 - C. മൂന്നുസ്ഥാനങ്ങളിൽ വളവുകാണുന്നു
 - D. രണ്ടായി കാണുന്നു.

PART - B രസതന്ത്രം (CHEMISTRY)

51. ഓർബിറ്റൽ എന്നാൽ എന്ത്?
 - A. ഇലക്ട്രോൺ സഞ്ചരിക്കുന്ന പഥം
 - B. പ്രോട്ടോൺ സഞ്ചരിക്കുന്ന പഥം
 - C. ഇലക്ട്രോണുകളെ കണ്ടുമുട്ടാൻ സാധ്യതയുള്ള മേഖല
 - D. പ്രോട്ടോണുകളെ കണ്ടുമുട്ടാൻ സാധ്യതയുള്ള മേഖല
52. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഒരു ആറ്റത്തിന്റെ ന്യൂക്ലിയസിലെ ഘടകങ്ങൾ ഏവ?
 - A. ന്യൂട്രോൺ, പ്രോട്ടോൺ
 - B. ന്യൂട്രോൺ, ഇലക്ട്രോൺ
 - C. പ്രോട്ടോൺ, ഇലക്ട്രോൺ
 - D. ഇലക്ട്രോൺ, പോസിട്രോൺ
53. മൂലകങ്ങളുടെ വിദ്യുത്ഗുണത താരതമ്യം ചെയ്യാൻ ഉപയോഗിക്കുന്ന ഇലക്ട്രോ നെഗറ്റിവിറ്റി സ്കെയിൽ കണ്ടുപിടിച്ച ശാസ്ത്രജ്ഞൻ ആര്?
 - A. മെൻഡലീഫ്
 - B. ഹെയ്സൻബർഗ്
 - C. ഡിബ്രോളി
 - D. ലീനസ് പോളിംഗ്
54. ഒരു ആറ്റത്തിന്റെ അടിസ്ഥാനമായതും എല്ലായ്പ്പോഴും തുല്യഎണ്ണത്തിൽ കാണപ്പെടുന്ന തുമായ കണങ്ങൾ ഏവ?
 - A. പ്രോട്ടോൺ, ന്യൂട്രോൺ
 - B. ന്യൂട്രോൺ, ഇലക്ട്രോൺ
 - C. പ്രോട്ടോൺ, ഇലക്ട്രോൺ
 - D. പ്രോട്ടോൺ, ന്യൂട്രോൺ, ഇലക്ട്രോൺ
55. "സൂക്ഷ്മ കണികകളുടെ കൃത്യമായ ആക്കം, സ്ഥാനം എന്നിവ ഒരേ സമയം നിർണ്ണയിക്കുക സാധ്യമല്ല" ഈ സിദ്ധാന്തം അറിയപ്പെടുന്നത്.
 - A. അനിശ്ചിതത്വതത്വം
 - B. അവഗാഡ്രോ നിയമം
 - C. തരംഗ സിദ്ധാന്തം
 - D. വേവ് മെക്കാനിക്സ്
56. ആധുനിക ആവർത്തന പട്ടികയിൽ മൂലകങ്ങളെ വർഗ്ഗീകരിച്ചതിനുള്ള അടിസ്ഥാന മാനദണ്ഡം എന്ത്?
 - A. സാന്ദ്രത
 - B. അറ്റോമിക ഭാരം
 - C. അറ്റോമിക സംഖ്യ
 - D. തന്മാത്രയിലെ ആറ്റങ്ങളുടെ എണ്ണം
57. സൾഫർ തന്മാത്രയിലെ ആറ്റങ്ങളുടെ എണ്ണം എത്ര?
 - A. 5
 - B. 6
 - C. 7
 - D. 8
58. ആവർത്തന പട്ടികയിൽ ഗ്രൂപ്പിൽ മുകളിൽനിന്ന് താഴോട്ട് പോകുന്നതോടും ആറ്റത്തിന്റെ വലിപ്പത്തിന് എന്ത് സംഭവിക്കുന്നു?
 - A. കൂടുന്നു
 - B. കുറയുന്നു
 - C. വ്യത്യാസപ്പെടുന്നില്ല
 - D. കുറഞ്ഞതിനുശേഷം കൂടുന്നു
59. ഒരു മൂലകത്തിന്റെ ഇലക്ട്രോൺ വ്യത്യാസം $1s^2, 2s^2, 2p^4$ ആയാൽ മൂലകത്തിന്റെ അറ്റോമിക സംഖ്യ എത്ര?
 - A. 4
 - B. 8
 - C. 6
 - D. 10
60. ആറ്റങ്ങളുടെ മാസ് താരതമ്യം ചെയ്യുന്നതിന് അടിസ്ഥാന മാനദണ്ഡമായി തെരഞ്ഞെടുത്ത മൂലകം ഏത്?
 - A. H^1
 - B. H^2
 - C. C^{12}
 - D. C^{14}
61. കാർബൺഡൈ ഓക്സൈഡ് തന്മാത്രയുടെ തന്മാത്രാഭാരം എത്ര
 - A. 38
 - B. 30
 - C. 44
 - D. 42

62. ബ്ലീച്ചിംഗ് പൗഡറിന്റെ രാസനാമം ഏതാണ്?
 എ. CaOCl_2 ബി. Ca(OH)_2
 സി. CaCO_3 ഡി. CaCl_2
63. അന്തരീക്ഷത്തിന്റെ ഓസോൺ പാളിയെ തകർക്കുന്ന സംയുക്ത ഏത്?
 A. ഹൈപ്പോക്ലോറസ് ആഡിസ് B. ക്ലോറോഫ്ലൂറോ കാർബൺ
 C. പോളിക്ലോറിനേറ്റഡ് ബൈഫിനൈലുകൾ
 D. ഹൈഡ്രോഫ്ലൂറോ കാർബൺ
64. രാസവസ്തുക്കളുടെ രാജാവ് എന്നറിയപ്പെടുന്ന രാസവസ്തു ഏതാണ്?
 A. H_2SO_4 B. HCl
 C. HNO_3 D. CuSO_4
65. താഴെകൊടുത്തിരിക്കുന്നവയിൽ ദ്വിവിയോജനത്തിന് ഉദാഹരണം ഏത്?
 A. $\text{Fe} + \text{S} \rightarrow \text{FeS}$ B. $2\text{H}_2 \rightarrow 2\text{H}_2 + \text{O}_2$
 C. $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$ D. $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$
66. സംക്രമണ മൂലകങ്ങൾ വ്യത്യസ്ത സംയോജകത പ്രദർശിപ്പിക്കുന്നതിന് കാരണമെന്ത്?
 A ഓർബിറ്റലിലെ ഇലക്ട്രോണുകളോടൊപ്പം d ഓർബിറ്റലിലെ ഇലക്ട്രോണുകൾ കൂടി രാസപ്രവർത്തനത്തിൽ പങ്കെടുക്കുന്നതുകൊണ്ട്.
 B. സംക്രമണ മൂലകങ്ങളുടെ ബാഹ്യതമഷെല്ലിലെ ഇലക്ട്രോണുകളുടെ എണ്ണം തുല്യമായതുകൊണ്ട്
 C. സംക്രമണ മൂലകങ്ങളുടെ ഓർബിറ്റലുകളുടെ എണ്ണം വ്യത്യസ്തമായതുകൊണ്ട്
 D. സംക്രമണ മൂലകങ്ങളിലെ d ഓർബിറ്റലിലെ ഇലക്ട്രോണുകളുടെ എണ്ണം ക്രമമായി വ്യത്യാസപ്പെടുന്നതുകൊണ്ട്.
67. ഏറ്റവും വിദ്യുച്ഛക്തി കൂടിയ മൂലകം ഏതാണ്?
 A. ഫ്ലൂറിൻ B. ക്ലോറിൻ
 C. ബ്രോമിൻ D. അയഡിൻ
68. ഏറ്റവും ചെറിയ ആറ്റം ഏത് മൂലകത്തിന്റേതാണ്?
 A. ഹൈഡ്രജൻ B. ഫ്ലൂറിൻ
 C. ഹീലിയം D. ഓക്സിജൻ
69. ചീഞ്ഞമുട്ടയുടെ ഗന്ധമുള്ള വാതകം ഏത്?
 A. അമോണിയ B. നൈട്രസ് ഓക്സൈഡ്
 C. ഹൈഡ്രജൻ സൾഫൈഡ് D. സൾഫർ ഡയോക്സൈഡ്
70. വാട്ടർ ഗ്യാസ് ഏതിന്റെയൊക്കെ മിശ്രിതമാണ്
 A. CO_2, H_2 B. C, H_2
 C. C, O_2 D. CO, H_2
71. HNO_3 യിൽ നൈട്രജന്റെ ഓക്സീകരണാവസ്ഥ എത്ര?
 A. -2 B. +5
 C. +1 D. 6
72. അക്വാറീജിയ എന്നാൽ എന്ത്
 A. ഗാഢനൈട്രിക് ആസിഡും ഗാഢഹൈഡ്രോക്ലോറിക് ആസിഡും 1:3 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.
 B. ഗാഢ സൾഫ്യൂറിക് ആസിഡും ഗാഢനൈട്രിക് ആസിഡും 3:1 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.
 C. ഗാഢഹൈഡ്രോക്ലോറിക് ആസിഡും ഗാഢ സൾഫ്യൂറിക് ആസിഡും 1:3 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.
 D. ഗാഢ സൾഫ്യൂറിക് ആസിഡും ഗാഢ ഹൈഡ്രോക്ലോറിക് ആസിഡും 3 : 1 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.

73. അലൂമിനിയത്തിന്റെ സംയോജകത 3ഉം ഓക്സിജന്റെത് 2 ഉം ആണെങ്കിൽ അലൂമിനിയം ഓക്സൈഡിന്റെ തന്മാത്രാ രാസവാക്യം എന്ത്?
 A. Al_3O_2 B. AlO_2
 C. O_2Al_3 D. Al_2O_3
74. ഒരു മൂലകത്തിന്റെ അറ്റോമിക സംഖ്യ 12 ആണ്. എന്നാൽ ആ മൂലകത്തിന്റെ ബാഹ്യതമ ഷെല്ലിൽ എത്ര ഇലക്ട്രോണുകൾ ഉണ്ട്?
 A. 1 B. 2
 C. 3 D. 8
75. എല്ലാ വാതകങ്ങളുടേയും എസ്.ടി.പി യിലെ വ്യാപ്തം എത്രയായിരിക്കും?
 A. 22.4 L B. 4.22 L
 C. 2.24 L D. 44.2 L
76. താഴെകൊടുത്തിരിക്കുന്നവയിൽ ഭൗതികമാറ്റത്തിന് ഉദാഹരണം ഏത്?
 A. മഗ്നീഷ്യംറിബ്ബൺ കത്തിക്കുന്നു.
 B. തീപ്പെട്ടി ഉരസുന്നു
 C. ആസിഡ് ചേർത്ത ജലത്തിൽകൂടി വൈദ്യുതി കടത്തി വിടുന്നു.
 D. ജലം തിളപ്പിക്കുന്നു.
77. ഒരു മൂലകത്തിന്റെ ഗ്രൂപ്പ് നമ്പർ 6 ആണ്. അതിന്റെ ബാഹ്യതമഷെല്ലിലെ ഇലക്ട്രോണുകളുടെ എണ്ണമെത്രെ?
 A. 6 B. 4
 C. 2 D. 1
78. താഴെകൊടുത്തിരിക്കുന്ന ഏത് സന്ദർഭത്തിലാണ് ഒരാറ്റം നെഗറ്റീവ് അയോണായി മാറുന്നത്?
 A. ഇലക്ട്രോൺ ലഭിക്കുമ്പോൾ
 B. ഇലക്ട്രോൺ നഷ്ടപ്പെടുമ്പോൾ
 C. പ്രോട്ടോൺ നഷ്ടപ്പെടുമ്പോൾ
 D. പ്രോട്ടോൺ ലഭിക്കുമ്പോൾ
79. ഒരു മൂലകത്തിന്റെ ഐസോടോപ്പുകളെ സംബന്ധിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ തെറ്റായത് ഏത്?
 A. പ്രോട്ടോണുകളുടെ എണ്ണം തുല്യമായിരിക്കും
 B. ന്യൂട്രോണുകളുടെ എണ്ണം തുല്യമായിരിക്കും
 C. ഇലക്ട്രോണുകളുടെ എണ്ണം തുല്യമായിരിക്കും
 D. ഒരേ രാസഗുണങ്ങൾ ആയിരിക്കും
80. മോൾ എന്നതിന്റെ ഏറ്റവും ശരിയായ നിർവചനം ഏത്?
 A. ആറ്റങ്ങൾ, തന്മാത്രകൾ, അയോണുകൾ ഇലക്ട്രോണുകൾ എന്നിവയുടെ എണ്ണം പ്രകടിപ്പിക്കുന്നതിന് സ്വീകരിച്ച യൂണിറ്റാണ്.
 B. അറ്റോമികസംഖ്യ പ്രകടിപ്പിക്കുന്നതിന് സ്വീകരിച്ച യൂണിറ്റാണ്
 C. അറ്റോമിക ഭാരം പ്രകടിപ്പിക്കുന്നതിന് സ്വീകരിച്ച യൂണിറ്റാണ്
 D. വാതകങ്ങളുടെ S.T.P യിലെ വ്യാപ്തം പ്രകടിപ്പിക്കുന്നതിന് സ്വീകരിച്ച യൂണിറ്റാണ്.
81. ഒരു ടെസ്റ്റുബിൽ അൽപം പഞ്ചസാര എടുത്ത് അതിൽ നാലഞ്ചുതുളളി H_2SO_4 ഒഴിക്കുന്നു. ക്രമേണ അതുകറുത്ത നിറത്തിലാകുന്നു. ഇത് സൾഫ്യൂറിക് ആസിഡിന്റെ ഏതു ഗുണമാണ് കാണിക്കുന്നത്?
 A. അസിഡിക് B. നിർജ്ജലീകരണം
 C. സ്ഫോടകഗുണം D. ഓക്സീകരണം

91. ഹാലോജനുകൾ സമുദ്രലവണങ്ങളായി കാണപ്പെടുന്നത് എന്തുകൊണ്ട്?
- A. ഹാലോജൻ ലവണങ്ങൾ ജലത്തിൽ ലയിക്കുന്നവയായതുകൊണ്ട് അവ മഴവെള്ളത്തിൽ ലയിച്ച് കടലിലേക്ക് ഒഴുകിപ്പോകുന്നു.
 - B. ഹാലോജനുകൾ ക്രിയാശീലമുള്ള ലോഹങ്ങളാണ്
 - C. ഹാലോജനുകൾ സംയുക്തമായി മാത്രമേ കാണപ്പെടുന്നുള്ളൂ.
 - D. ഹാലോജൻ ലവണങ്ങൾ സമുദ്രത്തിൽ ഉൽപാദിപ്പിക്കുന്നതുകൊണ്ട്.
92. ക്ലോറിന്റെ ബ്ലീച്ചിംഗ് പ്രവർത്തനത്തിന്റെ പ്രത്യേകതകളെക്കുറിച്ച് താഴെ ചില പ്രസ്താവനകൾ കൊടുത്തിരിക്കുന്നു. അവയിൽ ക്ലോറിന്റെ ബ്ലീച്ചിംഗ് പ്രവർത്തനവുമായി ബന്ധമില്ലാത്തതേത്?
- A. ക്ലോറിന്റെ ബ്ലീച്ചിംഗിന് ഊഷ്മാവ് ആവശ്യമാണ്
 - B. ക്ലോറിൻ ഊർപ്പവുമായി ചേർന്ന് ഓക്സിജൻ ഉണ്ടാകുന്നു
 - C. ക്ലോറിൻ നിറമുള്ള വസ്തുക്കളിൽ പ്രവർത്തിച്ച് അവയെ നിറമില്ലാത്തവയായി മാറ്റുന്നു.
 - D. ക്ലോറിൻ അച്ചടിമഷിയെ ബ്ലീച്ച് ചെയ്യുന്നു.
93. ആവർത്തന പട്ടികയിലെ ഒന്നാം ഗ്രൂപ്പിലെ മൂലകങ്ങളെ സംബന്ധിച്ച് താഴെകൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ ഏതാണ് തെറ്റ്?
- A. അവയെല്ലാം ക്ഷാരലോഹങ്ങൾ (ആൽക്കലിമെറ്റൽസ്) ആണ്
 - B. അവയ്ക്ക് ഉൽകൃഷ്ടമൂലകങ്ങളുടെ ഇലക്ട്രോൺ വിന്യാസത്തെക്കാൾ ഒരു ഇലക്ട്രോൺ കുറവാണ്
 - C. അവ ഹാലോജനുകളുമായി ശക്തിയായി പ്രതിപ്രവർത്തിക്കുന്നു.
 - D. അവയെല്ലാം ഉയർന്ന വിദ്യുത്ധനത (ഇലക്ട്രോ പോസിറ്റിവിറ്റി) ഉള്ളവയാണ്
94. ഒരേ വ്യാപ്തമുള്ള A,B എന്നീ രണ്ട് കുപ്പികളിൽ ഒരേ മർദ്ദത്തിലും ഊഷ്മാവിലുമുള്ള ഹൈഡ്രജനും കാർബൺഡയോക്സൈഡും നിറച്ചിരിക്കുന്നു. ഈ വാതകങ്ങളുടെ തന്മാത്രകളുടെ എണ്ണത്തെ സംബന്ധിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ ഏതാണ് ശരി?
- A. കുപ്പി A യിലെ തന്മാത്രകൾ കുപ്പി B യിലെ തന്മാത്രകളേക്കാൾ കൂടുതലായിരിക്കും.
 - B. കുപ്പി Aയിലെ തന്മാത്രകൾ കുപ്പി Bയിലെ തന്മാത്രകളേക്കാൾ കുറവായിരിക്കും.
 - C. രണ്ടുകുപ്പികളിലും ഒരേഎണ്ണം തന്മാത്രകളായിരിക്കും.
 - D. കുപ്പി A യിലെ തന്മാത്രകൾ കുപ്പി B യിലെ തന്മാത്രകളുടെ ഇരട്ടി ആയിരിക്കും.
95. ഒരു ദ്രാവകത്തിന്റെ ഭൗതികഗുണങ്ങളും രാസഗുണങ്ങളും താഴെകൊടുത്തിരിക്കുന്നു. വാതകം എന്തെന്നു പറയുക
1. നിറമില്ലാത്തതാണ്
 2. വായുവിൽ പുകയുന്നു
 3. സാധാരണയായി നിറമുള്ള കുപ്പികളിൽ മാത്രമേ സൂക്ഷിക്കാറുള്ളൂ.
 4. ചെമ്പു ചീളുകളുമായി പ്രവർത്തിച്ച് നൈട്രജൻഡയോക്സൈഡ് ഉണ്ടാകുന്നു
- A. നൈട്രിക് ആസിഡ്
 - B. അമോണിയ
 - C. സൾഫ്യൂറിക് ആസിഡ്
 - D. നൈട്രസ് ആസിഡ്
96. ഒരു ടെസ്റ്റുബിൽ അൽപം മാംഗനീസ് ഡയോക്സൈഡ് എടുക്കുക. അതിൽഗാഢ ഹൈഡ്രോക്ലോറിക് ആസിഡ് ചേർത്ത് സാവധാനം ചൂടാക്കുക. പച്ചയും മഞ്ഞയും കലർന്ന നിറമുള്ള രൂക്ഷ ഗന്ധമുള്ള വാതകം പുറത്തു വരുന്നു. ഇത് ഏത് വാതകമാണ്?
- A. ഫ്ലൂറിൻ
 - B. ക്ലോറിൻ
 - C. ബ്രോമിൻ
 - D. അയഡിൻ

97. പൊതുവേ നിറമുള്ള ലവണങ്ങൾ ഉൽപാദിപ്പിക്കുന്ന മൂലകങ്ങൾ താഴെ പറയുന്ന ഏത് വിഭാഗത്തിൽപ്പെടുന്നു?
- A. ക്ഷാരലോഹങ്ങൾ (Alkali metals)
 - B. സംക്രമണ മൂലകങ്ങൾ (Transition Elements))
 - C. ഹാലോജനുകൾ (Halogens)
 - D. ഉൽകൃഷ്ടമൂലകങ്ങൾ (Inert Gases)
98. $2\text{Cu}^{+2}\text{O}^{-2} + \text{C}^0 \rightarrow 2\text{Cu}^0 + \text{C}^{+4}\text{O}^{-2}$ ഈ രാസപ്രവർത്തനത്തെ സംബന്ധിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ ശരി ഏത്?
- A. കാർബൺ നിരോക്സീകരിക്കപ്പെടുകയും കോപ്പർ ഓക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
 - B. കോപ്പർ നിരോക്സീകരിക്കപ്പെടുകയും കാർബൺ ഓക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
 - C. ഓക്സിജൻ ഓക്സീകരിക്കപ്പെടുകയും കാർബൺ നിരോക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
 - D. ഓക്സിജൻ നിരോക്സീകരിക്കപ്പെടുകയും കാർബൺ ഓക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
99. ഗ്ലൂക്കോസ് തന്മാത്രയുടെ ആപേക്ഷിക തന്മാത്രാഭാരം എത്ര?
- | | |
|--------|--------|
| A. 24 | B. 156 |
| C. 180 | D. 150 |
100. താഴെ പറയുന്നവയിൽ ഏതിന്റെ അളവ് അയോണോസ്ഫിയറിൽ കൂടുമ്പോഴാണ് ആസിഡ് മഴ ഉണ്ടാകുന്നത്.
- A. സൾഫർഡയോക്സൈഡും നൈട്രിക് ഓക്സൈഡും
 - B. കാർബൺ മോണോക്സൈഡും ഹൈഡ്രജൻ സൾഫേറ്റും
 - C. കാർബൺഡയോക്സൈഡും ഓക്സിജനും
 - D. ഓസോൺഡസ്റ്റ്

4. വാട്ടർ റിസർവോയർ ഏറ്റവും ഉയരംകൂടിയ സ്ഥലത്ത് വളരെ ഉയരത്തിൽ സ്ഥാപിക്കുന്നു. ഇതിനു കാരണമെന്ത് ?
 - A. ഉയർന്ന സ്ഥലത്ത് ജലം വളരെ പരിശുദ്ധമായിരിക്കും
 - B. ഉയർന്ന സ്ഥലത്ത് വെള്ളത്തിന് നല്ല തണുപ്പായിരിക്കും
 - C. ഉയർന്ന സ്ഥലത്തു വെള്ളം ശേഖരിച്ചാൽ എല്ലായിടത്തും വെള്ളം എത്തിക്കാൻ വേണ്ട മർദ്ദം ലഭിക്കും
 - D. ഉയർന്ന സ്ഥലത്ത് നിന്ന പൈപ്പ് ലൈനുകൾ നാനാ ഭാഗത്തേക്കും ഇടുവാൻ സൗകര്യമായിരിക്കും

5. താരണം എന്നാൽ എന്ത്?
 - A. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന വേഗത
 - B. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന സ്ഥാനാന്തരം
 - C. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന പ്രവേഗമാറ്റം
 - D. യൂണിറ്റ് സമയത്തിലുണ്ടാകുന്ന പ്രവേഗം

6. റോക്കറ്റുകൾ പ്രവർത്തിക്കുന്നത് താഴെ പറയുന്ന ഏത് നിയമത്തെ ആസ്പദമാക്കിയാണ്.?
 - A. ഒരു വസ്തുവിനുണ്ടാകുന്ന ത്വരണം അതിൽ പ്രയോഗിക്കപ്പെടുന്ന ബലത്തിന് ക്രമമായ അനുപാതത്തിലാണ്.
 - B. ഒരു വസ്തുവിനുണ്ടാകുന്ന ത്വരണം അതിന്റെ പിണ്ഡത്തിന് വിപരീത അനുപാതത്തിലാണ്
 - C. അസന്തുലിതമായ ബലത്തിന് വിധേയമാകുന്നതുവരെ ഒരു വസ്തു സ്ഥിതിയിലോ നേർരേഖാ ചലനത്തിലോ തുടരുന്നതാണ്.
 - D. ഏതൊരു പ്രവർത്തനത്തിനും തുല്യവും വിപരീതവുമായ പ്രതിപ്രവർത്തനമുണ്ട്

7. ഒരേ ഉഷ്മാവിലും മർദ്ദത്തിലും സ്ഥിതിചെയ്യുന്ന എല്ലാ വാതകങ്ങളുടേയും തുല്യ വ്യാപ്തത്തിൽ കാണുന്ന തന്മാത്രകളുടെ എണ്ണം തുല്യമായിരിക്കും. ഇത് ഏത് നിയമമാണ്.?

A. പോസിറ്റീവും നെഗറ്റീവും	B. നീലയും ചുവപ്പും
C. ആനോഡും കാഥോഡും	D. ഉത്തരധ്രുവവും ദക്ഷിണധ്രുവവും

8. ഒരു കാന്തത്തിന്റെ രണ്ടുഗ്രന്ഥങ്ങൾക്കും പറയുന്ന പേരെന്ത് ?

A. പ്ലാസ്റ്റിക്	B. അലൂമിനിയം
C. റബ്ബർ	D. വജ്രം

9. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ചലനാത്മകത കൂടുതലുള്ള ദ്രാവകം ഏത് ?

A. തേൻ	B. മെർക്കുറി
C. മണ്ണെണ്ണ	D. ആവണക്കെണ്ണ

10. ഒരേയിനം തന്മാത്രകൾ തമ്മിലുള്ള ആകർഷണ ബലമേത്?

A. പ്രതലബലം	B. കൊഹിഷൻ ബലം
C. അഡ്ഹിഷൻ ബലം	D. വിസികസ് ബലം

11. ഭൂമിയുടെ കേന്ദ്രത്തിൽ ഒരു വസ്തുവിന്റെ ഭാരം എന്തായിരിക്കും?
 - A. പുജ്യം
 - B. വസ്തുവിന്റെ യഥാർത്ഥ ഭാരം
 - C. വസ്തുവിന്റെ യഥാർത്ഥ ഭാരത്തെക്കാൾ കുറവ്
 - D. വസ്തുവിന്റെ യഥാർത്ഥ ഭാരത്തേക്കാൾ കൂടുതൽ

12. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ വൈദ്യുത ചാലകം ഏത് ?.

A. പ്ലാസ്റ്റിക്	B. അലൂമിനിയം
C. റബ്ബർ	D. വജ്രം

13. വായു ശൂന്യമാക്കിയ ഒരു ഗ്ലാസ്കുഴലിലൂടെ ഒരു ചെമ്പു നാണയവും ഒരു പക്ഷിത്തുവലും ഒരേ സമയം താഴേക്കിട്ടാൽ ആദ്യം എത്തുന്നത് ഏതായിരിക്കും?

A. പക്ഷിത്തുവൽ	B. ചെമ്പു നാണയം
C. രണ്ടും എത്തുന്നില്ല	D. രണ്ടും ഒരേ സമയത്ത് എത്തുന്നു
14. ശക്തിയേറിയ സ്ഥിരകാന്തങ്ങൾ നിർമ്മിക്കുന്നതിന് ഉപയോഗിക്കുന്ന പദാർത്ഥമേത്?

A. നിക്രോം	B. ഡുറാലുമിൻ
C. ടങ്സ്റ്റൺ	D. അൽനിക്കോ
15. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ അനുപ്രസ്ത തരംഗമല്ലാത്തത് ഏത്?

A. ജലതരംഗം	B. സ്പ്രിംഗിലെ തരംഗം
C. ശബ്ദ തരംഗം	D. പ്രകാശ തരംഗം
16. ഒരു യൂണിറ്റ് മാസ് പദാർത്ഥം അവസ്ഥാപരിവർത്തനം നടക്കുമ്പോൾ സ്വീകരിക്കുന്ന താപപരിമാണത്തെ എന്തുവിളിക്കും?

A. ലീനതാപം	B. തിളനില
C. ബാഷ്പീകരണ ലീനതാപം	D. വിശിഷ്ട താപധാരിത
17. 100 കി. ഗ്രാം പിണ്ഡമുള്ള ഒരു വസ്തു നിശ്ചലമായി ഇരിക്കുന്നു. അതിന്റെ ആക്കം എത്ര?

A. 0	B. 100 Kgm/S ²
C. 50 Kgm/S ²	D. 25 Kgm/s ²
18. ഒരു ചെമ്പു ക്ഷണവും ഒരു ഗ്ലാസ്സ് ക്ഷണവും ഒരേ ജാലയിൽ തൂല്യസമയം ചൂടാക്കിയതിനുശേഷം തൊട്ടു നോക്കിയാൽ

A. ചെമ്പിന്റെ ഉഷ്മാവ് കൂടിയിരിക്കും.
B. ഗ്ലാസ്സിന്റെ ഉഷ്മാവ് കൂടിയിരിക്കും
C. രണ്ടും ഒരേ ഉഷ്മാവിൽ ആയിരിക്കും
D. ചെമ്പിന് കൂടുതൽ തണുപ്പു തോന്നും
19. താഴെകൊടുത്തിരിക്കുന്നവയിൽ വിദ്യുത്രോധി ഏത്?

A. കാർബൺ	B. അയൺ
C. റബ്ബർ	D. ചെമ്പ്
20. ഒരു വസ്തുവിന്റെ മാസ് 'm' ഉം പ്രവേഗം 'V'യും ആയിരുന്നാൽ അതിന്റെ ആക്കം എത്ര ?

A. mV	B. mV ²
C. $\frac{m}{V}$	D. $\frac{m}{V^2}$
21. ഒരു ബിക്കറിലെ ജലത്തിൽ കിടക്കുന്ന ഐസ് ക്ഷണം ഉരുകിത്തീരുമ്പോൾ ബിക്കറിലെ ജലനിരപ്പിന് എന്ത് സംഭവിക്കുന്നു?

A. ജലനിരപ്പ് ഉയരുന്നു
B. ജലനിരപ്പ് താഴുന്നു
C. ജലനിരപ്പ് മാറ്റമില്ലാതെ നിൽക്കുന്നു
D. ജലനിരപ്പ് ആദ്യം വർദ്ധിക്കുന്നു. ഉടൻ തന്നെ കുറയുകയും ചെയ്യുന്നു.
22. ചന്ദ്രനിൽ ഒരു വസ്തുവിന്റെ ഭാരം 50 kg ആണ്. ഭൂമിയിൽ ആ വസ്തുവിന്റെ ഭാരം എത്രയായിരിക്കും?

A. 0	B. 50 Kg
C. 100 kg	D. 300 Kg
23. ഏറ്റവും ഉയരത്തിൽ എത്തുമ്പോൾ ഒരു കല്ലിന്റെ സ്ഥാനികോർജ്ജം എത്രയായിരിക്കും?

A. $3 \times 10^3 \text{ m/sec}^2$	B. $3.28 \times 10^8 \text{ m/sec}^2$
C. 0	D. 0.25

24. ഒരു കാറിന് ഏറ്റവും കൂടുതൽ ഘർഷണം അനുഭവപ്പെടുന്നത് താഴെ കൊടുത്തിരിക്കുന്ന ഏത് സാഹചര്യത്തിലാണ്.
- A. കാർ സഞ്ചരിക്കാൻ ആരംഭിക്കുമ്പോൾ
 - B. കാർ സമവേഗതയിൽ സഞ്ചരിക്കുമ്പോൾ
 - C. കാർ അതിവേഗതയിൽ സഞ്ചരിക്കുമ്പോൾ
 - D. കാർ സമതരണത്തിൽ സഞ്ചരിക്കുമ്പോൾ
25. താഴെകൊടുത്തിരിക്കുന്നവയിൽ പ്രതലബലത്തെക്കുറിച്ച് തെറ്റായ പ്രസ്താവന ഏത്?
- A. പ്രതലബലം ദ്രാവകങ്ങളെ സംബന്ധിച്ചുള്ളതാണ്.
 - B. ദ്രാവകോപരിതലങ്ങൾക്ക് വിസ്തീർണ്ണം കുറഞ്ഞിരിക്കാൻ വേണ്ടി ഉളവാക്കുന്ന ബലമാണ്.
 - C. തന്മാത്രകൾ തമ്മിലുള്ള ബലം കൊണ്ടാണ് ഇതുണ്ടാകുന്നത്
 - D. പ്രതലബലം കൂടുന്തോറും കേശികത്വവും കൂടിക്കൊണ്ടിരിക്കും.
26. ഒരാൾ 5 സെക്കന്റിൽ 50 മീറ്റർ ഓടുന്നുവെങ്കിൽ അയാളുടെ വേഗത എത്ര ?
- A. 250 ms
 - B. 45 m/s
 - C. 10 m/s
 - D. 55 m/s
27. ലെൻസ് സമവാക്യം ഏത്?
- A. $\frac{1}{u} + \frac{1}{f} = \frac{1}{v}$
 - B. $\frac{1}{u} - \frac{1}{v} = \frac{1}{f}$
 - C. $\frac{1}{f} + \frac{1}{v} = \frac{1}{u}$
 - D. $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$
28. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ കേശികത്വത്തിന് ഉദാഹരണമേത് ?
- A. ഒരു ബ്ലോട്ടിങ് പേപ്പർ മഷി ഒപ്പിയെടുക്കുന്നു.
 - B. കറൻസി നോട്ട് എണ്ണി തിട്ടപ്പെടുത്തുമ്പോൾ വിരൽതുമ്പിൽ ജലാംശം പുരട്ടുന്നു.
 - C. വസ്ത്രം അലക്കാൻ സോപ്പ് ഉപയോഗിക്കുന്നു.
 - D. ഷോക്കേറ്റവരുടെ ശരീരം അമർത്തി തിരുമ്മുന്നു.
29. ഒരു റബ്ബർദണ്ഡ് കമ്പിളിയുമായി ഉരസുമ്പോൾ റബ്ബറിന് നെഗറ്റീവ് ചാർജ്ജ് ലഭിക്കുന്നത് എന്തുകൊണ്ട്?
- A. ഇലക്ട്രോണുകൾ കമ്പിളിയിൽ നിന്ന് റബ്ബറിലേക്ക് മാറ്റപ്പെടുന്നു.
 - B. ഇലക്ട്രോണുകൾ റബ്ബറിൽ നിന്ന് കമ്പിളിയിലേക്ക് മാറ്റപ്പെടുന്നു.
 - C. പ്രോട്ടോണുകൾ കമ്പിളിയിൽ നിന്ന് റബ്ബറിലേക്ക് മാറ്റപ്പെടുന്നു.
 - D. പ്രോട്ടോണുകൾ റബ്ബറിൽ നിന്ന് കമ്പിളിയിലേക്ക് മാറ്റപ്പെടുന്നു.
30. ഒരു വസ്തുവിനെ നിരക്കി മാറ്റുന്നതിനേക്കാൾ എളുപ്പം ഉരുട്ടി മാറ്റുന്നതാണ് കാരണമെന്ത് ?
- A. ഉരുട്ടി മാറ്റുമ്പോൾ ഘർഷണം തീരെ അനുഭവപ്പെടുന്നില്ല
 - B. നിരങ്ങൽ ഘർഷണം ഉരുളൽ ഘർഷണത്തേക്കാൾ കുറവാണ്
 - C. നിരങ്ങൽ ഘർഷണം ഉരുളൽ ഘർഷണത്തേക്കാൾ കൂടുതലാണ്
 - D. പ്രതലം മിനുസമായതുകൊണ്ട് എളുപ്പം ഉരുട്ടിമാറ്റാം
31. മുഴുവനായും വെള്ളം നിറച്ച ഒരു ജാറിന്റെ ഭാരം 700g ആണ്. ഇതിലേക്ക് 100g ഭാരമുള്ള വസ്തു പൂർണ്ണമായും മുങ്ങിക്കിടക്കുന്ന വിധത്തിൽ ഇടുന്നു. വസ്തു ഇട്ടതിനുശേഷം വെള്ളം നിറച്ച ആ ജാറിന്റെ ഭാരം എത്ര ആയിരിക്കും ?
- A. 100g
 - B. 500g
 - C. 700g
 - D. 800g
32. ന്യൂട്ടന്റെ രണ്ടാം ചലന നിയമം ഏത് പ്രതിഭാസത്തെ കുറിക്കുന്നു?
- A. ത്വരണം
 - B. ബലം
 - C. ആക്കം
 - D. മർദ്ദം



33. ജലത്തിന്റെ വിശിഷ്ടതാപധാരിത എത്ര?
 A. $4.18 \times 10^3 \text{ J/Kg}^\circ\text{C}$ B. $0.24 \times 10^3 \text{ J/Kg}^\circ\text{C}$
 C. $0.48 \times 10^3 \text{ J/Kg}^\circ\text{C}$ D. $0.50 \times 10^3 \text{ J/K}^\circ\text{C}$
34. ഒരാൾക്ക് പത്തു മീറ്റർ ചുറ്റളവിലുള്ള വസ്തുക്കൾ മാത്രമേ കാണാൻ കഴിയുന്നുള്ളൂ. -
 ദൂരെയുള്ള വസ്തുക്കളെ കാണാൻ അയാൾ ഏതു തരം ഗ്ലാസ്സ് ഉപയോഗിക്കണം
 A. സംവ്രജനലെൻസ് B. പ്ലെയിൻ ഗ്ലാസ്സ്
 C. വിവ്രജനലെൻസ് D. കട്ട് ഗ്ലാസ്സ്
35. പകുതി ഭാഗം ജലവും പകുതിഭാഗം വെളിച്ചെണ്ണയും നിറച്ചിരിക്കുന്ന ഒരു ഗ്ലാസ്സ് ബീക്കറിൽ,
 ഒരു ചുവന്ന പെൻസിലിന്റെ കുറച്ചുഭാഗം ദ്രാവകത്തിനു മുകളിൽ നിൽക്കത്തക്കവണ്ണം
 മുക്കിവെച്ചിരിക്കുന്നു. ബീക്കറിന്റെ വശത്തുകൂടി നോക്കിയാൽ പെൻസിൽ കാണപ്പെടുന്നത്
 എങ്ങനെ ?
 A. നിവർന്നു കാണുന്നു
 B. രണ്ടുസ്ഥലങ്ങളിൽ വളവു കാണുന്നു
 C. മൂന്നു സ്ഥാനങ്ങളിൽ വളവു കാണുന്നു
 D. രണ്ടായി കാണുന്നു.
36. അബ്സല്യൂട്ട് സീറോ സൂചിപ്പിക്കുന്ന ഊഷ്മാവ് ഏത് ?
 A. 0°C B. 100°C
 C. -273°C D. 273°C
37. മനുഷ്യ ശരീരത്തിന്റെ ഊഷ്മാവ് 37°C ആണ് കെൽവിൻ സ്കെയിൽ പ്രകാരം
 ഇതെത്രയായിരിക്കും ?
 A. 37 K B. 100 K
 C. 236 K D. 310 K
38. ജലത്തിന് മെർക്കുറിയേക്കാൾ വേഗത്തിൽ ഒരു കഷണം തൂണിയെ നനക്കുവാൻ
 സാധിക്കുന്നു. ഇതിനു കാരണം ?
 A. ജലം സംയുക്തവും മെർക്കുറി മൂലകവുമാണ്.
 B. ജലത്തിന് മെർക്കുറിയേക്കാൾ സാന്ദ്രത കുറവാണ്
 C. ജലത്തിന്റെ പ്രതലബലം മെർക്കുറിയേക്കാൾ വളരെ കുറവാണ്.
 D. ജലത്തിന് മെർക്കുറിയേക്കാൾ ചലനാത്മകത വളരെ കൂടുതലാണ്.
39. ചന്ദ്രനിൽ ഒരു വൻ സ്പോടനം നടന്നാൽ ആ ശബ്ദം നമുക്ക് കേൾക്കാൻ കഴിയുന്നില്ല.
 കാരണമെന്ത്?
 A. സഞ്ചരിക്കാൻ മാധ്യമം ഇല്ലാത്തതിനാൽ ശബ്ദം കേൾക്കാൻ കഴിയുന്നില്ല
 B. അൾട്രാസോണിക് ശബ്ദമായതുകൊണ്ട് കേൾക്കാൻ കഴിയുന്നില്ല
 C. ഇൻഫ്രാസോണിക് ശബ്ദമായതുകൊണ്ട് കേൾക്കാൻ കഴിയുന്നില്ല
 D. വൈദ്യുതികാന്തിക തരംഗങ്ങളായതിനാൽ കേൾക്കാൻ കഴിയുന്നില്ല
40. ചുടുകാലത്ത് മൺകുജയിലെ വെള്ളം തണുത്തതായിരിക്കും കാരണമെന്ത്?
 A. മൺകുജയിലെ ചെറുസൂഷിരങ്ങളിലൂടെ വെള്ളം ഊറി ബാഷ്പീകരിച്ചുകൊണ്ടിരിക്കും
 B. കളിമൺ കുജ താപവാഹിയല്ലാത്തതുകൊണ്ട് വെള്ളം ചുടുപിടിക്കുന്നില്ല
 C. കളിമൺ കുജ അതിനകത്തുള്ള ജലത്തിന്റെ താപം പുറത്തെ അന്തരീക്ഷത്തിലേക്ക്
 പ്രസരിച്ചുകൊള്ളുന്നു.
 D. മൺകുജ ജലത്തിലെ താപം ആഗിരണം ചെയ്യുന്നു.

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11. ഏറ്റവും ചെറിയ ആറ്റം ഏത് മൂലകത്തിന്റേതാണ്.

A. ഹൈഡ്രജൻ	B. ഫ്ലൂറിൻ
C. ഹീലിയം	D. ഓക്സിജൻ
12. ഒരു മൂലകത്തിന്റെ അറ്റോമിക സംഖ്യ 12 ആണ്. എന്നാൽ ആ മൂലകത്തിന്റെ ബാഹ്യതമഘോഷത്തിൽ എത്ര ഇലക്ട്രോണുകൾ ഉണ്ട്.?

A. 1	B. 2
C. 3	D. 8
13. സർഫർ തന്മാത്രയിലെ ആറ്റങ്ങളുടെ എണ്ണമെത്ര ?

A. 5	B. 6
C. 7	D. 8
14. ആവർത്തന പട്ടികയിൽ ഗ്രൂപ്പിൽ മുകളിൽ നിന്ന് താഴോട്ട് പോകുന്നതോടും ആറ്റത്തിന്റെ വലിപ്പത്തിന് എന്ത് സംഭവിക്കുന്നു ?

A. കൂടുന്നു	B. കുറയുന്നു
C. വ്യത്യാസപ്പെടുന്നില്ല	D. കുറഞ്ഞതിനുശേഷം കൂടുന്നു
15. അന്തരീക്ഷത്തിന്റെ ഓസോൺ പാളിയെ തകർക്കുന്ന സംയുക്തം ഏത്?

A. ഹൈപ്പോക്ലോറസ് ആസിഡ്	B. ക്ലോറോഫ്ലൂറോ കാർബൺ
C. പോളിക്ലോറിനേറ്റഡ് ബൈഫിനൈലുകൾ	
D. ഹൈഡ്രോഫ്ലൂറോ കാർബൺ	
16. ആറ്റങ്ങളുടെ മാസ് താരതമ്യം ചെയ്യുന്നതിന് അടിസ്ഥാന മാനദണ്ഡമായി തിരഞ്ഞെടുത്ത മൂലകം എന്ത്?

A. H^1	B. H^2
C. C^{12}	D. C^{14}
17. താഴെ കൊടുത്തിരിക്കുന്ന ഏത് സന്ദർഭത്തിലാണ് ഒരാറ്റം നെഗറ്റീവ് അയോണായി മാറുന്നത്?

A. ഇലക്ട്രോൺ ലഭിക്കുമ്പോൾ	B. ഇലക്ട്രോൺ നഷ്ടപ്പെടുമ്പോൾ
C. പ്രോട്ടോൺ നഷ്ടപ്പെടുമ്പോൾ	D. പ്രോട്ടോൺ ലഭിക്കുമ്പോൾ
18. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഭൗതികമാറ്റത്തിന് ഉദാഹരണം ഏത്?

A. മെഗ്നീഷ്യം റിബൺ കത്തിക്കുന്നു	B. തീപ്പെട്ടി ഉരസുന്നു
C. ആസിഡ് ചേർത്ത ജലത്തിൽകൂടി വൈദ്യുതി കടത്തിവിടുന്നു	
D. ജലം തിളപ്പിക്കുന്നു	
19. രാസവസ്തുക്കളുടെ രാജാവ് എന്നറിയപ്പെടുന്ന രാസവസ്തു ഏതാണ്?

A. H_2SO_4	B. HCl
C. HNO_3	D. $CuSO_4$
20. ബ്ലീച്ചിംഗ് പൗഡറിന്റെ രാസനാമം ഏതാണ്?

A. $CaOCl_2$	B. $Ca(OH)_2$
C. $CaCO_3$	D. $CaCl_2$
21. അക്വാറിജിയ എന്നാൽ എന്ത്?

A. ഗാഢനൈട്രിക് ആസിഡും ഗാഢ ഹൈഡ്രോ ക്ലോറിക് ആസിഡും 1:3 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.
B. ഗാഢ സൾഫ്യൂറിക് ആസിഡും ഗാഢ നൈട്രിക് ആസിഡും 3:1 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.
C. ഗാഢ ഹൈഡ്രോക്ലോറിക് ആസിഡും ഗാഢ സൾഫ്യൂറിക് ആസിഡും 1:3 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.
D. ഗാഢ സൾഫ്യൂറിക് ആസിഡും ഗാഢ ഹൈഡ്രോക്ലോറിക് ആസിഡും 3:1 എന്ന അംശബന്ധത്തിൽ കലർത്തിയിരിക്കുന്ന മിശ്രിതമാണ്.



30. ക്ലോറിന്റെ ബ്ലീച്ചിംഗ് പ്രവർത്തനത്തിന്റെ പ്രത്യേകതകളെക്കുറിച്ച് താഴെ ചില പ്രസ്താവനകൾ കൊടുത്തിരിക്കുന്നു. അവയിൽ ക്ലോറിന്റെ ബ്ലീച്ചിംഗ് പ്രവർത്തനവുമായി ബന്ധമില്ലാത്തതേത്?
- A. ക്ലോറിന്റെ ബ്ലീച്ചിംഗിന് ഉഷ്ണമാവ് ആവശ്യമാണ്.
 - B. ക്ലോറിൻ ഇൗർപ്പവുമായി ചേർന്ന് ഓക്സിജൻ ഉണ്ടാകുന്നു
 - C. ക്ലോറിൻ നിറമുള്ള വസ്തുക്കളിൽ പ്രവർത്തിച്ച് അവയെ നിറമില്ലാത്തവയായി മാറ്റുന്നു.
 - D. ക്ലോറിൻ അച്ചടിമഷിയെ ബ്ലീച്ച് ചെയ്യുന്നു.
31. ഒരു ദ്രാവകത്തിന്റെ ഭൗതിക ഗുണങ്ങളും രാസഗുണങ്ങളും താഴെകൊടുത്തിരിക്കുന്നു. വാതകം ഏതെന്നുപറയുക
- | | |
|--|----------------------|
| 1. നിറമില്ലാത്തതാണ് | 2. വായുവിൽ പുകയുന്നു |
| 3. സാധാരണയായി നിറമുള്ള കുപ്പികളിൽ മാത്രമേ സൂക്ഷിക്കാറുള്ളൂ | |
| 4. ചെമ്പുചീളുകളുമായി പ്രവർത്തിച്ച് നൈട്രജൻ ഡയോക്സൈഡ് ഉണ്ടാക്കുന്നു | |
- A. നൈട്രിക് ആസിഡ്
 - B. അമോണിയ
 - C. സൾഫ്യൂറിക് ആസിഡ്
 - D. നൈട്രസ് ആസിഡ്
32. ഒരു മൂലകത്തിന്റെ ഐസോടോപ്പുകളെ സംബന്ധിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ തെറ്റായത് ഏത്?
- A. പ്രോട്ടോണുകളുടെ എണ്ണം തുല്യമായിരിക്കും
 - B. ന്യൂട്രോണുകളുടെ എണ്ണം തുല്യമായിരിക്കും
 - C. ഇലക്ട്രോണുകളുടെ എണ്ണം തുല്യമായിരിക്കും
 - D. ഒരേ രാസഗുണങ്ങൾ ആയിരിക്കും.
33. ഒരു മൂലകത്തിന്റെ മാസ് നമ്പർ 14 ഉം അറ്റോമിക നമ്പർ 7 ഉം ആണെങ്കിൽ, അതിലെ പ്രോട്ടോൺ, ന്യൂട്രോൺ, ഇലക്ട്രോൺ എന്നിവയുടെ എണ്ണം യഥാക്രമം താഴെകൊടുത്തിരിക്കുന്നവയിൽ ഏതാണ് ?
- A. 14, 7, 7
 - B. 7, 14, 7
 - C. 7, 7, 14
 - D. 7, 7, 7
34. X എന്ന മൂലകവും (ഇലക്ട്രോൺ വിന്യാസം 2, 8, 1) Y എന്ന മൂലകവും (ഇലക്ട്രോൺ വിന്യാസം 2,8,7) സയോജിച്ച് XY എന്ന സംയുക്തം ഉണ്ടാകുന്നു. ഈ സംയുക്തത്തിൽ ഉണ്ടാകുന്ന രാസബന്ധനം ഏതു തരത്തിൽ ഉള്ളതായിരിക്കും?
- A. ലോഹീയ ബന്ധനം
 - B. അയോണിക ബന്ധനം
 - B. സഹസംയോജകബന്ധം
 - D. ത്രി ബന്ധനം
35. അലൂമിനിയത്തിന്റെ സംയോജകത 3 ഉം ഓക്സിജന്റേത് 2 ഉം ആണെങ്കിൽ അലൂമിനിയം ഓക്സൈഡിന്റെ തന്മാത്രാ രാസവാക്യം എന്ത് ?
- A. Al_3O_2
 - B. $3AlO_2$
 - C. O_2Al_3
 - D. Al_2O_3
36. ഹാലോജനുകൾ സമുദ്ര ലവണങ്ങളായി കാണപ്പെടുന്നത് എന്തുകൊണ്ട്?
- A. ഹാലോജൻ ലവണങ്ങൾ ജലത്തിൽ ലയിക്കുന്നവയായതുകൊണ്ട് അവ മഴവെള്ളത്തിൽലയിച്ച് കടലിലേക്ക് ഒഴുകിപ്പോകുന്നു.
 - B. ഹാലോജനുകൾ ക്രിയാശീലമുള്ള ലോഹങ്ങളാണ്.
 - C. ഹാലോജനുകൾ സംയുക്തങ്ങളായി മാത്രമേ കാണപ്പെടുന്നുള്ളൂ.
 - D. ഹാലോജൻ ലവണങ്ങൾ സമുദ്രത്തിൽ ഉല്പാദിപ്പിക്കുന്നതുകൊണ്ട്.



37. $2\text{Cu}^{+2}\text{O}^{-2} + \text{C}^0 \rightarrow 2\text{Cu}^0 + \text{C}^{+4}\text{O}^{-2}$ ഈ രാസപ്രവർത്തനത്തെ സംബന്ധിച്ച് താഴെകൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ ശരി ഏത് ?

- A. കാർബൺ നിരോക്സീകരിക്കപ്പെടുകയും കോപ്പർ ഓക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
- B. കോപ്പർനിരോക്സീകരിക്കപ്പെടുകയും കാർബൺ ഓക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
- C. ഓക്സിജൻ ഓക്സീകരിക്കപ്പെടുകയും കാർബൺ നിരോക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.
- D. ഓക്സിജൻ നിരോക്സീകരിക്കപ്പെടുകയും കാർബൺ ഓക്സീകരിക്കപ്പെടുകയും ചെയ്യുന്നു.

38. വാട്ടർ ഗ്യാസ് ഏതിന്റെയൊക്കെ മിശ്രിതമാണ്.

- A. CO_2, H_2
- B. C, H_2
- C. C, O_2
- D. CO, H_2

39. HNO_3 യിൽ നൈട്രജന്റെ ഓക്സീകരണാവസ്ഥ എത്ര?

- A. -2
- B. +5
- C. +1
- D. -6

40. ഒരു മൂലകത്തിന്റെ ഗ്രൂപ്പ് നമ്പർ 6 ആണ്. അതിന്റെ ബാഹ്യതമഷെല്ലിലെ ഇലക്ട്രോണുകളുടെ എണ്ണമെത്ര ?

- A. 6
- B. 4
- C. 2
- D. 1

**UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
TEST OF ACHIEVEMENT IN PHYSICAL SCIENCE**

Dr. USHA P. and SUCHITRA K.

(Final Test)

Time: 60 minutes

(Approximate English Translation)

Instructions

1. This is a test of Physics and Chemistry. Part A consists of 40 questions in Physics and Part B consists of 40 questions in Chemistry. Separate response sheet is provided for marking answers.
2. For each question, four answers are given marked as A, B, C, D. Among these four, only one is correct answer.
3. Find out the correct answer for each question. Against each question in the response sheet, A, B, C, D are given. Mark the correct answer against the particular question number by putting an 'x' mark on the alphabet.
4. To change the first marking at a wrong place, darken the first marking and put 'x' mark on the correct alphabet.

Example 1

Which of the following is an example for a compound?

- A. Oxygen B. Ammonia C. Helium D. Chlorine
A ~~B~~ C D

Try to attempt as many questions as possible within the time limit.

PART A

PHYSICS

1. Which of the following is a non-magnetic substance?
A. Cobalt B. Glass C. Nickel D. Iron
2. Which of the following instrument is used for measuring current?
A. Ammeter B. Rheostat C. Resistance box D. Voltmeter

3. A passenger standing inside a fast moving bus tends to fall forward if the driver applies a sudden break. Why?
- A. Inertia B. Friction C. Momentum D. Centrifugal force
4. Water reservoirs are constructed at high places and at high altitude, what is the reason?
- A. At high places water will be pure B. At high places water will be cool
- C. If water is collected at high altitudes it acquires sufficient pressure and thereby water reaches everywhere
- D. It will be convenient to put pipelines to different direction from a high altitude.
5. Acceleration is defined as
- A. Speed in unit time B. Displacement in unit time
- C. Change in velocity in unit time D. velocity in unit time.
6. What is the principle of working of a rocket?
- A. Acceleration of a body is directly proportional to the external force.
- B. Acceleration of a body is inversely proportional to the mass of the particle
- C. A body continues to be in a state of rest or of uniform motion along a straight line, unless it is compelled by an external force to change its position of rest or motion
- D. For every action, there is an equal and opposite reaction.
7. Equal volume of all gases at the same temperature and same pressure contain the same number of molecules. Which is the law?
- A. Boyle's law B. Avogadro law C. Ohm's law D. Charle's law
8. What are the two ends of a magnet called?
- A. Positive and negative B. Blue and red
- C. Anode and cathode D. North pole and south pole
9. Which of the following liquids exhibit maximum mobility?
- A. Honey B. Mercury C. Kerosene D. Castor oil
10. Name the force of attraction between same kind of molecules?
- A. Surface tension B. Force of cohesion
- C. Force of adhesion D. Viscous force
11. How much is the weight of an object at the centre of the earth?
- A. Zero B. Actual weight of the object
- C. Less than the actual weight D. Greater than the actual weight

12. Which of the following is a conductor?
A. Plastic B. Aluminium C. Rubber D. Diamond
13. A copper coin and a feather are dropped at the same time into a vacuum glass tube. Which of them will reach the bottom of the glass tube first?
A. Feather B. Copper coin
C. Both do not reach the bottom D. Both reach the bottom at the same time
14. Name the substance used for making strong artificial magnets?
A. Nichrom B. Duralumin C. Tungston D. Alnico
15. Which of the following is not a longitudinal wave?
A. Water wave B. Wave in a spring C. Sound wave D. Light wave
16. What is called the quantity of heat absorbed by unit mass of a substance during its change of state?
A. Latent heat B. Boiling point
C. Latent heat of vapourisation D. Specific heat
17. An object which is having a mass of 100 kg is at rest. How much is its momentum?
A. 0 B. $100 \text{ kgm} / \text{s}^2$ C. $50 \text{ kg m} / \text{S}^2$ D. $25 \text{ kgm} / \text{s}^2$
18. When we touch a piece of copper and a piece of glass heated in an open flame for same duration, we feel that
A. Copper has higher temperature than glass
B. Glass has higher temperature than copper
C. Both have same temperature
D. Copper is cooler than glass.
19. Which of the following is an insulator?
A. Carbon B. Iron C. Rubber D. Copper
20. If 'm' is the mass of the substance and 'V' is the velocity, find its momentum?
A. mV B. Mv^2
C. $\frac{m}{V}$ D. $\frac{m}{V^2}$
21. What will happen to the water level when a piece of ice melts in a beaker containing water?
A. Water level increases B. Water level decreases
C. Water level remains the same D. Water level first increases, then decreases

22. Weight of an object in the moon is 50 kg. What will be the weight of the same object on earth?
 A. Zero B. 50 kg C. 100 kg D. 200 kg
23. What is the potential energy of a stone at a maximum weight?
 A. $3 \times 10^8 \text{ m / sec}^2$ B. $3.28 \times 10^8 \text{ m /sec}^2$
 C. 0 D. 0.25
24. In which of the following situations a motor car has maximum inertia?
 A. When the car starts moving
 B. When the car travels in uniform speed
 C. When the car travels in high speed
 D. When the car travels in uniform acceleration
25. Which among the following is a wrong statement about surface tension?
 A. Surface tension is related to liquid
 B. A tension to reduce area of liquid surface
 C. This is created by the molecular attraction
 D. Capillarity increases with an increase of surface tension
26. A man runs 50 meters in 5 seconds. Find his speed of running.
 A. 250 ms B. 45 m/s C. 10 m/s D. 55 m/s
27. Which of the following is a correct lens equation?
 A. $\frac{1}{u} + \frac{1}{f} = \frac{1}{v}$ B. $\frac{1}{f} + \frac{1}{v} = \frac{1}{u}$
 C. $\frac{1}{u} - \frac{1}{v} = \frac{1}{f}$ D. $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$
28. Which one of the following is an example for capillarity?
 A. Blotting paper absorb ink
 B. Wetting fingers while counting currency note
 C. Using soap for washing clothes
 D. Strong body massage given to a person who has got an electric shock
29. Why does a rubber rod get negative charge when it is rubbed with wool?
 A. Electrons are transferred from wool to rubber
 B. Electrons are transferred from rubber to wool
 C. Protons are transferred from wool to rubber
 D. Protons are transferred from rubber to wool

30. It is easy to roll a substance than to slide it. Give reason.
- When it is rolled, friction is not at all felt
 - Sliding friction is less than rolling friction
 - Sliding friction is greater than rolling friction
 - Surface is smooth.
31. The weight of a jar which is completely filled with water is 700 g. An object weighing 100 g is put into the jar so that it is completely immersed in water. What will be the weight of the jar after the object is put into the jar?
- A. 100g B. 500 g C. 700 g D. 800 g
32. Which of the following phenomena is indicated by Newton's second law?
- A. Acceleration B. Force C. Momentum D. Pressure
33. How much is the specific heat of water?
- A. $4.18 \times 10^3 \text{ J / Kg}^\circ\text{c}$ B. $0.24 \times 10^3 \text{ J/Kg}^\circ\text{C}$
C. $0.48 \times 10^3 \text{ J/Kg}^\circ\text{c}$ D. $0.50 \times 10^3 \text{ J/K}^\circ\text{C}$
34. A man can see objects within 10 meters. What type of glass is recommended for seeing distant objects?
- A. Converging lens B. Plain glass
C. Diverging lens D. Cut glass
35. A glass beaker is first filled half with water and then the other half with coconut oil. A red pencil is put into the liquid so that a portion of it is seen above the liquid level. If we observe the pencil through the side of the beaker, how does it appear?
- A. Erect B. Bends are seen in two places
C. Bends are seen in three places D. Appears double
36. Indicate the temperature corresponding to absolute zero?
- A. 0°C B. 100°C C. -273°C D. 273°C
37. Temperature of human body is 37°C . Convert this to Kelvin scale.
- A. 37 K B. 100 K C. 236 K D. 310 K
38. Water wets a piece of cloth much faster than mercury does. Give the reason.
- Water is a compound whereas mercury is an element
 - The density of water is less than that of mercury
 - The surface tension of water is less than that of mercury
 - The mobility of water is greater than that of mercury

39. We are unable to hear the sound of a terrific explosion which happens on the moon. What is the reason?
- A. There is no medium for sound to travel
 - B. Because it is ultrasonic sound, it cannot be heard
 - C. Because it is infrasonic sound, it cannot be heard.
 - D. Sound cannot be heard because it is electromagnetic waves.
40. Water in an earthen pot will be cool in summer. Why?
- A. Water evaporates through the pores of the earthen pot.
 - B. Earthen pot is a poor conductor of heat
 - C. Earthen pot radiates the heat of the water inside it
 - D. Earthen pot absorbs the heat of water.

PART B
CHEMISTRY

1. Which of the following gas has the smell of rotten eggs?
- A. Ammonia
 - B. Nitrous oxide
 - C. Hydrogen sulphide
 - D. Sulphur dioxide
2. The best definition of the term 'mole' is that it is the unit
- A. which is used for denoting the number of atoms, molecules, ions and electrons
 - B. adopted to express atomic number
 - C. adopted to express atomic weight
 - D. used to denote volume of gases at S.T.P.
3. Who discovered the electronegativity scale to compare the electronegativity of elements?
- A. Mendeleev
 - B. Heisenberg
 - C. de Broglie
 - D. Linus Pauling
4. What are the components of the nucleus of an atom?
- A. Neutron, Proton
 - B. Neutron, Electron
 - C. Proton, Electron
 - D. Electron, Positron
5. "It is not possible to find out the momentum and position of subatomic particles at the same time". This principle is known as
- A. Uncertainty principle
 - B. Avogadro's law
 - C. Wave theory
 - D. Wave Mechanics

6. What is the molecular weight of carbon dioxide molecule?
A. 38 B. 30 C. 44 D. 42
7. What is an orbital?
A. The path along which electron moves
B. The path along which proton moves
C. Region where there is a probability of finding electrons
D. Region where there is a probability of finding protons
8. Which element has the highest electronegativity?
A. Fluorine B. Chlorine C. Bromine D. Iodine
9. Which of the following form the basis for classification of elements in the modern periodic table?
A. Density B. Atomic weight
C. Atomic number D. Number of atoms in the molecule
10. On the basis of maximum number of electrons that can be accommodated in the orbital of an atom, four, electronic configurations are given. Among them which one is not correct?
A. $3s^3$ B. $3d^2$ C. $4p^2$ D. $4f^3$
11. Which element has the smallest atom?
A. Hydrogen B. Fluorine C. Helium D. Oxygen
12. The atomic number of an element is 12. How many electrons are there in its outermost orbit?
A. 1 B. 2 C. 3 D. 8
13. How many atoms are there in sulphur molecule?
A. 5 B. 6 C. 7 D. 8
14. What happens to the size of the atoms that are arranged from top to bottom in a group in the periodic table?
A. Increases B. Decreases
C. No change D. First decreases and then increases
15. Which of the following compound destroys the ozone layer in the atmosphere?
A. Hypochlorous acid B. Chlorofluoro carbon
C. Polychlorinated biphenyls D. Hydrofluoro carbon
16. Which of the following element is used as the basis for comparing the mass of atoms?
A. H^1 B. H^2 C. C^{12} D. C^{14}

17. An atom becomes a negative ion when it
- A. Gains electron B. Loses electron
C. Loses proton D. Gains proton
18. Which of the following denotes physical change?
- A. Burns magnesium ribbon
B. Strikes a match stick
C. Electricity passes through water containing acid
D. Boils water
19. Which chemical is known as the 'King of chemicals'?
- A. H_2SO_4 B. HCl C. HNO_3 D. CuSO_4
20. What is the chemical formula for bleaching powder?
- A. CaOCl_2 B. $\text{Ca}(\text{OH})_2$ C. CaCO_3 D. CaCl_2
21. What is aquaregia?
- A. It is a mixture of con: nitric acid and Con: hydrochloric acid in the ratio 1:3
B. It is a mixture of con: sulphuric acid and con: nitric acid in the ratio 3:1
C. It is a mixture of con: hydrochloric acid and con: sulphuric acid in the ratio 1:3
D. It is a mixture of con: sulphuric acid and con: hydrochloric acid in the ratio 3:1
22. The pH of a solution is 4, the solution belong to which of the following category?
- A. Acidic B. Alkaline C. Neutral D. Water
23. Increase in the quantity of which one of the following compounds in the atmosphere causes acid rain?
- A. Sulphur dioxide and nitric oxide
B. Carbon monoxide and hydrogen sulphate
C. Carbon dioxide and oxygen
D. Ozone dust
24. Find out the chemical equation for the combination of hydrogen and nitrogen to form ammonia
- A. $\text{N} + 3 \text{H} \longrightarrow \text{NH}_3$ B. $\text{N} + \text{H}_3 \longrightarrow \text{NH}_3$
C. $2 \text{N}_2 + 2 \text{H}_2 \longrightarrow 2 \text{NH}_3$ D. $\text{N}_2 + 3 \text{H}_2 \longrightarrow 2 \text{NH}_3$
25. Take some manganese dioxide in a test tube. Add concentrated hydrochloric acid and heat. A greenish yellow gas with a pungent smell is produced. Which is the gas?
- A. Fluorine B. Chlorine C. Bromine D. Iodine

33. Mass number of an element is 14 and its atomic number is 7. Find out the number of protons, neutrons and electrons in it.
A. 14, 7, 7 B. 7, 14, 7 C. 7, 7, 14 D. 7, 7, 7
34. An element X (electron configuration 2, 8, 1) combines with an element Y (electron configuration 2, 8, 7) to form a compound XY. Find out the type of bonding in this compound.
A. Metallic bond B. Ionic bond C. Covalent bond D. Triple bond
35. Valency of aluminium is 3 and that of oxygen is 2. Give the molecular formula of aluminium oxide.
A. Al_3O_2 B. 3AlO_2 C. O_2Al_3 D. Al_2O_3
36. Why halogens are seen as sea salts?
A. Since halogen salt are water soluble, they get dissolved in rain water and are carried to the sea.
B. Halogens are metals having high reactivity
C. Halogens are seen only as compounds
D. Since halogen salts are produced in the sea, halogens are seen as sea salt.
37. $2\text{Cu}^{+2}\text{O}^{-2} + \text{C}^0 \rightarrow 2\text{Cu}^0 + \text{C}^{+4}\text{O}^{-2}$. Which of the following statements regarding the given reaction is correct?
A. Carbon redoxes and copper oxidises
B. Copper redoxes and carbon oxidises
C. Oxygen oxidises and carbon redoxes
D. Oxygen redoxes and carbon oxidises
38. Which of the following gases combined to form water gas?
A. CO_2, H_2 B. C, H_2 C. C, O_2 D. CO, H_2
39. What is the oxidation state of nitrogen in HNO_3 ?
A. -2 B. +5 C. +1 D. -6.
40. If group number of an element is 6, what is the number of electrons in its outermost shell?
A. 6 B. 4 C. 2 D. 1

PUNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION C

TEST OF ACHIEVEMENT IN PHYSICAL SCIENCE

 TRESPONSE SHEET

വിദ്യാർത്ഥിയുടെ പേര് ക്ലാസ്സ് ക്ലാസ്സ് നമ്പർ
 സ്കൂളിന്റെ പേര് ആൺകുട്ടി/പെൺകുട്ടി വയസ്സ്

PART A - PHYSICS

Sl. No.					Sl. No.				
1	A	B	C	D	21	A	B	C	D
2	A	B	C	D	22	A	B	C	D
3	A	B	C	D	23	A	B	C	D
4	A	B	C	D	24	A	B	C	D
5	A	B	C	D	25	A	B	C	D
6	A	B	C	D	26	A	B	C	D
7	A	B	C	D	27	A	B	C	D
8	A	B	C	D	28	A	B	C	D
9	A	B	C	D	29	A	B	C	D
10	A	B	C	D	30	A	B	C	D
11	A	B	C	D	31	A	B	C	D
12	A	B	C	D	32	A	B	C	D
13	A	B	C	D	33	A	B	C	D
14	A	B	C	D	34	A	B	C	D
15	A	B	C	D	35	A	B	C	D
16	A	B	C	D	36	A	B	C	D
17	A	B	C	D	37	A	B	C	D
18	A	B	C	D	38	A	B	C	D
19	A	B	C	D	39	A	B	C	D
20	A	B	C	D	40	A	B	C	D

RESPONSE SHEET

PART B - CHEMISTRY

Sl. No.					Sl. No.				
1	A	B	C	D	21	A	B	C	D
2	A	B	C	D	22	A	B	C	D
3	A	B	C	D	23	A	B	C	D
4	A	B	C	D	24	A	B	C	D
5	A	B	C	D	25	A	B	C	D
6	A	B	C	D	26	A	B	C	D
7	A	B	C	D	27	A	B	C	D
8	A	B	C	D	28	A	B	C	D
9	A	B	C	D	29	A	B	C	D
10	A	B	C	D	30	A	B	C	D
11	A	B	C	D	31	A	B	C	D
12	A	B	C	D	32	A	B	C	D
13	A	B	C	D	33	A	B	C	D
14	A	B	C	D	34	A	B	C	D
15	A	B	C	D	35	A	B	C	D
16	A	B	C	D	36	A	B	C	D
17	A	B	C	D	37	A	B	C	D
18	A	B	C	D	38	A	B	C	D
19	A	B	C	D	39	A	B	C	D
20	A	B	C	D	40	A	B	C	D

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Appendix VI E

Test of Achievement in Physical Science – Scoring Key

PART A				PART B			
1.	B	21.	C	1.	C	21.	A
2.	A	22.	D	2.	A	22.	A
3.	A	23.	C	3.	D	23.	A
4.	C	24.	A	4.	A	24.	D
5.	C	25.	D	5.	A	25.	B
6.	D	26.	C	6.	C	26.	A
7.	B	27.	D	7.	C	27.	A
8.	D	28.	A	8.	A	28.	D
9.	C	29.	A	9.	C	29.	C
10.	B	30.	C	10.	A	30.	D
11.	A	31.	C	11.	A	31.	A
12.	B	32.	C	12.	B	32.	B
13.	D	33.	A	13.	D	33.	D
14.	D	34.	C	14.	A	34.	B
15.	D	35.	B	15.	B	35.	D
16.	A	36.	C	16.	C	36.	A
17.	A	37.	D	17.	A	37.	B
18.	A	38.	C	18.	D	38.	D
19.	C	39.	A	19.	A	39.	B
20.	A	40.	A	20.	A	40.	A