2020

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer ***all*** questions

Part-I

1. Answer the following : 1 × 8

   a) Kroll process is used for the extraction of _____metal.

   b) Roasting is done in the_____of air.

   c) Oxygen and Ozone are _____ .

   d) Chemical formula of nitrous acid is _____.

   e) $PCl_5 + NHuCl \xrightarrow[O^{12}]{C_2HuCl_2} \_\_\_\_\_ + HCl$

      C_6H_5Cl

   f) $XeF_6 + H_2O \longrightarrow \_\_\_\_\_ + HF$

   g) According to VSEPR theory shape of XeF_4 is _____.

   h) Among $HClO_3$, $HBrO_3$ and HIO_3 the strongest acid is_____.

Part-II

2. Answer any ***eight*** of the following : 1½ × 8

   a) Name three sulphide ores.

   b) Give example of Hard acid, hard base and soft acid one each.

   c) Define catenation.

   d) Give one preparation method for boron nitride.

   e) Arrange Cl, Cl^+ and Cl^- in the increasing order of their size.

   f) How can you show that phosphoric acid is a tribasic acid ?

   g) What do you mean by inorganic polymer ? Give on example.

   h) What are pseudohalogens ?

   i) What are clathrates ?

   j) Name three peroxo acids of sulphur,

Part-III

3. Answer any ***eight*** of the following : 2 × 8

   a) What is the difference between calcination and roasting ?

b) Name the different methods used for the reduction of roasted ores to the metallic state.

c) What is the difference between hard acid and soft acid ?

d) What are allotropes ? give one example.

e) Why borazine is known as inorganic benzene ?

f) How does B_2H_6 react with ammonia at high and low temperature ?

g) Why boron nitride is a poorer electrical conductor than graphite ?

h) Complete the reaction

$XeF_2 + H_2 \rightarrow$

$XeF_6 + SiO_2 \rightarrow$

i) How XeF_4 is prepared ?

j) How can you prepare silicones ?

Part-IV

4. a) Write short notes on the following : 3 + 3

i) Zone refining

ii) hydrometallurgy.

OR

b) What is Lewis concept of acids and bases ? Arrange the following in the order of decreasing base strength : 4 + 2

(i) NH_3, NCl_3, NF_3 (ii) NH_3, PH_3, ASH_3

5. a) i) What is inert pair effect ? Which elements shows this ? 3

ii) Write a note on main allotropic forms of sulphur. 3

OR

b) How would you account for the diagonal relationship in elements arranged in the periodic table ? 6

6. a) Discuss the preparation, and structure of diborane. 6

OR

b) How is boric acid is prepared ? Discuss its structure. How does boric acid react with ethyl alcohol. 6

7. a) Discuss the preparation and bonding in XeF_2. 6

OR

b) Discuss the synthesis and application of phosphazenes. 6

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CC-V INORGANIC CHEMISTRY

PART I (1 mark)

1. The method used for the refining of semiconductors is called____ ?
2. Name the metal which is purified by Mond' process?
3. Out of zinc and copper, the_____ metal can be extracted by hydrometallurgy?
4. Give the formula of rutile ore used to extract titanium metal ?
5. Which refining method is used to purify semi-conductors?
6. Name method in which NaCN is used to extract gold metal ?
7. The powdered____ metal is added to soluble complex of gold $Na[Au(CN)_2]$ which displaces gold by reduction process.
8. H^+ is a____acid by HSAB principle ?
9. In liquid HF solvent PF_5 acts as a_____acid?
10. OH is a_____base by HSAB principle?
11. In $HCl + H_2O \rightarrow H_3O^+ + Cl^-$ write the conjugate acid of H_2O?
12. Which acid base theory fails to explain that $FeCl_3$ is an acid?
13. Which out of Li^+ and Ag^+ is a soft acid ?
14. Which type of bond is predominantly present between a hard acid and a soft base ?
15. Write the molecular formula of basic beryllium nitrate?
16. Write the allotropic from of oxygen other than oxygen ?
17. What is the shape of XeF_4 molecule ?
18. What is the structure of $XeOF_4$ compound ?
19. What is the structure of inorganic polymers ?
20. What product is obtained when n-monomers undergo polymerization?
21. Write the general formula of double chains (amphiboles)?
22. Which metal out of Ag and Fe is not extracted by hydrometallurgical process?
23. The metal that is prepared in pure state by the van Arkel process is____.
24. Which rubber was used in lunar boots for the Apollo-astronauts ?
25. The chemical formula of inorganic benzene is_____?
26. Phosphazenes are a group of compounds having general formula _____?

27. Silicones have high thermal stability due to _____chain?

28. As compared to inorganic polymers,organic polymers are _____ductile?

29. PdH_{06} is _____hydride?

30. Oxygen exist as diatomic molecules but sulphur exist as _____?

PART II (1.5 marks)

31. What does parting process signify in metallurgical processes?

32. Give reaction to show the purification of titanium metal by van Arkel de-Boer process?

33. Write the use of Ellingham diagram?

34. What is the thermodynamic principle of metallurgy?

35. How does zone refining method help to refine impure metals?

36. What is zone refining? Which type of substances are purified by it and how?

37. Define Lewis acids. Give one example.

38. What are Bronsted acids and bases? Give one example of each.

39. What is HSAB principle? Is H^+ is hard acid or soft acid?

40. What are soft acids and soft bases? Give one example of each.

41. What is inert pair effect?

42. Define allotropy. Describe about any two allotropic forms of carbon.What is catenation? Give two examples of elements which shows catenation and how does this property vary in a group?

43. How does lithium differ from the other alkali metals?

44. Why $Be(OH)_2$ is insoluble in water but $Ba(OH)_2$ is soluble?

PART III (2 marks)

45. Why Pb^{2+} is more stable than Sn^{2+}ion ?

46. How BH_4 complex is formed ?

47. Describe one anionic complex of flourine ?

48. Describe in details the allotropic forms of carbon ?

49. Explain the order of stability of oxides of alkali metals?

50. Define interstitial hydrides.
51. Why noble gases are inert in nature?
52. What is caisson's disease? How it occurs and why?
53. What do you mean by leaching process in hydrometallurgy?
54. Give two use each of neon ?
55. Give the rationalisation of the inertness of noble gases ?
56. Give 3 uses of neon gas.
57. What are clathrates ? Why helium does not form clathrates ?
58. Write any two characteristics of organic polymers ?
59. What are polysulphates ?
60. What are silicates ?What is mica?
61. Give one preparation of polysiloxane . Write its property.
62. What are polysulphates ? What are its main constituents?
63. How is polymeric sulphur prepared? Give one example.
64. What is diagonal relationship? Discuss diagonal relationship between lithium and magnesium.
65. Bring out points of difference between beryllium and other members of the family.

PART IV (6 marks)

66. Describe in details with suitable examples , the chief modes of occurrence of metals based on electrode potentials?
67. Explain Ellingham diagram taking CO as reducing agent ?
68. Define electrolytic reduction process. Explain your answer with at least two examples?
69. What are diagonal relationships? Which elements show diagonal relationship and why? Give any diagonal relationship in support of your answer ?
70. What are inorganic and organic polymers ?Give the comparison between the two?
71. What are Borates? Write its preparation and properties of Borates ?
72. Describe the preparation and the chemistry of polycarboranes?
73. What are silicones? Give the preparation of linear and cross-linked silicones?

74. Why borazine is called inorganic benzene? How is it prepared from diborane ?Give its action on HCl at 50 to100^{0}C?
75. What are macro-molecules ? How will you distinguish between inorganic polymers and macro-molecules? Discuss different types of inorganic polymers.
76. How is Mond‘s process helpful to purify metals ?Give one example?
77. What do you understand by the electrolytic process of purify metals?Give one example.
78. Describe the term hydrometallurgy .How it helps to purify Cu from copper ores ?
79. Describe the structure of the following compounds .

    (i)Borazine (ii) $(PNCl_3)_2$
80. Describe the synthesis of sulphur-phosphorus polymers and polydimethyoxy-phosphazene?
81. Why first member of each group of *s* and *p*- block elements show anomalous behaviour ? Describe anomalous behavior of either lithium or carbon?
82. Explain Classification, Preparations & uses of Silicones.
83. What are Pseudohalogens. Explain the Structures of any one AX3 & AX5interhalogen compounds.
84. Explain the structure of Borazine.
85. What are Hydrides? Discuss the classification and properties of Hydrides.
86. Describe the structure, preparation and properties of basic beryllium acetate.

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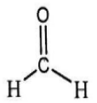
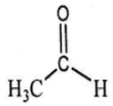
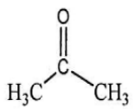
Answer ***all*** questions

Part - I

1. Answer the following : 1×8

i) Which of the following gives a tertiary alcohol when treated with Grignard reagents ?

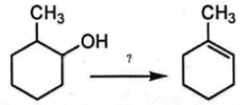
(a)  (b)  (c)  (d) Non of these

ii) Which of the following compounds would react most rapidly in an SN_2 reaction ?

(a) CH_3CH_2I (b) CH_2= CH-I

(c) $(CH_3)_2CHI$ (d) $(CH_3)_3CI$

iii) Which is the best reagent for carrying out the following conversion ?



(a) $LiAlH_4$ (b) Con.H_2SO_4

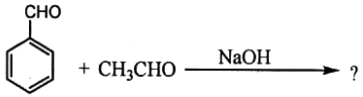
(c) H_2/Ni (d) NaOH.

iv) Ethylene Oxide reacts with Ammonia to give :

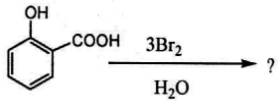
(a) 1-Aminoethanol (b) Ethylamine

(c) 2-Aminoethanol (d) Acetamide.

v) Write the product of the following reaction.



vi) Write the product of the following reaction.



vii) Ethylacetoacetate reacts with phenylhydrazine to give :

(a) Antipyrine (b) Aspirin

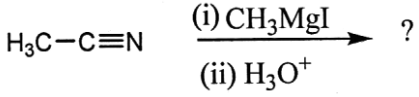
(c) 4-Methyl Uracil (d) DDT

viii) What will be the product obtained when Diethyl sulphide reacts with bromine ?

Part - II

2. Answer any ***eight*** of the following : $1\frac{1}{2} \times 8$

i) Write the product of the following two reactions.



ii) Explain why Vinyl Chloride is less reactive than ethyl chloride ?

iii) How will you synthesize 2-Butanol from Acetylene ?

iv) What happens when n-propyl bromide is treated with alcoholic KOH ?

v) How will you synthesize Diphenylmethane from Benzophenone ?

vi) How Benzoin is synthesized from Benzaldehyde ? Write reaction.

vii) Write synthesis of 4-Methyl Uracil from Urea.

viii) How will you synthesize Succinic acid from Ethylene bromide ?

ix) Write Hoffmann bromamide degradation reaction.

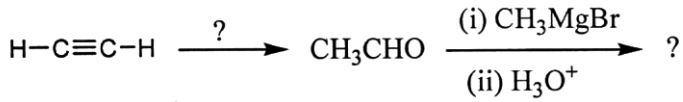
x) What happens when Ethane thiol is treated with KOH ?

Part - III

3. Answer any ***eight*** of the following : 2×8

i) What is SNi Reaction ? Explain with a suitable example.

ii) Complete the following reaction.



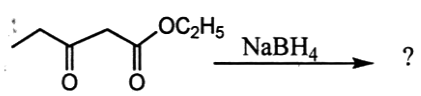
iii) What happens when Ethyl magnesium iodide is treated with the following reagents and the product hydrolyzed ?

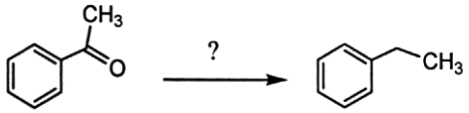
(a) HCHO (b) Acetone.

iv) What is Bouvaelt-Blanc reduction reaction ? Explain with a suitable example.

v) How do primary, secondary and tertiary alcohols differ in their behaviour towards oxidation ?

vi) Complete the following reactions.

(a) 

(b) 

vii) How will you synthesize Ethyl acetoacetate from Ethyl alcohol ?

viii) Write two methods of preparation of Fumaric acid.

ix) Give one method of preparation of Diethylsulfide. Write the reaction of diethylsulfide with the following reagents.

(a) Br_2 (b) CH_3CH_2Br

x) How will you synthesize Maleic acid from Succinic acid ?

Part - IV

4. a) What is SN_1 reaction ? Explain with suitable example. What are the differences between SN_1 and SN_2 reactions ? Give energy profile diagram of SN_1 reaction. 2 + 2 + 2

OR

b) i) Discuss the reactivity of Vinyl and Aryl halides towards Nucleophilic substitution reaction. Explain with suitable examples. 4

ii) Write the synthesis of a organic compound using organometallic compound Li. 2

5. a) i) What is Pinacol-pinacolone rearrangement ? Explain with mechanism. 3

ii) Explain Reimer-Tiemann reaction with meachinsm. 3

OR

b) Write notes on the following :

i) Claisen Rearrangement

ii) Kolbe's Schmidt Reaction 3 + 3

6. a) i) Explian wittig reaction with meachnism. 3

ii) What is Cannizzaro reaction ? Give mechanism. 3

OR

b) Write notes on the following : 3 + 3

i) Wolff-Kishner Reduction

ii) Baeyer-Villiger Oxidation.

7. a) i) What is Curtius rearrangement ? Explain with mechanism. 3

ii) Explain Dieckmann reaction with meachanism. 3

OR

b) i) How will you synthesize Tartaric acid from Ethylene ? 3

ii) Give mechanism of alkaline hydrolysis of Ester.

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CHEMISTRY- CC-VII

PART I (1 mark)

1. What is phase rule?
2. What is condensed phase rule?
3. Define triple point.
4. Define eutectic point.
5. Define eutectic mixture.
6. What are ideal and non-ideal solutions?
7. What is an ideal solution? Give one example.
8. Define rate of a reaction. Give its unit.
9. Define molecularity of a reaction.
10. Define order of a reaction.
11. What is threshold energy?
12. What is activation energy?
13. Give one example of a zero order reaction.
14. Define Half-life period of a reaction.
15. What is an azeotrope?
16. What are catalytic poisons?

PART II (1.5 marks)

17. Give one example of a three component system and write the phase rule for this system.
18. What are Binary liquid solutions? Give examples of completely miscible, completely immiscible and partially miscible binary liquid solutions.
19. What is CST? Differentiate between UCST and LCST with examples.
20. State the characteristics of an ideal solution. Give one example of ideal solution.
21. How does absorption differ from adsorption?
22. Write three applications of adsorption.
23. Explain poisoning of catalyst with an example.
24. Define adsorbate and adsorbent. Give one example of each.
25. State and explain Raoult's law for vapour pressure of binary solutions of volatile liquids.
26. What is steady state principle?
27. Explain the effect of presence of a catalyst on the energy of activation of the reaction.
28. Discuss briefly the Arrhenius equation for the effect of temperature on rate of reaction.
29. Differentiate between molecularity and order of a reaction.
30. Distinguish between 1^{st} and pseudo 1^{st} order reaction with example.
31. Discuss the general characteristics of catalytic reactions.
32. Define phase, component and degree of freedom.
33. Define catalysis. Give one example.
34. What is autocatalysis? Explain with an example.
35. Define promoter. Give one example.
36. What is the effect of temperature on chemisorption?

PART III (2 marks)

37. What are congruent and incongruent melting points?
38. Write Gibbs-Duhem-Margules equation. Explain the terms and write its applications.

39. Describe steam distillation.
40. Find the degree of freedom for the following systems.
    i. Decomposition of $CaCO_3$
    ii. Decomposition of PCl_5
41. State and explain Lever rule.
42. Explain Critical Solution Temperature with examples.
43. State Nernst distribution law.
44. What are the limitations of Nernst distribution law?
45. Describe the applications of Nernst distribution law.
46. Distinguish between Homogenous and heterogenous catalysis.
47. Differentiate between physisorption and chemisorption,
48. Discuss the factors affecting the extent of adsorption.
49. What is an adsorption isotherm? Write its significance.
50. Give a brief account of specificity and selectivity in catalysis with examples.
51. What is acid-base catalysis? Discuss with one example.
52. Discuss the factors affecting rate of a reaction.
53. Describe fractional distillation. Write one application of this method.
54. How does absorption differ from adsorption?

PART IV (6 marks)

55. State Gibbs phase rule. How can it be derived thermodynamically?
56. Draw the phase diagram of water system. Discuss the importance of various points, lines and areas at equilibrium.
57. Draw and describe the phase diagram of sulphur system.
58. Draw and discuss the phase diagram of Pb-Ag system.
59. Draw and discuss the phase diagram of Ferric chloride-water system.
60. Draw and discuss the phase diagram of Sodium sulphate-water system.
61. Derive Clausius-Clapeyron equation for solid-vapour equilibrium.
62. Draw and discuss the phase diagram of CH_3COOH-$CHCl_3$-H_2O system.
63. Discuss vapour pressure – composition curve and boiling point-composition curve of system containing binary mixtures of liquids miscible in all proportions. Describe briefly how the distillation of such mixtures of liquids takes place?
64. Explain the basic principles and the method of steam distillation. When is the method used?
65. Derive Gibbs-Duhem-Margules equation.
66. What are ideal and non-ideal solutions? How does the vapour pressure of the components and the total vapour pressure vary with mole fraction of the components in case of an ideal solution and non-ideal solutions?
67. What are azeotropic mixtures? Describe briefly the types of azeotropic mixtures.
68. How are non-ideal solutions classified into different types? Briefly explain the behaviour of each type graphically giving reason and with a suitable example in each case.
69. Explain the method of fractional distillation.
70. Briefly explain the following systems giving one example from each.
    a. System with upper CST
    b. System with lower CST
    c. System with upper as well as lower CST
71. State and explain Nernst Distribution Law. What are the conditions under which the law is applicable? Derive the law thermodynamically.

72. State Nernst Distribution Law. How is the law modified if the solute undergoes
    1. association in one of the solvents
    2. dissociation in one of the solvents
    3. the solute undergoes chemical combination with one of the solvents
73. Discuss transition theory of reaction rates.
74. Explain the collision theory of bimolecular reactions. What are the limitations of this theory?
75. Derive the expression for the rate constant of a first order reaction.
76. Derive the expression for the rate constant of a second order reaction.
77. Discuss the methods for the determination of order of a reaction.
78. Derive expression for half-life of a zero order and 1^{st} order reaction. Explain how do the $t_{1/2}$ values depend upon the initial concentration of these reactions.
79. Give a brief account of enzyme catalysis. Discuss in detail the mechanism of enzyme catalysed reactions. Derive Michaelis- Menten equation.
80. Explain Freundlich adsorption isotherm.
81. Discuss the Langmuir theory of adsorption.
82. Draw and discuss fractional distillation process. The vapour pressures of pure benzene and toluene at 40^0C are 184.0 torr and 59.0 torr, respectively. Calculate the total vapour pressure of the solution, assume that the solution is ideal and contains 0.40 mole fraction of benzene.
83. Draw and discuss the variation of vapour pressure of completely miscible liquid pairs with composition.

2018

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1. a) What do you mean by Hydrometallurgy ? Give in detail the application of Hydrometallurgy. 9

   b) i) Write notes on Ellingham diagram. 3

   ii) Write notes on van Arkel-de Boer process. 3

OR

   c) Explain the different concepts on acids and bases. How the solvents affect the strength of acids and bases. 9

   d) i) Write short notes on HSAB principle. 3

   ii) Write short notes on conjugate acids and conjugate bases with examples. 3

2. a) Discuss the inert pair effect, diagonal relationship and anomalous behavior of first member of s and p block elements. 9

b) i) Why does the reactivity of nitrogen differ from phosphorus ? 3

ii) Why NH_3 form hydrogen bond but PH_3 does not ? 3

OR

c) Give in details the complex formation tendency of s and p block element. 9

d) i) Write main differences between the properties of white phosphorus and red phosphorus. 3

ii) Why does nitrogen show catenation properties less than phosphorus ? 3

3. a) Discuss the structure and nature of bonds in diborane. Give any two methods of preparation of diborane. 9

b) i) Give any two methods of preparation of orthoboric acid. 3

ii) What happens when diborane reacts with CO and Chlorine ? 3

OR

c) Write notes on silicon, silanes and silicon dioxide. 9

d) i) Write a short note on abnormal behaviour of beryllium. 3

ii) Why boron is diagonally related to silicon ? 3

4. a) Explain important characteristics of noble gases, with special reference to their position in the periodic table. 9

b) i) How are xenon fluorides XeF_2, XeF_4 and XeF_6 obtained ? 3

ii) Write notes on Clathrate compounds. 3

OR

c) Discuss briefly on different types of inorganic polymers. Give a brief comparison with organic polymers. 9

d) i) Write notes on Borazines. 3

ii) Give the applications of silicones and siloxanes. 3

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1. a) Aromatic Nucleophilic substitution reactions are occurs mainly by the addition-elimination and elimination-addition type mechanistic pathways. Discuss both of the mechanisms with examples for each in details. 9

   b) Propose a mechanism and predict the product(s) for the solvolysis of 1-bromo-1-methyl cyclopentane in ethanol. 3

   c) Considering suitable reactions, explain, how Organolithium reagents are prepared by the processes of hydrogen-metal exchange, halogen-metal exchange and metal with alkyl halides. 3

   OR

   d) Prepare a comparative statement over the functions of substrate, solvent, leaving group and Stereochemical aspects in the E1, SN^1 and E2, SN^2 reactions mechanism. Summarize the best conditions in each case required for a suitable reaction to occur. 9

e) Unlike alkyl halide, explain why aryl and vinyl halides are unreactive towards SN^1 and SN^2 reactions ? 3

f) How steric hindrance become a factor affecting the reactivity of Organomagnesium reagents and in which conditions its lithium counterpart is more feasible for organic synthesis ? 3

2. a) What are glycols ? How is ethylene glycol prepared ? Account for its reactivity and Product(s). When ethylene glycol is allowed to reacts with PCl_5, Conc. H_2SO_4, H_5IO_6 and lead tetra-acetate. 9

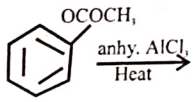
b) What do you understand by reductive cleavage of epoxides into alcohols ? With nucleophilic reducing agent like $LiAlH_4$, how it can be done ? 3

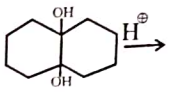
c) Describe briefly the process methylation of alcohols with diazomethane to get ethers. Give an example of your choice. 3

OR

d) Narrate the method of preparations, atleast two methods for each of alcohols, ethers and esters. Outline the mechanism incorporated into acid and base-catalyzed ring opening of epoxides. 9

e) Complete the following reactions by drawing structure of the products(s) expected. 3×2

(i) 

(ii) 

3. a) Explain ambident nature of enolate ions in Aldol addition. Write down the Keto-enol forms of ethylacetoacetate. In which tautomeric form the ester can display intramolecular Hydrogen bonding ? 9

b) How will you transform Ketoxime to an N-substituted amide strarting with a suitable Ketone ? 3

c) Briefly discuss the mechanism involved in a Cannizzaro reaction. What would happen, if p-hydroxybenzaldehyde is subjected to this reaction ? 3

OR

d) Considering one general reaction, discuss the mechanism associated with Michael type addition of activated double bond. Highlight the scope and applications of this reaction. 9

e) Explain, why the α–hydrogen of an aldehyde is relatively acidic and show the mechanism of its removal from propanol. 3

f) "Though witting reagent has no net charge, still it shows nucleophilic addition reaction" - Comment on it. 3

4. a) Discuss the mechanism of Claisen condensation. How will you synthesize β–Ketoester without α–hydrogen. 9

b) Predict the outcome of esterification of ethanoic acid with Sec-butyl alcohol in presence of dry HCl. 3

c) Give an account of boiling points, acidity and hydrolysis properties of thiols and thioethers in comparision to their parent alcohols and ethers. 3

OR

d) How are amides and acid anhydrides prepaired ? Discuss any two best method of their preparations. Offer explanations for their suitability towards SN^2 mechanism and aqueous hydrolysis. 9

e) How Maleic acid can be prepared commercially by oxidising But-2-ene ? Give equation. 3

f) Compare nucleophilic substitution reactions in alkyl and acyl compounds. In which case, SN^2 reaction will be much faster and why ? 3

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2019

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) Discuss the $S_{N}1$, $S_{N}2$ and $S_{N}i$ mechanisms with sterochemical aspects. 9

   b) How can your prepare chlorobenzene from benzenediazonium chloride ? Show the mechanism. 3

   c) Nucleophilic substitutions in alkyl halides are influenced by solvents–Explain. 3

   OR

   d) What is Grignard reagent ? How can you prepare it ? Synthesise the following compounds using suitable Grignard reagent- 9

      i) ter-butyl alcohol

      ii) 2-phenyl ethanol

      iii) ethymethyl ketone

iv) butanal

v) butyric acid.

e) $RLi + CO_2 \rightarrow$?
Predict the product and show how it is formed ? 3

f) Griganrd reagent is a carbanion precurssor-explain. 3

2. a) Discuss the following reaction mechanisms : 9

i) Reimer-Tiemann reaction

ii) Pinacol-Pinacolone rearrangement.

b) Suggest the path by which n-butyl alcohol can be prepared by Bouveault-Blanc reduction. 3

c) Explain why p-nitrophenol is more acidic than p-cresol ?

OR

d) Discuss the reactions of ethylene epoxide with 9

i) alcohol

ii) ammonia derivative and

iii) $LiAlH_4$.

e) Phenol is less acidic than carboxylic acids-explain. 3

f) Compare the reactivities 1°, 2° and 3° alcohols with Luca's reagent. 3

3. a) Discuss the following reaction mechanisms with one application– 9

i) Perkin reaction

ii) Aldol condensation.

b) $R-\overset{\overset{O}{\|}}{C}-R' \xrightarrow{PAA} R-\overset{\overset{O}{\|}}{C}-R'$

Name the above reaction and show how the product is formed ? 3

c) How does a ketone react with MPV for reduction into a secondary alcohol. 3

OR

d) How can you prepare acetoacetic ester by Claisen condensation ? Synthesise the following compounds from AAE - 3 + 8

i) Pentan -2-one

ii) Succinic acid

iii) Crotonic acid and

iv) acetylacetone.

e) Write a note on Keto-enol tautomerism. 4

4. a) Discuss the relative nucleophilic substitutions of different acyl derivatives of carboxylic acid. Justify your answer by conjugate acid-base pair and reasonance concept. 9

b) Carboxylic acids have higher boiling points than corresponding alcohols. Explain. 3

c) Between Fumaric acid and Maleic acid, which is thermodynamically more stable ? Show how they can be interconverted. 3

OR

d) Discuss the various mechanisms suggested for both acid catalysed and base catalysed ester hydrolysis. 9

e) Discuss the following reaction mechanisms : 3 + 3

i) Dieckmann condensation

ii) Reformatsky reaction.

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2021

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) How Alkyl halides can be prepared ? Explain nucleophilic substitution and elimination methods. 9

   b) Grignard reagent is a carbanion precursor-Explain. 3

   c) Show the mechanism of preparation of Chlorobenzene from benzenediazonium chloride. 3

   OR

   d) Synthesize 2-phynyl ethanol, ethymethyl keton, butanal and butyric acid using suitable Grinard reagent. 10

   e) Neucleophilic substitutions in alkyl-halides are influenced by solvents-Explain. 5

2. a) Discuss the reactions of ethylene epoxide with
   i) Alcohol
   ii) Ammonia Derivative
   iii) $LiAlH_4$. 12

   b) Compare the relativities 1°, 2° and 3° alcohols with Luca's reagent. 3

OR

   c) Explain ring substitution reactions and Reimer-Tiemann and KolbesSchmidt Reactions. 11

   d) Suggest the path by which n-butyl alcohol can be prepared by Bouveault-Blanc reduction. 4

3. a) Discuss on the preparation and synthetic applications of diethyl malonate and ethyl aceto-acetate. 10

   b) Write a note on Addition reactions of unsaturated carnonyl. 5

OR

   c) Discuss the following reaction mechanisms with one application 12
      i) Perkin reaction
      ii) Aldol condensation.

   d) How does a ketone react with MPV for reduction into a secondary alcohol ? 3

4. a) Discuss various mechanisms suggested for both acid catalysed and base catalysed ester hydrolysis. 10

   b) Discuss the following reaction mechanisms : $2\frac{1}{2} \times 2$
      i) Dieckmann condensation
      ii) Reformatsky reaction.

OR

   c) Discuss the mechanisms of 12
      i) Hofmann-bromide degradation
      ii) Curtius re-arrangement.

   d) Carboxylic acids have higher boiling points than corresponding alcohols. Explain. 3

2018

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer ***all*** questions

1. a) Draw a neat labeled phase diagram of water system and explain areas, curves and triple point on it. 9

b) i) Explain the term eutectic point and eutectic mixture. 3

ii) Define degree of freedom. How many degree of freedom are present in the following system ? 3

i) $I_2(s) \leftrightarrow I_2(g)$

ii) $Ice(s) \leftrightarrow water(I) \leftrightarrow water\ vapor(g)$

OR

c) Explain how with the help of the Clausius - Clapeyron equation you may predict the following : 9

i) Effect of pressure on the melting point of ice or freezing point of water.

ii) Effect of pressure on the melting point of sulphur.

iii) Effect of pressure on the transition temperature of sulphur rhombic.

d) i) What is condensed phase rule ? 3

ii) Why cannot all the phases of sulpur system co-exist at the same temperature and pressure ? 3

2. a) Explain what is meant by the distribution law for a substance between two immiscible solvents. Discuss the practical applications of distribution law. 9

b) i) Explain the term azeotropes. 3

ii) Calculate how much succinic acid would be extracted from 100 ml of water containing 5 gm of the acid if extracted with 50 ml of ether. The partition coefficient of succinic acid between water and ether is 5.5 3

OR

c) What is Gibbs-Duhem-Margules equation ? Give its applications to fractional distillations of binary miscible liquids. 9

d) i) Discuss the limitations of distribution law. 3

ii) How distribution law is modified when the solute undergoes association in one of the liquids. 3

3. a) What is meant by order of a reaction ? Derive the equations for reactions of the first order. What are the characteristics of the reactions of the first order ? 9

b) i) A first order reaction is 50% completed in 20 minutes at 300 K and in 5 min at 350 K. Calculate the energy of activation of the reaction. 3

ii) Explain why order of a reaction cannot be predicted from overall stoichiometry ? 3

OR

c) Enumerate the methods employed the order of a reaction. Discuss one method in detail. 9

d) i) The half life period for a 1st order reaction is 50 sec. How long will it take for the completion of 60% of the reaction ? 3

ii) Explain with example the 'chain reaction'. 3

4. a) Explain giving examples the following terms : 9

Catalyst, Catalysis, Autocatalysis. Negative catalysis and Promoters.

b) i) Discuss the general characteristics of catalytic reactions. 3

ii) Discuss the applications of catalysis in industry. 3

OR

c) What is meant by acid-base catalysis ? Explain giving examples the theories of acid-base catalysis. 9

d) i) Write notes on poisoning of catalysis. 3

ii) Differentiate between homogeneous and heterogeneous catalysis. 3

2021

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Answer the following : 1×8

   a) The Gibb's phase rule for general system is ____.

   b) The point at which all phases can exist in equilibrium is called ____.

   c) What is the unit of rate constant in zero order reaction ____ .

   d) Calculate the number of component of the following reaction

   $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

   e) What is the effect of increasing pressure on a system having UCST as well as LCST ?

   f) Calculate the order of reaction in the following equation when $r = [A]^{3/2}[B]^{1/2}$.

   g) What is the main role of catalyst in a chemical reaction ?

   h) What is homogeneous catalyst ?

Part-II

2. Answer any ***eight*** of the following : $1\frac{1}{2} \times 8$

a) What is meant by metastable equilibrium ?

b) What is degree of freedom and give equation as well as their meaning ?

c) Why the mixture of two immiscible liquids boils at a lower temperature ?

d) Write Duhem-Margule equation only.

e) Define the term activation energy.

f) The half life period of first order chemical reaction is 6.93 minutes. Calculate the time required for the completion of 99% of chemical reaction.

g) What is rate law and rate constant ?

h) Write a note on heterogeneous catalyst.

i) Why all adsorptions are exothermic in nature ?

j) Give the derivation of Nernst distribution law.

Part-III

3. Answer any ***eight*** of the following : 2×8

a) How is supercooled water an example of metastable equilibrium.

b) What is the form of the Gibbs phase rule for two component system ?

c) What is an azeotrope ?

d) What are ideals and non ideal solution ?

e) State distribution law. How is the law derived from thermodynamic considerations ?

f) Discuss the Arrhenius equation for the temperature dependence of reaction rate.

g) What is activation energy ? Explain graphically.

h) Write a note on adsorption isotherm and its significane.

i) Distiguish between physical and chemical adsorption.

j) How nanoparticles act as catalyst more efficiently ?

Part-IV

4. a) Discuss the appilication of phase rule to the equilibrium met in case of sulphur system. 6

OR

b) Derive Clausis-Clapeyron equation for the equilibrium liquid = vapour. How will you obtain the heat of vapourisation using this equation ?

5. a) Write a note on three component system water-chloroform-acetic acid. 6

OR

b) Write notes on the following : 3 + 3

i) Write a few lines on minimum boiling azeotrope.

ii) Phenol-water binary system (upper critical solution type)

6. a) Derive an expression for the rate constant of a first order reaction. Define half life period first order reaction. 6

OR

b) Write notes on the following : 3 + 3

i) Parallel raction

ii) Consecutive reactions.

7. a) What is Langmuir adsorption ? Derive and explain Langmuir adsorption isotherms. 6

OR

b) Derive the Michaells-Menten equation in enzyme catalysis of following reaction

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES, \qquad ES \xrightarrow{k_2} E + P$$

□□

2021

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer *all* questions

1. a) State and explain Clausius-Clapeyron equation and its applications to solid, liquid and liquid vapour equilibria. 10

   b) Write short notes on the following : 2½×2

      i) Congruent melting point

      ii) Predict the phase when Calcium carbonate is heated in a closed vessel.

      OR

   c) Explain Triple point, Meta-stable triple point and Critical point using phase diagram of sulphur system. 10

   d) Write short notes on the following : 2½×2

      i) Solid Solution

      ii) Incongruent Melting point.

2. a) Define and discuss Gibbs-Duhem-Margules equation and its derivation and applications to fractional distillation of binary miscible liquids. 12

b) Write short notes on Steam distillation. 3

OR

c) Discuss water-chloroform-acetic acid system. 11

d) Write short notes on critical solution temperature. 4

3. a) Describe order and molecularity of a chemical reaction. 10

b) Write short notes on Opposing reactions and Chain reactions. 2½ × 2

OR

c) Discuss the Kinetics of the first order consecutive reactions. 11

d) Write short notes activation energy. 4

4. a) Discuss the various characteristics of enzyme catalyst. Derive Michaelis-Menten equation for enzymecatalysis. 10

b) Write a note on Specificity of Catalyst. 5

OR

c) Derive Langmuir adsorption isotherm equation. Show how under what conditions it becomes identical with Freundlich adsorption isotherm equation. 10

d) Write a note a Chemical adsorption. 5

2020

Full Marks - 60

Time - 3 hours

The figures in the right-hand margin indicate marks

Answer ***all*** questions

Part-I

1. Answer the following : 1 × 8

   a) Gibbs phase rule is ____.

   b) The point where freezing point curves of two solid component meet in the phase diagrams is called ____

   c) For an ideal solution obeying Raoult's law is given by ____.

   d) ____ is a constant boiling mixture in which the composition of the vapour is the same as that of liquid.

   e) The unit of second order reaction is ____.

   f) For a first order reaction $A \rightarrow B$ (products), $t_{½}$ is 100S. The rate constant of the reaction is ____.

   g) The type of reaction in which one of the product itself acts as a catalyst is known as ____.

   h) A plot of log x/m Vs log P for the adsorption of a gas on a solid gives a straight line with slope _____.

Part-II

2. Answer any ***eight*** of the following : 1½ × 8

   a) Determine the number of components, number of phases and degree of freedom for the system $CaCO_3(s) \quad CaO(s) + CO_2(g)$

   b) Under what condition phase rule, $F = C - P + 2$ changes to $F = C - P + 1$.

   c) What do you mean by ideal solution ?

   d) State lever rule.

   e) How the reaction $H_2 + Cl_2 \xrightarrow{hv} HCl$ is zero order ?

   f) What do you mean by Pseudo first order reaction ? Give one example.

   g) What is the effect of temperature on order of reaction ?

   h) Write the role of catalyst's particle size on reaction.

   i) What is heterogeneous catalysis ?

   j) What are the factors that affect the extent of adsorption ?

Part-III

3. Answer any ***eight*** of the following : 2 × 8

a) What is triple point of water ?

b) Why phase diagrams for two component systems require three dimensional presentations ?

c) Define the following terms with suitable examples.

i) Eutectic System

ii) Metastable equilibrium.

d) Define and explain critical solution temperature.

e) Write the principle of distillation of constant pressure ?

f) A first order reaction is 10% complete in 50 minutes. Calculate the value of rate constant.

g) The half life of the reaction $SO_2Cl_2 \rightarrow SO_2 + Cl_2$ which obeys first order kinetics is 8 minutes. How long it will take for the concentration of SO_2Cl_2 to be reduced to 1% of the initial value ?

h) Explain the effect of presence of catalyst on the energy of activation of the reaction.

i) Why chemisorption is irreversible whereas physisorption is reversible ?

j) How does adsorption differ from absorption ?

Part-IV

4. a) Draw and discuss phase diagram of H_2O system. 6

OR

b) Discuss in detail $FeCl_3 - H_2O$ system that show congruent melting point.

5. a) Derive Gibbs-Duhem-Margles equation. 6

OR

b) State and derive Nernst distribution law.

6. a) What is 1st order reaction ? Derive the expression for the rate constant of a first order reaction. 6

OR

b) Discuss the collision theory of bimolecular reaction. What are the limitations of this theory ?

7. a) Explain Michaelis Menten equation for enzyme catalysis. 6

OR

b) Derive thermodynamically the Gibbs adsorption isotherm for the adsorption of a solute on the surface of a liquid.

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