

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3E 04—SYNTHETIC ORGANIC CHEMISTRY

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Part A*Answer all questions.**Each question carries 1 mark.*

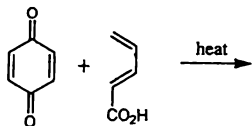
1. A stereoselective reaction gives a mixture of enantiomers in the ratio 85 : 15. The enantiomeric excess in the transformation is :
 - (a) 85.
 - (b) 15.
 - (c) 70.
 - (d) 17.6.
2. BINOL is an example of a :
 - (a) Chiral reagent.
 - (b) Chiral catalyst.
 - (c) Member of chiral pool.
 - (d) Chiral auxiliary.
3. Bischler-Nappieralski synthesis is a convenient method for the synthesis of :
 - (a) Pyridine.
 - (b) Quinoline.
 - (c) Isoquinoline.
 - (d) Pyrrole.
4. Which of the following is NOT true about Beckmann rearrangement ?
 - (a) Useful for converting cyclic ketones to lactams
 - (b) Structure of amide formed do not depend on the geometry of oximes
 - (c) Reaction proceeds through oximes
 - (d) Reaction involves a *trans* migration
5. Enzymes in detergent formulations are capable of removing :
 - (a) Proteins and starches only.
 - (b) Starches and lipids only.
 - (c) Proteins and lipids only.
 - (d) Proteins, starches and lipids.

Turn over

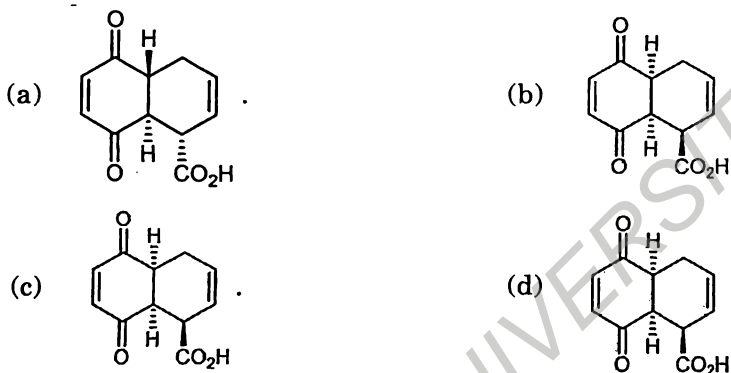
6. Which of the following is NOT a therapeutic enzyme ?

- (a) Asparaginase. (b) Glutaminase.
(c) Streptokinase. (d) Glycosidase.

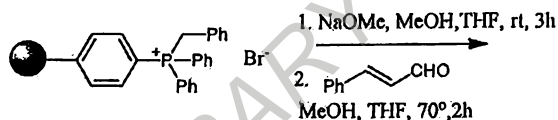
7. The following reaction was used in the Woodward synthesis of Reserpine :



The product obtained is :



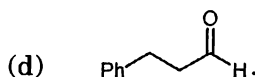
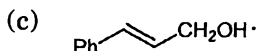
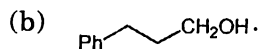
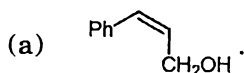
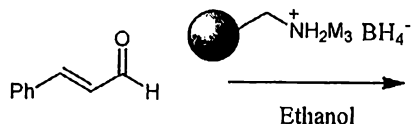
8. Predict the product in the following reaction :



9. Which of the following statement is NOT true about polymer supported reagents ?

- (a) Product isolation is simple.
(b) Multistep procedures can be done in one pot
(c) Activity of the reagents are usually higher than in solution phase leading short reaction times and higher yields.
(d) Automation is possible.

10. Predict the product in the following reaction :



11. Which of the following is NOT true for liquid crystal polymers ?

- (a) Have high heat resistance.
- (b) Have high electrical resistance.
- (c) Have intertwining molecular chains.
- (d) Have high anisotropy.

12. Which of the following is NOT a part of the resin-based oligomer matrix of a dental composite ?

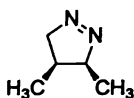
- (a) Bisphenol A-glycidyl methacrylate.
- (b) Urethane dimethacrylate.
- (c) Semi-crystalline polyceram.
- (d) Silicon dioxide.

(12 × 1 = 12 marks)

Part B

*Answer all questions.
Each question carries 2 marks.*

13. Discuss the use of chiral auxiliaries in asymmetric synthesis, stating clearly the criteria for choosing effective auxiliaries.
14. How will you access the following compound using a 1, 3-dipolar addition reaction ? Justify the answer.



Turn over

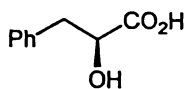
15. List the major steps in the purification of enzymes.
16. Explain the use of triethylbenzyl ammonium salts as phase transfer agents.
17. What are the advantages organic reactions in mesoporous materials over the conventional methods ?
18. Illustrate the application of polymers in medicine with any suitable example.

(6 × 2 = 12 marks)

Part C

*Answer any six questions.
Each question carries 6 marks.*

19. Suggest three methods for the preparation of the following non-racemic hydroxy acid from achiral or racemic precursors.



20. Write a brief note on the application of chiral pool strategy in asymmetric synthesis.
21. With appropriate examples illustrate the application of Bischler-Nappieralski reaction in synthesis of heterocyclic systems.
22. Give a short account of the enzymes commonly used in organic transformations and prominent enzymatic transformations.
23. Depict the steps involved up to the formation of the β-lactam ring in the synthetic scheme of penicillin V.
24. Briefly discuss the major strategies of flavone synthesis.
25. Write a note on organic reactions on organised media, with zeolite as an example.
26. What are polymer blends ? Give two examples and discuss the composition, preparation and properties.
27. Give a short account of nitroxide mediated polymerization. What are its advantages and disadvantages ?

(6 × 6 = 36 marks)

Part D

*Answer any two questions.
Each question carries 10 marks.*

28. Give an account of major electrochemical methods in organic synthesis. Give applications.
29. Write a detailed note on synthetically useful base catalysed condensation reactions for C-C bond formation.
30. Discuss the major strategies of C-N bond formation. Give examples.
31. Outline the synthesis of cephalosporin.

(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3E 03—SOLID STATE CHEMISTRY

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A*Answer all questions.*

Choose the correct answer :

- Which of the following has the largest band gap energy ?
 - Silicon.
 - Germanium.
 - Tellurium.
 - Diamond.
- Which of the following statements is not true about Fermi level ?
 - It is the highest occupied state at OK.
 - It is independent of temperature.
 - Its location is halfway between highest filled level and lowest unfilled level.
 - It is independent of the amount of impurity.
- If the current exceeds a critical level super conductivity is destroyed. It is known as :
 - Meisner effect.
 - Silsbee effect.
 - Morgen effect.
 - Kamerlingh effect.
- Which of the following is not an example for antiferromagnetism ?
 - Ni.
 - Hematite.
 - NiO.
 - Fe-Mn alloy.
- Which of the following dopants produces *p*-type semiconductivity with Germanium ?
 - Carbon.
 - Arsenic.
 - Indium.
 - Sodium.
- Which of the following shows both Schöttky and Frenkel defect ?
 - NaCl.
 - AgCl.
 - AgBr.
 - ZnO.

Turn over

7. Which of the following statements is true for decomposition of barium azide ?
- (a) Radius of nuclei increases linearly with time.
 - (b) Number of nuclei increases as the third power of time.
 - (c) Pressure of nitrogen evolved increases with the 6th to 8th power of time.
 - (d) All the above statements are true.
8. _____ is measured in DSC.
- (a) Weight loss.
 - (b) Temperature difference.
 - (c) Enthalpy.
 - (d) Time.
9. Coats Redfern equation used for the evaluation of kinetic parameters of solid state decomposition is :
- (a) A differential method.
 - (b) An integral method.
 - (c) An approximation method.
 - (d) None of the above.
10. Solid state decomposition reactions in general follows _____ order kinetics.
- (a) 0.
 - (b) 1.
 - (c) 2.
 - (d) Fractional.
11. The reference material used in DTA is :
- (a) Silica.
 - (b) MgO.
 - (c) Alpha alumina.
 - (d) Quartz.
12. TG of Calcium oxalate monohydrate shows _____ stages of decomposition.
- (a) 1.
 - (b) 2.
 - (c) 3.
 - (d) 4.

(12 × 1 = 12 marks)

Section B

*Answer all questions.
Each question carries 2 marks.*

13. Calculate the maximum wavelength of radiation to be absorbed to show photoconductivity if the band gap is 1.5 eV.
14. How would you study solid state diffusion ? Explain.
15. Account for the origin of colour centers in crystals.
16. What is the effect of doping Li₂O in NiO ? Explain.

17. Thermal decomposition of MnCO_3 was studied in both CO_2 and N_2 atmosphere. Do you find any difference in DTA curves. Justify your answer.
18. What is thermometric titration ?

(6 × 2 = 12 marks)

Section C

*Answer any six questions.
Each question carries 6 marks.*

19. Briefly discuss free electron theory of solids.
20. Discuss the effect of temperature on the electrical conductivity of metals and semiconductors.
21. Derive an equation to find the number of defects in a Schöttky defect crystal.
22. Draw alpha-time plot for the solid state decomposition $\text{A}(s) \rightarrow \text{B}(s) + \text{C}(g)$. Discuss the nature of the plot.
23. Discuss kinetics of nucleation.
24. Discuss application of SEM in the study of solid state reactions.
25. Compare DTA and DTG.
26. Briefly discuss BCS theory of superconductivity.
27. With the help of suitable examples discuss antiferromagnetism.

(6 × 6 = 36 marks)

Section D

*Answer any two questions.
Each question carries 10 marks.*

28. Briefly discuss band theory of solids.
29. Compare isothermal and non-isothermal methods of thermal analysis.
30. Discuss instrumentation and application of DSC.
31. Compare Coats Refern, Horowitz-Metzger and Freeman-Carrol equations for the evaluation of kinetic parameters for thermal decomposition of solids.

(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3E 02—NANO SCIENCE AND TECHNOLOGY

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A

*Answer all questions.**Each question carries 1 mark.*

- Nanomaterials are the materials with at least one dimension measuring less than :
 - 1 nm.
 - 10 nm.
 - 100 nm.
 - 1000 nm.
- A material with all three dimensions in the nano range and third large is called :
 - Micro-material.
 - Quantum wire.
 - Quantum well.
 - Quantum dot.
- Nanoparticles have :
 - 10^6 atoms.
 - Less than 10^6 atoms.
 - 10^8 atoms.
 - Less than 10^8 atoms.
- Which among the following is not a complementary technique for XPS ?
 - RPES.
 - IPES.
 - XAS.
 - HAS.
- The experimental technique that provides information about the nature of ligation in QCs
 - XRD.
 - FTIR.
 - TEM.
 - MALDI.
- Magic number is :
 - $1 + \sum_1^k 10k^2$.
 - $1 + \sum_1^k (10k^2 + 2)$.
 - $\sum_1^k (10k^2 + 2)$.
 - $\sum_1^k 10k^2$.

Turn over

7. _____ synthesis is very efficient for obtaining highly ordered and mesoporous nanomaterials.
- Sol-gel.
 - Vapor deposition.
 - Nanolithography.
 - Template based.
8. Electrochemical reduction method can be used for making highly size selective nanoparticles by altering the :
- Electric potential.
 - Current density.
 - Electrode.
 - Electrolyte.
9. The method used for preparing patterned array of nanoparticles :
- arc evaporation.
 - nanolithography.
 - gas phase method.
 - template based.
10. The signal enhancing mechanisms in SERS are :
- Electrical and Chemical.
 - Electro-Magnetic and Chemical.
 - Magnetic and Chemical.
 - Electrical and Magnetic.
11. Brust Synthesis is :
- Two phase reduction.
 - Single phase reduction.
 - Biomolecule assisted.
 - Etching from template.
12. _____ is evaporation of a material by AC or DC.
- SMAD.
 - Laser ablation.
 - Arc discharge.
 - Ion sputtering.

(12 × 1 = 12 marks)

Section B

Answer all questions.

Each question carries 2 marks.

13. Discuss briefly the electrical conductance of fullerene.
14. List the characteristic of nanoporous materials.
15. Illustrate the different electron beam induced process in a sample.
16. Explain how ^{13}C nmr can be used to differentiate C60 and C70.

17. List the characteristics of nanoparticles that enable their use in nanomedicine.
18. Relate surface structure and catalytic activity.

(6 × 2 = 12 marks)

Section C

*Answer any six questions.
Each question carries 6 marks.*

19. Discuss the classification on nanoparticle based on dimensional size.
20. Explain the energetics of nanoparticles.
21. Explain how XPS can be used for valence band analysis.
22. Describe Auger effect and how it can be used as complementary tool for nanoparticle characterization.
23. Discuss the key components and two applications of XRD in nanoparticle analysis.
24. Discuss how Surface Plasmon Resonance can be used for developing efficient photocatalyst.
25. Explain the principle behind the application of nanoparticles in data storage.
26. Explain the bottom-up approach for preparation of nanostructures.
27. Describe the electrochemical method for the synthesis of nanoparticles.

(6 × 6 = 36 marks)

Section D

*Answer any two questions.
Each question carries 10 marks.*

28. Discuss the different types of core shell nanoparticles.
29. Describe how Quantum confinement effect result in unusual properties at nanoscale.
30. Discuss in details the surface characterization of nanomaterials using SEM, TEM and AFM.
31. Discuss in detail the reactivity, geometry and electronic structure of nanoparticles.

(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3E 01—ORGANOMETALLIC CHEMISTRY

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A

*Answer all questions.
Each question carries 1 mark.*

- The simplest cobalt carbonyl is ———.
(a) $\text{Co}(\text{CO})_4$. (b) $\text{Co}_3(\text{CO})_9$.
(c) $\text{Co}_4(\text{CO})_{10}$. (d) $\text{Co}_2(\text{CO})_8$.
- What hapticities are possible for 1, 3-butadiene with a metal atom?
(a) 2 only. (b) 1 and 3.
(c) 2 and 4. (d) 1 and 2.
- A polynuclear carbonyl which does not contain bridging carbonyl group is ———.
(a) $\text{Co}_4(\text{CO})_{12}$. (b) $\text{Fe}_2(\text{CO})_9$.
(c) $\text{Ir}_4(\text{CO})_{12}$. (d) $\text{Rh}_6(\text{CO})_{16}$.
- The species which is isolobal with $\text{Co}(\text{CO})_3$ is ———.
(a) CH_3 . (b) CH_2 .
(c) CH . (d) CH^+ .
- The formula for cobaltcarbonylnitrosyl is ———.
(a) $\text{Co}(\text{CO})_2(\text{NO})_2$. (b) $\text{Co}(\text{CO})_3\text{NO}$.
(c) $\text{Co}(\text{CO})(\text{NO})_2$. (d) $\text{Co}(\text{CO})_2(\text{NO})_3$.

Turn over

6. The by-product formed in the characteristic reaction of $(\text{CO})_5\text{-Cr} = \text{C}(\text{OMe})(\text{Me})$ with MeNH_2 is _____.
- (a) CO. (b) MeCHO.
(c) MeOH. (d) MeCONH₂.
7. Which statement about Zeise's salt is not correct ?
- (a) It is diamagnetic.
(b) Oxidation state of Pt in this compound is + 2.
(c) All Pt-Cl bond length in Zeise's salt are equal.
(d) C-C bond length of ethylene moiety in Zeise's salt is longer than that of free ethylene molecule.
8. Oxidation state of iron in $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2] \text{BF}_4$ is _____.
- (a) + 1. (b) + 2.
(c) + 3. (d) 0.
9. The reaction ; $\text{Mn}_2(\text{CO})_{10} + \text{Br}_2 \rightarrow 2\text{MnBr}(\text{CO})_5$ is an example for _____.
- (a) Reductive elimination. (b) Oxidative addition.
(c) Insertion reaction. (d) Reductive addition.
10. Which catalyst is involved in olefin metathesis ?
- (a) Schrock arbenes organometallic. (b) Palladium (II) complexes.
(c) Zeise's salt. (d) Nickel (II) complexes.
11. The catalyst and co-catalyst used in Wacker process respectively are _____.
- (a) Pd and Cu. (b) Pd and CuCl.
(c) CuCl_2 and $[\text{PdCl}_4]^{2+}$. (d) $[\text{PdCl}_4]^{2-}$ and CuCl_2 .
12. The intermediate formed during the hydroformylation of olefins using $\text{Co}_2(\text{CO})_8$ as catalyst is _____.
- (a) $\text{HCo}(\text{CO})_6$. (b) $\text{H}_2\text{Co}(\text{CO})_4$.
(c) $\text{HCo}(\text{CO})_4$. (d) $\text{H}_4\text{Co}(\text{CO})_3$.

(12 × 1 = 12 marks)

Section B

Answer all questions.

Each question carries 2 marks.

13. What do you mean by hapticity of organometallic compounds ? Explain with examples.
14. With reference to metal carbonyls, what is meant by matrix isolation?
15. Which is less reactive ; Fischer carbenes or Schrock carbenes ? Give reasons.
16. What is Pauson-Khand reaction ?
17. What is meant by oxidative coupling ? Explain with an example.
18. The polymer produced by Ziegler-Natta catalysis is generally stereoregular ; why ?

(6 × 2 = 12 marks)

Section C

Answer any six questions.

Each question carries 6 marks.

19. Explain 16- and 18-electron rules as applied to organometallic compounds.
20. How IR spectroscopy can be used to identify the different bonding modes of CO to towards a metal atom ?
21. Give an account of the synthesis and structure of carbyne organometallics.
22. Write a note on fluxional organometallics.
23. Explain reductive elimination and oxidative coupling reactions of organometallic compounds.
24. Discuss the catalytic cycle and mechanism involved in Monsanto acetic acid process.
25. How is methyl lithium prepared ? Explain the formation of molecular aggregates by this compound.
26. What are carbometallates ? Give any *two* synthetic routes for the preparation of these compounds. Mention any two important reactions of carbometallates.
27. Write briefly on *f*-block organometallic compounds.

(6 × 6 = 36 marks)

Turn over

Section D

*Answer any two questions.
Each question carries 10 marks.*

28. Describe the synthesis and structure of metal nitrosyl complexes. How will you distinguish between terminal and bridging NO groups in metal nitrosyls with the use of IR spectroscopy ?
29. (a) Describe the synthesis and structure of Zeise's salt.
(b) How does the reactivity of a ligand get modified on chelation with a metal ion? Illustrate with examples.
30. Describe the catalytic cycle and mechanism of the reactions involved in Wacker process. Explain the role of a co-catalyst in this process.
31. Write notes on :
- (a) Electron counting schemes in metal carbonyls.
 - (b) Migratory insertion reaction of metal carbonyls.
 - (c) Hydrosilation of alkenes.

(5 + 5 = 10 marks)

(4 + 3 + 3 = 10 marks)

[2 × 10 = 20 marks]

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3C 12—INSTRUMENTAL METHODS : THEORY AND INSTRUMENTATION

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A*Answer all questions.*

Choose the correct answer :

- Which of the following is *not* a statistical parameter ?
 - Standard deviation.
 - Variance.
 - Confidence limit.
 - Mean deviation.
- Correlation coefficient can have _____ value.
 - Any positive.
 - Between 0 and 1.
 - Between -1 and +1.
 - Any positive value.
- Which of the following is *not* an organic precipitating agent in Inorganic Chemistry ?
 - Oxene.
 - Cupferron.
 - Dithiocarbamate.
 - Ethylenediamine.
- A weak base was titrated against a strong acid. The pH at the equivalence point is :
 - 7.0.
 - > 7.0.
 - < 7.0.
 - 0.
- In polarography exceeds supporting electrolyte like KCl is added to :
 - Minimise migration current.
 - Maximise migration current.
 - To increase diffusion current.
 - To decrease diffusion current.
- Which of the following statements is *not* true for amperometric titration ?
 - Current is measured against volume.
 - Current is measured against volume of titrant.
 - Current is measured at constant potential.
 - Three electrode system is employed.

Turn over

7. A solution shows absorbance $A = 1.0$ at 480 nm. The % radiation absorbed is :
- (a) 10. (b) 50.
(c) 90. (d) 100.
8. In IR spectroscopy the detector is :
- (a) Photocell. (b) Grating.
(c) Prism. (d) Bolometer.
9. Which of the following is *not* a thermal method ?
- (a) DTG. (b) DTA.
(c) DSC. (d) DMA.
10. _____ is *not* a nuclear detector.
- (a) PMT. (b) G.M. counter.
(c) Proportional counter. (d) Scintillation counter.
11. Which of the following is *not* a detector in GC ?
- (a) FID. (b) TCD.
(c) MS. (d) UV-visible.
12. Which of the following is *not* true for the number of theoretical plates ?
- (a) It depends on the column used.
(b) It is proportional to the peak width of the chromatogram.
(c) It is proportional to the square of the retention time.
(d) It is inversely proportional to the peak width of the chromatogram.

(12 × 1 = 12 marks)

Section B

Answer all questions.

Each question carries 2 marks.

13. Replicate estimation of Na^+ in a sample gave the following results :
30.1, 30.3, 29.8, 29.9, 30.2, 30.3 mg.
Calculate standard deviation.
14. What do you mean by color change interval in titrimetry ? Explain.
15. What is anodic stripping voltammetry ? Explain.
16. Explain the term 'nebulization'.

17. What is thermometric titration ?
18. Predict the order in which following compounds are eluted from alumina using *n*-hexane. Explain $\text{CH}_3\text{CH}_2\text{OH}$, CH_3CHO , CH_3COOH .

(6 × 2 = 12 marks)

Section C

*Answer any six questions.
Each question carries 6 marks.*

19. The following data were obtained for *x* – *y* plot. Find the slope and intercept by linear least square method :

x_i	0.100	0.200	0.400	0.800	0.100
	7.2	14.5	21.3	42.0	72.2

20. Explain with example theory of adsorption indicators.
21. Briefly discuss non-aqueous titrimetry.
22. Discuss applications of fluorescence spectrometry.
23. What is Coulometric titration ? Discuss.
24. Discuss instrumentation in DSC.
25. Compare SEM and TEM.
26. Explain with example super critical fluid chromatography.
27. Write a brief account of detectors in HPLC.

(6 × 6 = 36 marks)

Section D

*Answer any two questions.
Each question carries 10 marks.*

28. Briefly discuss organic precipitating agents used in Inorganic Chemistry.
29. Discuss theory and applications of polarography.
30. Write a brief account of neutron activation analysis.
31. Discuss the theory and applications of size exclusion chromatography.

(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3C 11—PHYSICAL CHEMISTRY – III

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A

Answer all questions.

Choose the correct answer :

- A non-linear molecule reacts with another non-linear molecule to form a non-linear activated complex to give products the temperature dependence of the pre-exponential term is :
 - $T^{1/2}$.
 - $T^{-1/2}$.
 - T^{-1} .
 - T^{-2} .
- Threshold energy in Collision theory is related to experimental activation energy by :
 - E_a .
 - $E_a + \frac{1}{2}RT$.
 - $E_a - \frac{1}{2}RT$.
 - $E_a + RT$.
- Which of the following statements is true for ionic reactions in solution ?
 - Rate increases when dielectric constant of the medium increases for reaction between like.
 - Rate decreases when dielectric constant charges of the medium decreases for reaction between like charges.
 - Rate is independent of the dielectric constant of the medium.
 - For reaction between ions of like charges rate increases with increase in temperature.
- Which of the following statements is *not* true for relaxation method ?
 - The equilibrium is disturbed.
 - It can be studied by temperature jump method.
 - Pressure jump method is applicable for all reactions.
 - Pressure jump method is applicable only for some of the gas phase reactions.

Turn over

5. Which of the following statements is *not* true for laser ?
- (a) The beam is monochromatic. (b) Coherent.
(c) High intensity. (d) It is of low energy.
6. Which of the following is *not* true for multiphoton excitation ?
- (a) It is observed in photochemical reactions.
(b) It is observed in laser.
(c) IR radiation is used for excitation.
(d) Vibrational changes are taking place.
7. Which of the following is *not* associated with acid base Catalysis ?
- (a) Brönsted catalysis law. (b) Secondary salt effect.
(c) Bronsted Bjerrum relationship. (d) Protolytic mechanism.
8. Identify the *wrong* statement :
- (a) Unimolecular gas phase surface catalysed reactions follow first order kinetics at low pressures.
(b) Unimolecular gas phase surface catalysed reactions follow zero order kinetics at low pressures.
(c) Unimolecular gas phase surface catalysed reactions follow zero order kinetics at high pressure.
(d) Reaction follows a complex mechanism.
9. Which of the following is not a nuclear particle detector ?
- (a) Geiger Muller counter. (b) Scintillation counter.
(c) Proportional counter. (d) Sychrotron.
10. Which of the following has highest penetrating power ?
- (a) α -particles. (b) β -particles.
(c) Gamma particles. (d) Neutrons.
11. The orbitals having no cusp at the nucleus is :
- (a) STO. (b) Hydrogen orbitals.
(c) GTO. (d) None of the above.

12. The trial wave function used in HF method is of determinantal form because :
- To incorporate antisymmetry.
 - To incorporate indistinguishability.
 - For computational simplicity.
 - It is easier to calculate the integrals.

(12 × 1 = 12 marks)

Section B

*Answer all questions.
Each question carries 2 marks.*

- Distinguish between collision cross-section and reaction cross-section.
- What is Cage effect ? Explain.
- The dissociation energy of a diatomic molecule is 390.4 kJ mol⁻¹. Calculate the maximum wavelength of radiation capable of dissociating the molecule.
- Distinguish between Vant Hoff complex and Arrhenius complex.
- What do you mean by range of alpha-particles ? How is it related to energy of alpha-particles ?
- Write Z-matrix for HCHO.

(6 × 2 = 12 marks)

Section C

*Answer any six questions.
Each question carries 6 marks.*

- How would you calculate activation energy theoretically ? Discuss.
- Calculate the number of bimolecular collisions between O₂ molecules at 300°K and 400 Torr pressure. The Collision diameter is 200 pm use collision theory.
- Equilibrium in the water dissociation reaction was disturbed by heating with a pulse of microwave radiation. The relaxation time for the reestablishment of equilibrium was found to be 36 p microsec at 25°C. Calculate k₁ and k₋₁ in $\text{H}^+ + \text{OH}^- \xrightleftharpoons[k_{-1}]{k_1} \text{H}_2\text{O}$. Ion product of water is 10⁻¹⁴.
- What is pulse radiolysis ? Discuss its applications ?
- Briefly discuss rotating sector method of following radiochemical processes.
- What is Michaelis Menton theory of enzyme catalysis ? Discuss.
- Discuss the working of a Fick's dosimeter.

Turn over

26. Write a brief account of ab initio methods of computational Chemistry.
27. Derive an equation to show primary salt effect.

(6 × 6 = 36 marks)

Section D

*Answer any two questions.
Each question carries 10 marks.*

28. Using Absolute Rate theory derive an equation for bimolecular rate constant.
29. Compare Langmuir Hinshelwood and Riedel model of bimolecular surface catalysed reactions in gas phase. How would you identify the mechanism under a given set of conditions ? Discuss.
30. Discuss briefly the working of a nuclear reactor.
31. Discuss briefly :
- (a) Linear free energy relationship.
 - (b) Chemiluminescence.
 - (c) Industrial application of heterogeneous catalysis.

(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3C 10—ORGANIC CHEMISTRY—III

(2019 Admissions)

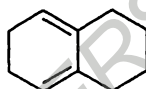
Time : Three Hours

Maximum : 80 Marks

Part A

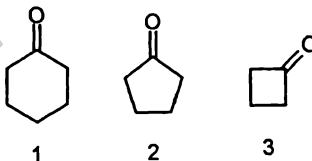
*Answer all questions.**Each question carries 1 mark.*

1. The expected λ_{\max} for the following compound (in hexane) is :



- A) 234 nm. B) 244 nm.
C) 273 nm. D) 283 nm.

2. The correct order of C=O stretching frequency for the following compounds is :



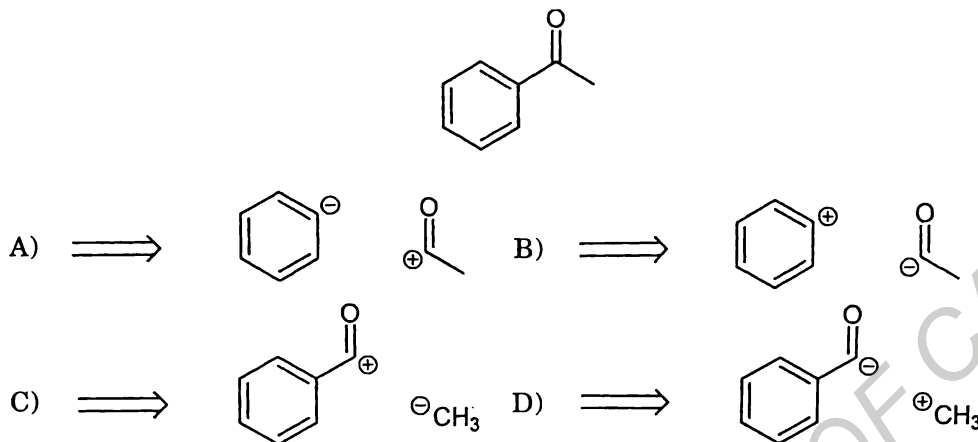
- A) 1>2>3. B) 1<2>3.
C) 1<2<3. D) 1>2<3.

3. In basic medium, the relative stabilities of silyl ether protecting groups for primary alcohols, are in the order :

- A) trimethylsilyl> triethylsilyl> tert-butyldimethylsilyl> triisopropylsilyl.
B) trimethylsilyl< triethylsilyl< tert-butyldimethylsilyl< triisopropylsilyl
C) trimethylsilyl< triethylsilyl< tert-butyldimethylsilyl> triisopropylsilyl.
D) trimethylsilyl> triethylsilyl< tert-butyldimethylsilyl> triisopropylsilyl.

Turn over

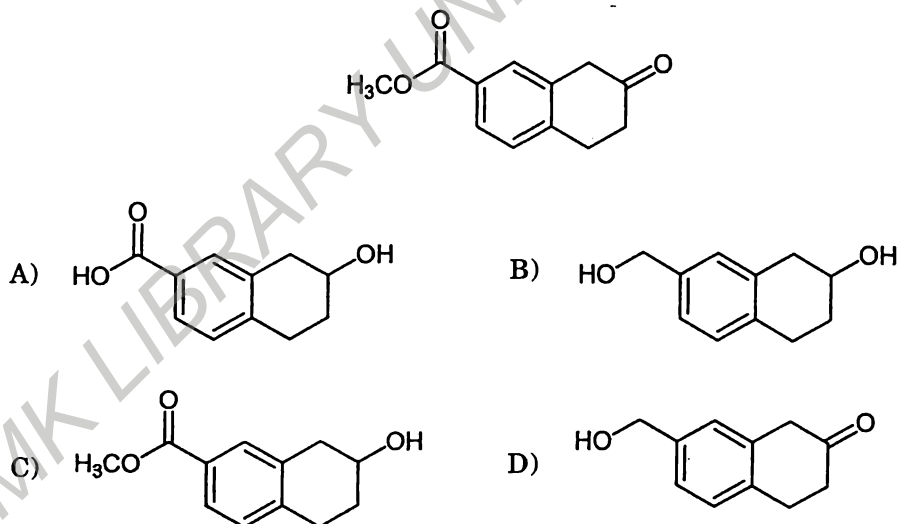
4. Which of the following is an ideal disconnection for the following compound ?



5. Which of the following is not an ideal example of a phase transfer catalyst ?

- A) Methyl ammonium bromide.
- B) Triethyl benzyl ammonium chlorides.
- C) 18-Crown-6.
- D) [2,2,2] Cryptand.

6. Major product of NaBH_4 reduction of the following compound is :



7. Number of hydrogen bonds between the DNA base pairs adenosine-thymine and cytosine-guanine are :

- A) 2 and 3 respectively.
- B) 3 and 2 respectively.
- C) 2 each.
- D) 3 each.

8. Which of the following interactions has got a strong directional character ?
- A) Ion-ion interaction. B) Ion-dipole interaction.
C) Hydrogen bonding. D) Hydrophobic interactions.
9. Which of the following is not considered as an example of a molecular receptor ?
- A) Calixarenes. B) Crown ethers.
C) Decalins. D) Cryptands.
10. Which of the following is NOT an atom economic reaction ?
- A) Diels-Alder reaction. B) Claisen rearrangement.
C) Wittig reaction. D) Michael addition.
11. Structurally, natural rubber is :
- A) Poly *cis*-butadiene. B) Poly *trans*-butadiene.
C) Poly *cis*-isoprene. D) Poly *trans*-isoprene.
12. Polyethylene terephthalate is usually prepared by :
- A) Addition polymerisation. B) Condensation polymerisation.
C) Free radical polymerisation. D) Emulsion polymerisation.

(12 × 1 = 12 marks)

Part B

Answer all questions.

Each question carries 2 marks.

13. Explain the term diamagnetic shielding with reference to ^1H NMR spectroscopy.
14. What are 1,2-difunctionalisation reactions ? Give any *two* examples.
15. Write down any *two* applications of DIBAL in organic synthesis. Give examples.
16. Explain the concept of pre-organization with a suitable example.
17. Define the term 'atom economy' according to the principles of green chemistry.
18. Write down the structure of the repeating units of polyethylene terephthalate and polycarbonate polymers and the corresponding monomers used in the synthesis of these polymers.

(6 × 2 = 12 marks)

Part C

Answer any six questions.

Each question carries 6 marks.

19. Discuss the prominent fragmentation pathways of alkenes and carbonyl compounds in the mass spectrum.
20. What are the factors that affect the coupling constants of NMR signals ? Explain any *three* in detail.

Turn over

21. What are protecting groups ? What are the advantages and disadvantages of using them ? Discuss the aspects to be considered while choosing a PG.
22. With appropriate examples, illustrate the application of DIBAL and LDA in organic synthesis.
23. Give a short account of SeO_2 in oxidations at activated positions and NBS in reactions involving allylic functionalisations.
24. What are host-guest complexes ? Discuss the forces of interactions involved in stabilising these. Give 2 examples for cation binding and anion binding hosts.
25. Explain the application of super critical fluids as green media for organic reactions.
26. Discuss the applications of solid acids and zeolites as green catalysts.
27. Give a comparative account of the structure, properties and applications of polyethylenes and polypropylenes.

(6 × 6 = 36 marks)

Part D

Answer any two questions.

Each question carries 10 marks.

28. a) Assign the structure of the compound (with proper stereochemistry) whose spectral data are given below. The spectral data should be adequately interpreted.
 UV (95% ethanol) : transparent above 210 nm ; IR (liquid film, partial) 3050, 2980, 2850, 1715, 1655, 1420, 1210, 1100, 980 cm^{-1} ; ^1H NMR (CDCl_3) : δ 6.8 (doublet of a quartet, $J_{\text{AM}} = 8 \text{ Hz}$, $J_{\text{AX}} = 14 \text{ Hz}$, 1H), 5.8 (*d*, $J = 14 \text{ Hz}$, 1H), 4.2 (*q*, $J = 7 \text{ Hz}$, 2H), 1.8 (*d*, $J = 8 \text{ Hz}$, 3H), 1.3 (*t*, $J = 7 \text{ Hz}$, 3H) ; ^{13}C NMR (CDCl_3 , off-resonance decoupled) : δ 168 (*s*), 143 (*d*), 122 (*d*), 61 (*t*), 19 (*q*), 17 (*q*) ; MS *m/z* (relative intensity, %) ; 114 (10), 99 (25), 86 (10), 69 (100), 41 (22), and other peaks ; FM = 114. 0683 (molecular formula is deduced as $\text{C}_6\text{H}_{10}\text{O}_2$).
- b) In the mass spectrum of 4-fluoronitrobenzene, four major peaks are observed at *m/z* 125, 111, 95 and 75. Identify the fragments and draw fragmentation modes leading to these fragments.
29. Write notes on :
 - a) Major FGIs of alcohols.
 - b) *Umpolung* reactions in synthesis.
 - c) Domino reactions.
30. Briefly discuss the 12 principles of green chemistry.
31. Give a brief account of the synthesis, structure, properties and application of : a) Silicon elastomers, b) Polycarbonates.

(2 × 10 = 20 marks)

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(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3C 09—INORGANIC CHEMISTRY—III

(2019 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A

*Answer all questions.**Each question carries 1 mark.*

1. A substance which initiates photochemical reaction; but it does not undergo any chemical change is called _____.
 - a) Adsorbent.
 - b) Promoter.
 - c) Sensitizer.
 - d) Fluorescent.
2. _____ is an example for a compound which exhibits photochromism.
 - a) *Trans*-[Pt(NH₃)₂(NO₃)₃].
 - b) Tetrasulphur tetranitride.
 - c) *Cis*-[Pt(NH₃)₂(NO₃)₃].
 - d) Zeise's salt.
3. In *trans*-[PtCl₂L(CO)], the CO stretching frequency for L=NH₃, pyridine, NMe₃ follows the order _____.
 - a) pyridine>NH₃>NMe₃.
 - b) NH₃> pyridine> NMe₃.
 - c) pyridine>NMe₃>NH₃.
 - d) NMe₃>NH₃> pyridine.
4. Total number of lines expected in the ¹H NMR spectrum of HPF₂ is _____ (I = ½ for both ¹⁹F and ³¹P).
 - a) 3.
 - b) 4.
 - c) 5.
 - d) 6.
5. Which of the following will not show ESR spectrum ?
 - a) O₂.
 - b) Cu⁺.
 - c) VO²⁺.
 - d) C₂H₅.

Turn over

6. Which one of the following is not correctly matched ?
- a) ESR-Microwave. b) NQR-Radiowave.
c) Photoelectron-UV or X-ray. d) Mössbauer-X-ray.
7. The biological function of Ca^{2+} is _____.
- a) Charge carrier. b) In blood clotting.
c) Stabilization of protein structure. d) All the above.
8. The most abundant element present in human body is _____.
- a) Si. b) O.
c) H. d) C.
9. The number of oxygen molecule(s) that a molecule of hemerythrin can transport is _____.
- a) 1. b) 2.
c) 3. d) 4.
10. The oxidation state of iron in ferritin is _____.
- a) + 3. b) + 2.
c) + 1. d) 0.
11. In photosynthesis, the metals involved are _____.
- a) Mg and Fe. b) Mg and Cu.
c) Mg and Mn. d) Mg only.
12. Vitamin B_{12} is a/an _____ enzyme.
- a) Isomerase enzyme. b) Catalase enzyme.
c) Hydrogenase enzyme. d) Peroxidase enzyme.

(12 × 1 = 12 marks)

Section B

Answer all questions.

Each question carries 2 marks.

13. Photochemical reactions of cobalt(III) complexes are often redox reactions, where as those of chromium(III) complexes are substitution reactions ; why ?

14. The ν (C=O) stretching vibration in an aldehyde give rise to strong absorption in the IR region, while the absorption due to C=C vibration in an alkene is normally weak ; why ?
15. Compare the Mössbauer spectrum of $\text{Na}_4[\text{Fe}(\text{CN})_6]$ with $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$
16. Explain the role of metal ions in stabilizing cell membrane ?
17. Hemocyanin is colourless in deoxy form, while it is blue coloured in oxy form ; why ?
18. Distinguish between metalloenzymes and metal activated enzymes.

(6 × 2 = 12 marks)

Section C

Answer any six questions.

Each question carries 6 marks.

19. Explain photoisomerization and photoracemization reactions of metal complexes, giving examples.
20. Discuss the important factors that affect metal-ligand vibrations.
21. Explain how low-spin and high-spin iron (II) complexes can be distinguished by using Mössbauer Spectroscopy ?
22. Write a note on the biological significance of nitric oxide.
23. Compare the oxygen uptake function of hemoglobin with that of hemerythrin.
24. What are the special characteristics of Vitamin B₁₂ which differentiate it from other vitamins ?
25. Write briefly on chemical actinometry.
26. What is biomineralisation ? Explain with an example.
27. Explain how does cis-platin function as an anti-cancer agent. Give the mechanism involved in it and in the light of this mechanism explain the reason for the inactivity of the trans-isomer.

(6 × 6 = 36 marks)

Section D

Answer any two questions.

Each question carries 10 marks.

28. Discuss the theory of IR spectroscopy. Describe how this technique is useful in the structural investigation of metal complexes.
29. What is the principle involved in ESR spectroscopy ? Discuss the applications of ESR spectroscopy in the structure elucidation of copper(II) complexes.

Turn over

30. Describe the molecular mechanism of ion transport across cell membrane. How vanadate ion interfere with the function of $\text{Na}^+\text{-K}^+$ pump ?
31. What is biological nitrogen fixation ? Bring out the role of M-cluster and P-cluster of nitrogenase in nitrogen fixation.

(2 × 10 = 20 marks)

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THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3C 18—INSTRUMENTAL METHODS OF ANALYSIS AND INSTRUMENTATION

(2015 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A (Choose the Correct Answer)*Answer all questions.**Each question carries 1 mark.*

- Which of the following sentence is true ?
 - Systematic error is caused by careless handling.
 - Random error is caused by careless handling.
 - Gross error is caused by careless handling.
 - None of the above.
- The ideal indicator for the titration of strong acid and weak base should have pH range between :
 - 5–8.
 - 4–6.
 - 8–10.
 - 7–8
- Which of the following is not a metal indicator ?
 - Erichrome Black T.
 - Xylenol orange.
 - Murexide.
 - Cupferon.
- In polarography any change in diffusion current is denoted by :
 - Ilkovic equation.
 - Nernst Equation.
 - Arrhenius equation.
 - Stock equation.
- The current remains zero and graph is plotted between E versus volume of titrant in :
 - Amperometric titrations.
 - Potentiometric titrations.
 - Conductometric titrations.
 - Voltametry.

Turn over

6. The unit of Absorbance and Absorptivity as per Beer Lamberts law are :
- (a) Absorbance has no unit and unit of Absorptivity is $L \text{ mol}^{-1} \text{ cm}^{-1}$.
 - (b) Absorptivity has no unit and unit of Absorbance is $L \text{ mol}^{-1} \text{ cm}^{-1}$.
 - (c) Absorbance and Absorptivity has no units.
 - (d) Unit of both Absorbance and Absorptivity is $L \text{ mol}^{-1} \text{ cm}^{-1}$.
7. The cathode of transmission electron microscope consists of a
- (a) Tungsten wire.
 - (b) Bulb.
 - (c) Iron filament.
 - (d) Gold wire.
8. Auxiliary electrode in Polarography is :
- (a) Dropping mercury.
 - (b) Mercury pool.
 - (c) Graphite electrode.
 - (d) Rotating platinum electrode.
9. Which of the following is used as a carrier gas in gas chromatography :
- (a) Carbon dioxide.
 - (b) Oxygen.
 - (c) Helium.
 - (d) Methane.
10. Which of the following spectroscopy techniques is associated with molecular emission ?
- (a) UV-Visible spectroscopy.
 - (b) IR spectroscopy.
 - (c) Fluorescence spectroscopy.
 - (d) X-ray diffraction.
11. Differential scanning calorimetry is a technique to measure :
- (a) Electrical conductivity.
 - (b) Specific heat.
 - (c) Thermal expansion.
 - (d) Magnetic field.
12. The density of a metal is calculated to 8.9377 g/cm^3 , using weight and volume measurements. The \pm absolute error is determined to be $\pm 0.006 \text{ g/cm}^3$. The \pm relative error for the above density determination is :
- (a) 0.006.
 - (b) 0.003.
 - (c) 0.09.
 - (d) 0.0007.

(12 × 1 = 12 marks)

Section B

Answer all questions.

Each question carries 2 marks.

13. Distinguish between systematic and random errors by quoting suitable examples.
14. In the gravimetric determination of silver, silver chloride is washed with a dilute solution of nitric acid. Why ?
15. Sketch the titration curve of a titration between strong acid and strong base.
16. Give one example each for acid/base, redox, adsorption and metal ion indicators.
17. How can you identify the position of Cyanide ligand in IR spectra ?
18. Why an auxiliary reagent is always required in coulometric titration ?

(6 × 2 = 12 marks)

Section C

Answer any six questions.

Each question carries 6 marks.

19. Calculate the absolute standard deviation and the relative standard deviation (%) of the following replicate set of data. Comment on the precision of the measurement. Weight of component/g is 5.346, 5.362, 5.379, 5.335, 5.341
20. Explain the terms (i) Co-precipitation ; (ii) Post precipitation ; and (iii) Masking and demasking.
21. How does electro gravimetric and coulometric methods differ from potentiometric methods in terms of current and voltage.
22. The following table summarizes some data about three Iron III Chlorides :

Compound	Mol. Mass	Melting Point
FeCl ₃ 6 H ₂ O	270	310
FeCl ₃ 5/2 H ₂ O	207	331
FeCl ₃	162	579

Sketch the thermogravimetric curve anticipated when a 25.0 mg of sample of FeCl₃ 6 H₂O is heated from 273 K to 673 K.

Turn over

Section B*Answer all questions.**Each question carries 2 marks.*

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*(6 × 2 = 12 marks)***Section C***Answer any six questions.**Each question carries 6 marks.*

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$\text{FeCl}_3 \cdot 5/2 \text{H}_2\text{O}$	207	331
FeCl_3	162	579

Sketch the thermogravimetric curve anticipated when a 25.0 mg of sample of $\text{FeCl}_3 \cdot 6 \text{H}_2\text{O}$ is heated from 273 K to 673 K.

Turn over

23. Distinguish between the salient features of Atomic emission spectrometry and Atomic absorption spectrometry.
24. Write down the principle and applications of SEM and TEM.
25. Discuss the principle and applications of Isotope dilution methods.
26. Give a brief note on size exclusion chromatography. What are the application of this method ?
27. Write down the principle and applications of amperometry. How are amperometric titrations carried out ?

(6 × 6 = 36 marks)

Section D

Answer any two questions.

Each question carries 10 marks.

28. Give and account of common inorganic precipitating agents used in gravimetry.
29. Discuss the application of statistics in data treatment and evaluation.
30. With the help of a neat diagram, describe the instrumentation of DSC. What are the advantages of DSC over TGA in its applications ?
31. Draw the block diagram for HPLC and explain the function of each component. Mention the different types of detectors used in HPLC.

(2 × 10 = 20 marks)

THIRD SEMESTER P.G. DEGREE EXAMINATION, NOVEMBER 2020

(CCSS)

M.Sc. Applied Chemistry

ACH 3C 17—PHYSICAL CHEMISTRY—III

(2015 Admissions)

Time : Three Hours

Maximum : 80 Marks

Part A

*Answer all questions.**Each question carries 1 mark.*

Choose the correct answer :

- The concentration of a reactant decreases linearly with time. The order of the reaction is :
 - First Order.
 - Fractional Order.
 - Second Order.
 - Zero Order.
- According to Transition State theory one of the vibrations in the activated complex is a loose vibration. The partition function for this loose vibration is equal to (k_B is Boltzmann constant, h is Planck's constant) :
 - $k_B T/h$.
 - $h\nu / k_B T$.
 - $k_B T$.
 - $k_B T / h\nu$.
- Consider the unimolecular reaction $A(g) \rightarrow$ products, for which the following remarks were made : (i) the reaction is second order at low pressure and becomes first order at high pressure (ii) the reaction is first order at low pressure and becomes second order at high pressure (iii) the reaction is zero order. Which of these is correct :
 - (i) and (ii).
 - (ii) and (iii).
 - Only (iii).
 - Only (i).
- Which among the following equation deals with the dependence of the ionic strength on the kinetics of solution :
 - London equation.
 - Bronsted-Bjerrum equation.
 - Hammett and Taft equation.
 - Arrhenius equation.

Turn over

5. The absorbance of solution having 20% transmittance is :
- (a) 0.301. (b) 0.699.
(c) 1.301. (d) 1.699.
6. Select the correct statement from the following :
- (i) The molar extinction coefficient is unitless.
(ii) Quantum yield of any reaction is always unity.
(iii) Delayed fluorescence is phosphorescence.
(iv) Absorption of a photon by a molecule always leads to a chemical reaction :
- (a) (i). (b) (ii).
(c) (iii). (d) (iv).
7. The conversion of excited singlet state (S_1) of a molecule to triplet state (T_1) is known as :
- (a) Fluorescence. (b) Phosphorescence.
(c) Intersystem Crossing. (d) Internal Conversion.
8. Curdling from milk, an enzyme catalysed reaction, is most efficient around :
- (a) 0°C and $\text{pH} \geq 10$. (b) 0°C and $\text{pH} \leq 4$.
(c) 0°C and $4 \leq \text{pH} \leq 10$. (d) 25°C and $4 \leq \text{pH} \leq 10$.
9. The ^{32}P radioisotope, used in leukemia therapy, has $t_{1/2} = 14.26$ days. The % of ^{32}P remains after 35 days is :
- (a) 30 %. (b) 8 %.
(c) 81.7 %. (d) 18.3 %.
10. When an element is made radioactive by placing it in a homogenous flux of energetic charged particles of neutrons, the activity produced in the element is given by :
- (a) $A = N \Phi \left[1 - e^{-\left\{ \frac{1}{t} \right\} t} \right]$. (b) $A = N \sigma \Phi \left[1 - e^{-\left\{ \frac{1}{t} \right\} t} \right]$.
(c) $A = N \sigma \Phi \left[1 - e^{-\left\{ \frac{0.693}{t} \right\} t} \right]$. (d) $A = N \sigma \Phi \left[1 - e^{-\left\{ \frac{2.303}{t} \right\} t} \right]$.

11. Among the following which is a minimal basis set :
- (a) 6-31G. (b) 3-21G.
(c) STO-3G. (d) 6-31G (d, p).
12. Of the following statements identify the one which does not agree with basis set :
- (a) STO is preferred in electronic structure calculations.
(b) Radical nodes are absent in STO.
(c) Electronic structure calculation prefers GTO.
(d) GTO has zero slope at the nucleus.

(12 × 1 = 12 marks)

Part B

*Answer all the questions.
Each question carries 2 marks.*

13. What is Hammett and Taft equation ? Explain.
14. Unimolecular gas phase reactions follow first order kinetics at high pressures and second order kinetics at low pressures. Why ?
15. What are the laws of photochemical equivalence ?
16. What do you know by Bronsted catalysis law ?
17. Explain the radiolysis of Frick's dosimeter solution.
18. Write the Z-matrix for methanol.

(6 × 2 = 12 marks)

Part C

*Answer any six questions.
Each question carries 6 marks.*

19. Explain the Eley-Rideal mechanism for the bimolecular reactions on the surface of solids.
20. Explain Michaelis Menten mechanism.
21. Give a brief account of various methods used for the study of fast reactions.
22. Describe and discuss the Jablonski diagram for depicting various photo physical processes. What are radiative and non-radiative transitions ?

Turn over

23. The enzyme catalysed conversion of a substance at 25°C has Michaelis constant of 0.042 mol L⁻¹. The rate of reaction is 2.45 mol L⁻¹S⁻¹ when the substrate concentration is 0.890 mol L⁻¹. What is the maximum velocity of this enzymolysis ?
24. Give a brief account of the comparison of activated complex and collision theories.
25. Write briefly on (i) Photonuclear ; and (ii) Thermonuclear reactions.
26. Explain Neutron activation analysis.
27. Explain basis sets used in computational chemistry calculations.

(6 × 6 = 36 marks)

Part D

Answer any two questions.

Each question carries 10 marks.

28. What are primary and secondary kinetic salt effects ? Derive the expressions.
29. Write briefly on : (a) Pulse radiolysis ; (b) Photosensitization ; (c) Hydrated electrons ; and (d) Chemiluminescence.
30. Describe briefly on the theory of nuclear fission. Explain how the fission fragments and fission energy are distributed.
31. (a) Discuss the Hartree Self - Consistent Field method. Explain its qualitative treatment.
(b) What are the differences between ab initio and semi empirical methods ?

(2 × 10 = 20 marks)