C 4030

INTEGRATED P.G. ENTRANCE EXAMINATION, APRIL 2021

PHYSICS AND CHEMISTRY

Time : Two Hours $\hspace{6cm}$ Maximum : 400 Marks

Instructions to Candidates

- Candidates are provided with a Question Booklet and an OMR Answer Sheet to mark the responses. Write the Register Number, Date of Examination and the integrated programme chosen by the candidate (Physics/Chemistry) in the space provided on the top of this booklet. Read carefully all the instructions given on the OMR sheet.

- This Question booklet contains of 100 objective type questions, with 30 questions in Section A : Physics, 30 questions in Section B : Chemistry, 20 questions in Section C : Mathematics, 10 questions in Section D : Biology and 10 questions in Section E : Computer Science. Each right and wrong answer will carry 4 and – 1 mark respectively.

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Section A (Physics)

1. A simple pendulum completes 20 oscillations in 25 s. The time is measured with a stop watch least count 0.1 s. The error in the measurement of time is :

   a) 1.6 %.
   b) 1.2 %.
   c) 0.8 %.
   d) 0.4 %.

2. The dimensional formula for latent heat is :

   a) $M^0 L^2 T^{-2}$.
   b) $M L^2 T^{-2}$.
   c) $M L T^{-2}$.
   d) $M L^2 T^{-1}$.

3. Find the ratio of distance covered to the displacement covered by a body along a semicircle of radius r :

   a) 2π.
   b) $\pi/2$.
   c) π.
   d) 3π.

4. The direction of motion of a projectile at the highest point of its trajectory is :

   a) Horizontal.
   b) Vertical.
   c) Tangential.
   d) None of these.

5. A hunter has a machine gun that can fire 50 g bullets with a velocity of 150 ms⁻¹, A 60 kg tiger springs at him with a velocity of 10 ms⁻¹. How many bullets must the hunter fire into the tiger in order to stop him in his track ?

   a) 80.
   b) 10.
   c) 32.
   d) 96.

6. The working of a rocket is based on the principle of :

   a) Elasticity.
   b) Newtons Law.
   c) Kepler's Law.
   d) Conservation of momentum.

Turn over

7. The escape velocity of a body depends on mass as :

    a) m^0.

    b) m.

    c) m^2.

    d) m^3.

8. A body floats in water such that 0.3 of its volume is outside. The relative density of the body is :

    a) 0.7.

    b) 0.3.

    c) 0.6.

    d) 3/7.

9. 540 g of ice at 0 °C is mixed with 540 g of water at 80 °C. The final temperature of the mixture is :

    a) 40°C.

    b) 0 °C.

    c) 80 °C.

    d) Less than 1 °C.

10. The rate of flow of a liquid in a capillary tube of length L and radius r is V. Then the rate of flow of the same liquid in another capillary tube of length 2L and radius $2r$ is :

    a) 2V.

    b) 4V.

    c) 8V.

    d) 16 V.

11. The spherical shape of rain drop is due to :

    a) Density of water.

    b) Gravity.

    c) Viscosity.

    d) Surface tension.

12. If the masses of all molecules of a gas are halved and their speeds doubled, then the ratio of initial and final pressures will be :

    a) 2 : 1.

    b) 1 : 2.

    c) 4 : 1.

    d) 1 : 4.

13. For a simple pendulum the graph between L and T will be a :

    a) Hyperbola.

    b) Curved one.

    c) Parabola.

    d) Straight line.

14. A source of sound is travelling with a velocity 40 km h^{-1} towards an observer and emits sound of frequency 200 Hz. If the velocity of sound is 1220 km h^{-1}, then what is the apparent frequency heard by an observer ?

    a) 206. 8 Hz.

    b) 218.0 Hz.

    c) Same frequency.

    d) 198. 0 Hz.

15. The speed of sound will be greatest in :

    a) Air.   b) Vacuum.

    c) Water.   d) Metal.

16. The point charges Q and $-2Q$ are placed at some distance apart. If the electric field at the location of Q is E, then the electric field at the location of $-2Q$ will be :

    a) $-E/2$.   b) $-3E/2$.

    c) $-E$.   d) $-2E$.

17. 27 drops of same size are charged at 220 V each. They coalesce to form a bigger drop. Calculate the potential of the bigger drop :

    a) 110 V.   b) 340 V.

    c) 1980 V.   d) 2341 V.

18. Ten identical wires each having a resistance of 1 Ω are connected in parallel. The combination will have a resistance of :

    a) 10 Ω.   b) 1 Ω.

    c) 0.1 Ω.   d) 0.01 Ω.

19. If the horizontal components of earths magnetic field at a place is 0.3×10^{-4} T. If the angle of dip is 60°, what is the total magnetic field of earth ?

    a) 0.4×10^{-4} T.   b) 0.34×10^{-4} T.

    c) 0.8×10^{-4} T.   d) 0.6×10^{-4} T.

20. At curie point, a ferromagnetic material becomes :

    a) Non-magnetic.   b) Diamagnetic.

    c) Paramagnetic.   d) Ferrimagnetic.

21. A 44 mH inductor is connected to 220 V, 50 Hz a.c. supply. Determine the r.m.s. value of current in the circuit :

    a) 15.9 A.   b) 16.4 A.

    c) 16.7 A.   d) 7.8 A.

Turn over

22. Velocity of light is equal to :

    a) $\sqrt{\varepsilon_0 \mu_0}$.

    b) ε_0/μ_0.

    c) $\sqrt{\varepsilon_0/\mu_0}$.

    d) $1/\sqrt{\varepsilon_0/\mu_0}$.

23. In a Young's double slit experiment, two wavelengths of 500 nm and 700 nm are used. What is the maximum distance from the central maximum, were their maximas coincide again ? Take $D/d = 10^3$. Symbols have their usual meaning :

    a) 4.3 mm.

    b) 3.5 mm.

    c) 3.7 mm.

    d) 8.2 mm.

24. Two mirrors are kept at 60° to each other and a body is placed at middle. The total number of images formed is :

    a) Six.

    b) Four.

    c) Five.

    d) Three.

25. An endoscope is employed by a physician to view the internal parts of a body organ. It is based on the principle of :

    a) Refraction.

    b) Reflection.

    c) Total internal reflection.

    d) Dispersion.

26. A radioactive element has a half-life period of 1600 years. After 6400 years what amount will remain ?

    a) 1/2.

    b) 1/16.

    c) 1/8.

    d) 1/4.

27. In terms of Bohr radius a_0, the radius of the second Bohr orbit of a hydrogen atom is given by :

    a) $4\, a_0$.

    b) $8\, a_0$.

    c) $6\, a_0$.

    d) $2\, a_0$.

28. An intrinsic semiconductor, at absolute zero temperature behaves like :

    a) Insulator.

    b) Superconductor.

    c) n-type semiconductor.

    d) p-type semiconductor.

29. In a binary number system, 111 represents :

    a) One.   b) Three.

    c) Seven.   d) Six.

30. The maximum distance up to which TV transmission from a TV tower of height h can be received is proportional to :

    a) $h^{3/2}$.   b) h.

    c) $h^{1/2}$.   d) h^2.

Section B (Chemistry)

31. The largest number of molecules is in :

    a) 22 g CO_2.   b) 46g of C_2H_5OH.

    c) 54 g of H_2O.   d) 54g of N_2O_5.

32. The standard reduction potentials at 298 K for single electrodes are given below :

Electrodes	Electrode potential
Mg^{2+}/Mg	-2.34
Zn^{2+}/Zn	-0.76
Fe^{2+}/Fe	-0.44

From this we can infer that

    a) Zn can reduce both Mg^{2+} and Fe^{2+}.

    b) Fe can reduce both Mg^{2+} and Zn^{2+}.

    c) Mg can reduce both Fe^{2+} and Zn^{2+}.

    d) Mg can reduce Zn^{2+} but not Fe^{2+}.

33. Which of the following is isoelectronic with 'Ne' atom :

    a) Na^+.   b) Al^+.

    c) O^-.   d) N^{2-}.   **Turn over**

34. Which of the following condition is not satisfied by an ideal solution ?

   a) $\Delta H_{mixing} = 0.$

   b) $\Delta V_{mixing} = 0.$

   c) Raoult's Law is obeyed.

   d) Formation of an azeotropic mixture.

35. Ester hydrolysis of ethyl acetate is :

   a) First order reaction.

   b) Second order reaction.

   c) Pseudo-first order reaction.

   d) Pseudo second order reaction.

36. The rate of a certain hypothetical reaction $A + B + C \rightarrow P$ is given by

   $Rate = -d[A]/dt = k[A]^{1/2}[B]^{1/3}[C]^{1/4}$. Then the order of the reaction is :

   a) 1/24.
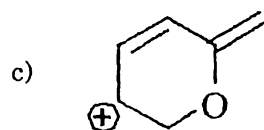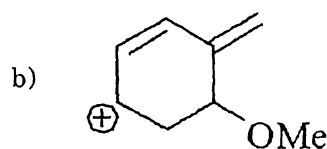
   b) 3/9.

   c) 13/12.

   d) 3.

37. The radius of second orbit of hydrogen atom is given by (in A^0) :

   a) 0.53.

   b) 1.06.

   c) 2.12.

   d) 4.24.

38. Plot of log (x/m) against log P is a straight line inclined at an angle of 45°. When the pressure is 0.5 atm and Fraundlich parameters k is 10, then the amount of solute adsorbed per gram of adsorbent will be (log 5 = 0.96) :

   a) 1 g.

   b) 2 g.

   c) 3 g.

   d) 5 g.

39. Most stable carbocation is :

   a)

   b)

   c)

   d)
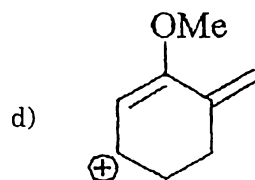
40. A real gas is expected to be ideal at :

    a) Low temperature and low pressure.

    b) Low temperature and high pressure.

    c) High temperature and low pressure.

    d) High temperature and high pressure.

41. The correct statement regarding with the molecules NH_3, H_2O, and CH_4 is :

    a) They have same number of lone pair electrons.

    b) They have tetrahedral geometry.

    c) They have same bond angle.

    d) All of them are showing sp^3 hybridization.

42. Which one the following is aromatic ?

    a) Cyclopentadienyl cation.   b) Cyclopropenyl anion.

    c) Cycloheptatrienyl cation.   d) Cyclopentadiene.

43. The correct acidic order from the following is :

    a) $BF_3 < BCl_3 < BBr_3 < BI_3$.   b) $BF_3 > BCl_3 > BBr_3 > BI_3$.

    c) $BCl_3 < BF_3 < BBr_3 < BI_3$.   d) $BCl_3 > BF_3 > BBr_3 > BI_3$.

44. The ratio of shortest distance between cation and anion in NaCl to that of CsCl is :

    a) $(3)^{-1/2}$.   b) $1/\sqrt{2}$.

    c) $\sqrt{2}/\sqrt{3}$.   d) 1.

45. The electronic configuration of central metal ion in $\left[Co\left(NH_3\right)_6 \right]Cl_3$ is :

    a) $t_{2g}^6\ eg^0$.   b) $t_{2g}3\ eg^3$.

    c) $t_{2g}^4\ eg^2$.   d) $t_{2g}^2\ eg^4$.

Turn over

46. Number of self-aldol condensation reaction in formaldehyde is :

   a) 1.   b) 2.

   c) 3.   d) 0.

47. Identify product C

$$\text{(p-nitrobenzaldehyde)} \xrightarrow[\Delta]{SnCl_2/HCl} \text{'A'} \xrightarrow{CH_3COCl} \text{'B'} \xrightarrow{Br_2/H_2O} \text{'C'}, \text{Product 'C' is}$$

a)

b)

c)

d)

48. 4-Nitrotoluene is treated with bromine to get P. 'P' is reduced with Sn/HCl to get compound Q. Q is diazotized and the product is treated with phosphinic acid to get compound 'R', 'R' is oxidised with alkaline $KMnO_4$ to get 'S'. Compound 'S' is :

   a) 2-Bromo-4-hydroxy benzoic acid.   b) 3-Bromo benzoic acid.

   c) 4-Bromo benzoic acid.   d) 2-Bromo benzoic acid.

49. Slag formed during the extraction of Iron is :

   a) $CaSiO_3$.   b) CaO.

   c) SiO_2.   d) $FeSiO_3$.

50. Iodoform reaction is shown by :

   a) Phenol.   b) Benzoic acid.

   c) Acetaldehyde.   d) Formaldehyde.

51. The incorrect statement in the following is :

     a)   Transition state is formed during $S_N{}^1$ reaction.

     b)   Carbocation is formed in $S_N{}^1$ reaction.

     c)   Inversion takes place during $S_N{}^2$ reaction.

     d) $S_N{}^2$ reaction is a single step reaction.

52. The order of basicity of methyl substituted amines in aqueous solution is :

     a) $3° > 2° > 1°$.   b) $2° > 1° > 3°$.

     c) $1° > 2° > 3°$.   d) $2° > 3° > 1°$.
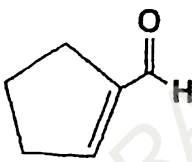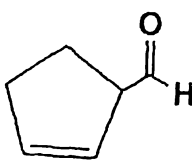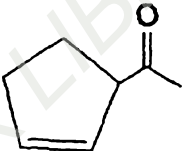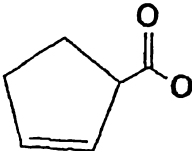
53. Which of the following has magnetic moment value of 5.9 ?

     a) Cu^{2+}.   b) Cr^{2+}.

     c) Fe^{2+}.   d) Fe^{3+}.

54. Cannizzaro reaction is not given by :

     c)   HCHO.   d) CH_3CHO.

55. Ozonolysis followed by Zn/H_2O treatment of cyclohexene yield compound 'A'. Which upon treatment with KOH, compound 'B' is formed. Compound 'B' is :

56. The process occur under adiabatic condition, the correct condition is :

     a) $\Delta V = 0$.   b) $w = 0$.

     c) $\Delta T = 0$.   d) $q = 0$.

Turn over

57. In a process, 500 J of heat is absorbed by a system and 300 J of work is done by the system. What is the change in internal energy for the process :

    a) 200 J.

    b) 800 J.

    c) -200 J.

    d) -800 J.

58. Which of the following reactions does not involve either oxidation or reduction ?

    a) $VO^{2+} \rightarrow V_2O_3$.

    b) $Mg \rightarrow Mg^{2+}$.

    c) $CrO^{2-}_4 \rightarrow Cr_2O_2^{-7}$.

    d) $Zn^{2+} \rightarrow Zn$.

59. Monomer of polystyrene is :

    a) $C_2H_5—CH=CH_2$.

    b) $CH_2=CH-Cl$.

    c) $CH_2=CH—CHO$.

    d) $Ph-CH=CH_2$.

60. The ion having highest bond order is :

    a) NO^+.

    b) O_2^+.

    c) N_2^+.

    d) C_2^+.

Section C (Mathematics)

61. The function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \dfrac{e^{|x|} - e^{-x}}{e^x + e^{-x}}$ is:

    a) Bijective.

    b) Injective but not surjective.

    c) Surjective but injective.

    d) Neither injective nor surjective.

62. If z_1 and z_2 are two complex numbers such that $|z_1 + z_2| = |z_1| + |z_2|$. Then :

    a) $\arg(z_1) - \arg(z_2) = 0$.

    b) $\arg(z_1) - \arg(z_2) = -\pi$.

    c) $\arg(z_1) - \arg(z_2) = \dfrac{\pi}{2}$.

    d) $\arg(z_1) - \arg(z_2) = \pi$.

63. If a, b, c are in GP and $a - b, c - a,$ and $b - c$ are in HP, then $a + 4(b+1) + c$ is equal to :

    a) 0.

    b) -2.

    c) 4.

    d) 2.

64. Number of real roots of the equation $x|x| - 3|x| + 3 = 0$ is :

    a) 1.

    b) 4.

    c) 0.

    d) 2.

65. What number of ways we can select two or more items form a group of 100 distinct items ?

    a) 2^{100}.

    b) $100^2 - 2$.

    c) $2^{100} - 1$.

    d) $2^{100} - 101$.

66. The number of ordered triplets of positive integers whose sum equal to 100 is :

   a) 5081.

   b) 6005.

   c) 4851.

   d) 4891.

67. The line $x + y = 4$ divides the line joining the points $(-1, 1)$ and $(5, 7)$ in the ratio :

   a) $2 : 1$.

   b) $1 : 2$.

   c) $1 : 1$.

   d) $2 : 3$.

68. The equation of a circle passing through the point $(1, 1)$ and cuts the circles $x^2 + y^2 + 2x + 4y + 6 = 0$ and $x^2 + y^2 + 4x + 6y + 2 = 0$ orthogonally is :

   a) $x^2 + y^2 + 16x + 12y + 2 = 0$.

   b) $x^2 + y^2 + 16x - 12y - 2 = 0$.

   c) $x^2 + y^2 - 16x - 12y + 2 = 0$.

   d) $x^2 + y^2 - 16x + 12y + 2 = 0$.

69. Co-ordinates of the focus of the parabola $x^2 - 4x - 8y - 4 = 0$:

   a) $(0, 2)$.

   b) $(1, 2)$.

   c) $(2, 1)$.

   d) $(-2, -1)$.

70. The eccentricity of the conic $x^2 - 4x + 4y + 4y^2 - 12 = 0$ is :

   a) $\dfrac{\sqrt{3}}{2}$.

   b) $\dfrac{3}{\sqrt{2}}$.

   c) $\dfrac{1}{2}$.

   d) $\dfrac{3}{4}$.

71. $\lim\limits_{x \to 0} \left[\tan\left(\dfrac{\pi}{4} + x \right) \right]^{\frac{1}{x}}$:

   a) e^2.

   b) e.

   c) $\sqrt{e}$.

   d) $\dfrac{1}{\sqrt{e}}$.

72. The set of all points at which the function $f(x) = \dfrac{x}{1 - |x|}$ is differentiable is :

   a) $(-\infty, 0) \cup (0, \infty)$.

   b) $(-\infty, -1) \cup (-1, \infty)$.

   c) $(-\infty, 1) \cup (1, \infty)$.

   d) $(-\infty, -1) \cup (-1, 1) \cup (1, \infty)$.

73. The point of the hyperbola $\dfrac{x^2}{24} - \dfrac{y^2}{18} = 1$ which is nearest to the line $3x + 2y + 1 = 0$:

   a) $(-6, 3)$.

   b) $(6, -3)$.

   c) $(6, 3)$.

   d) $(-6, -3)$.   **Turn over**

74. $\int_0^1 \tan^{-1} x \, dx$ is equal to :

    a) $\dfrac{\pi}{4} + \dfrac{1}{2} \log 2.$ b) $\dfrac{\pi}{4} - \dfrac{1}{2} \log 2.$

    c) $\dfrac{\pi}{4}.$ d) $\dfrac{\pi}{4} + \log 2.$

75. If $\vec{a} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = -2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c}$ and is a vector such that $\vec{a} \cdot \vec{c} = 0$ and $\vec{a} \times \vec{c} = \vec{b}$, then $\vec{c}$ is equal to :

    a) $-\hat{i} - \hat{j}.$ b) $\hat{i} - \hat{k}.$

    c) $\hat{j} + \hat{k}.$ d) $\hat{i} + \hat{j}.$

76. The angle between the lines $\dfrac{x-2}{3} = \dfrac{y+1}{-2}, z = 2$ and $\dfrac{x-1}{1} = \dfrac{2y+3}{3} = \dfrac{z+5}{2}$ is :

    a) $\dfrac{\pi}{3}.$ b) $\dfrac{\pi}{2}.$

    c) $\dfrac{\pi}{6}.$ d) $\dfrac{\pi}{4}.$

77. Out of 30 consecutive integers, three are selected at random. Then the probability of the sum of the selected numbers is divisible by 3 is equal to :

    a) $\dfrac{2}{3}.$ b) $\dfrac{136}{416}.$

    c) $\dfrac{68}{203}.$ d) $\dfrac{146}{406}.$

78. If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ then A^{13} is equal to :

    a) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}.$ b) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}.$

    c) $\begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}.$ d) $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}.$

79. Solution of the differential equation $\dfrac{dy}{dx} + y \tan x = \sec x$ is :

    a) $y = \sin x + c \cos x.$ b) $y = -\sin x + c \cos x.$

    c) $y = \cos x + c \sin x.$ d) $y = \tan x + c \cot x.$

80. If A is a finite set with 6 elements. Then number of bijections from A to A is equal to :

    a) 64.
    b) 720.
    c) 15.
    d) 36.

Section D (Biology)

81. In male cockroach, genital pouch is formed from :

    a) 7th, 8th and 9th sterna.
    b) 9th 10th terga and 9th sternum.
    c) 8th, 9th sterna and 10th tergum.
    d) 7th, 8th terga and 9th sternum.

82. In a DNA molecule, if the amount of thymine is 35%, then what is the amount of cytosine ?

    a) 35 %.
    b) 20 %.
    c) 15 %.
    d) 30 %.

83. Name the hormone secreted by the kidney :

    a) Secretin.
    b) Renin.
    c) Aldosterone.
    d) Erythropoietin.

84. In which of the following pairs of examples, both are hormone releasing IUDs ?

    a) Cu7 and Multiload 375.
    b) Progestasert and LNG 20.
    c) Multiload 375 and Progestasert.
    d) Lippes Loop and Multiload 375.

85. Industrial melanism is an example for :

    a) Natural selection.
    b) Artificial selection.
    c) Adaptive radiation.
    d) Convergent evolution.

86. Which among the following is known as phytogerentological hormone ?

    a) Auxin.
    b) Ethylene.
    c) Cytokinin.
    d) Gibberellin.

87. During photosynthesis, the immediate donor of electron to PSI is :

    a) Cty.b.
    b) Cyt.c.
    c) Ferredoxin.
    d) Plastocyanin.

88. Exanthema of fruit trees occurs due to the deficiency of :

    a) Cu.
    b) Fe.
    c) Zn.
    d) Mg.

89. Which among the following statements is **NOT** true for mature phloem sieve tube elements ?

    a) They lack ribosomes.
    b) They lack nuclei.
    c) They possess plastids.
    d) They possess microfilaments and microtubules.

90. Which among the following is **NOT** a sorosis ?

    a) Jack fruit.
    b) Mulberry.
    c) Custard apple.
    d) Pineapple.

Turn over

Section E (Computer Science)

91. FIFO policy is associated with ——————— data structure.

    a) Queue.
    b) Stack.

    c) Tree.
    d) Array.

92. In Hexadecimal number system has ——————— symbols.

    a) 10.
    b) 12.

    c) 15.
    d) 16.

93. ——————— IP address ts an example for loopback address.

    a) 127.0.0.1.
    b) 127.0.1.0.

    c) 127.1.0.0.
    d) 255.0.0.

94. HTML stands for ———————.

    a) Higher Text Makeup Language.
    b) Hyper Text Markup Language.

    c) Higher Text Markup Language.
    d) Hyper Text Making Language.

95. 1 KB means ——————— bytes.

    a) 1000.
    b) 2000.

    c) 1024.
    d) 8.

96. Which of the following is an example of system software ?

    a) MS-Office.
    b) MS-Windows.

    c) MS-Calc.
    d) MS-Excel.

97. Which of the following software is most suitable for making resume/biodata ?

    a) C++.
    b) MS-PowerPoint.

    c) MS-Excel.
    d) MS-Word.

98. Which feature of the Object Oriented Programming Language derives the class from another class ?

    a) Inheritance.
    b) Data Encapsulation.

    c) Polymorphism.
    d) Virtualization.

99. A program that is used to view website is called as ———————.

    a) Web viewer.
    b) Word processor.

    c) Browser.
    d) Spreadsheet.

100. The term ——————— is used to refer to a row in a table.

    a) Attribute.
    b) Field.

    c) Tuple.
    d) Instance.