

Total No. of Printed Pages—15

HS/XII/SC/Ch/26

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CHEMISTRY

(Theory)

Full Marks : 70

Time : 3 hours

The figures in the margin indicate full marks for the questions.

General Instructions :

Read the following instructions carefully :

- (i) All questions are compulsory.
- (ii) Attempt all parts of a question together at one place.
- (iii) There are 33 questions in this question paper with internal choice.
- (iv) Section—A consists of 16 multiple-choice questions carrying 1 mark each.
- (v) Section—B consists of 5 short answer-type questions carrying 2 marks each.
- (vi) Section—C consists of 7 short answer-type questions carrying 3 marks each.
- (vii) Section—D consists of 2 questions carrying 4 marks each.
- (viii) Section—E consists of 3 long answer-type questions carrying 5 marks each.

(2)

SECTION—A

(Marks : 16)

Question Nos. **1** to **16** are multiple-choice questions. Only one of the choices is correct. Select and write the correct choice to these questions.

1. The maximum amount of solid solute that can be dissolved in a specified amount of a given liquid solvent does not depend upon
 - (a) temperature
 - (b) nature of solute
 - (c) pressure
 - (d) nature of solvent1

2. The expression of concentration of solution which is temperature dependent is
 - (a) molarity
 - (b) molality
 - (c) mole fraction
 - (d) None of the above1

3. The influence of temperature on the rate of a reaction is determined by
 - (a) Nernst equation
 - (b) Gibbs-Helmholtz equation
 - (c) van't Hoff equation
 - (d) Arrhenius equation1

(3)

4. The value of rate constant of a pseudo-first-order reaction

- (a) depends on the concentration of reactants present in small amount
- (b) depends on the concentration of reactants present in excess
- (c) is independent of the concentration of the reaction
- (d) depends only on temperature

1

5. The reason of lanthanoid contraction is

- (a) negligible screening effect of f -orbital
- (b) increasing nuclear charge
- (c) decreasing nuclear charge
- (d) decreasing screening effect

1

6. The catalytic activity of transition metal's and their compounds is due to

- (a) their ability to adopt variable oxidation states
- (b) their chemical activity
- (c) their magnetic behaviour
- (d) their unfilled d -orbital

1

(4)

7. Primary, secondary and tertiary alcohols can be distinguished by

- (a) Hinsberg's test
- (b) Tollen's reagent
- (c) Fehling's solution
- (d) Lucas test

1

8. Phenol is more acidic than ethanol because

- (a) ethoxide ion is more stable than phenoxide ion
- (b) phenoxide ion is more stable than ethoxide ion
- (c) phenol undergoes electrophilic substitution reaction
- (d) phenol undergoes protonation easily

1

9. The most suitable reagent for the conversion of RCH_2OH to RCHO is

- (a) KMnO_4
- (b) $\text{K}_2\text{Cr}_2\text{O}_7$
- (c) LiAlH_4
- (d) PCC (Pyridinium Chlorochromate)

1

(5)

- 10.** The compound among the following which gives both iodoform and Fehling's test is
- (a) ethanol
 - (b) propanone
 - (c) butan-2-ol
 - (d) ethanal
- 1
- 11.** Aldol condensation does not occur between
- (a) two different aldehydes
 - (b) two different ketones
 - (c) an aldehyde and a ketone
 - (d) an aldehyde and an ester
- 1
- 12.** Which of the following on heating with aqueous KOH, produces acetaldehyde?
- (a) $\text{CH}_3\text{CH}_2\text{Cl}$
 - (b) $\text{CH}_2\text{ClCH}_2\text{Cl}$
 - (c) CH_3CHCl_2
 - (d) CH_3COCl
- 1
- 13.** Which one of the following is used in Friedel-Crafts acylation reaction?
- (a) Anhy. AlCl_3
 - (b) Aq. AlCl_3
 - (c) NH_2NH_2
 - (d) NH_2OH

14. Which one of the following is the correct statement? 1

- (a) Alkyl halides are more reactive than aryl halides towards nucleophilic substitution reaction
- (b) Alkyl halides are less reactive than aryl halides towards nucleophilic substitution reaction
- (c) Nucleophilic substitution reaction proceeds through carbocation
- (d) Aryl halides cannot be prepared by electrophilic substitution to arenes

15. Which complexes do not show geometrical isomerism? 1

- (a) Square planar complexes
- (b) Tetrahedral complexes
- (c) Octahedral complexes
- (d) All of the above

16. Copper sulphate cannot be stored in zinc vessel. This is because

- (a) EMF of the reaction is negative
- (b) EMF of the reaction is positive
- (c) reduction potential value of Zn is more than Cu
- (d) reduction potential value of Cu is negative 1

(7)

SECTION—B

(Marks : 10)

Question Nos. **17** to **21** are very short answer-type questions carrying 2 marks each.

17. *Either*

- (a) 10% solution of non-volatile solute in water has a vapour pressure 740 mm at 373 K. Calculate the molar mass of the solute. 2

Or

- (b) What mass of ethylene glycol must be added to 5.5 kg of water to lower the freezing point from 0 °C to -10 °C? K_f for water = 1.86 K kg mol⁻¹, molar mass of ethylene glycol = 62 g mol⁻¹.

18. *Either*

- (a) A first-order reaction has a rate constant $1.5 \times 10^{-3} \text{ s}^{-1}$. How long will 5 g of this reactant take to reduce to 3 g? 2

Or

- (b) Derive the integrated rate expression of a zero-order reaction.

19. (a) Write the formula of the coordination compound tetraamine aquachlorido cobalt (III) chloride. 1

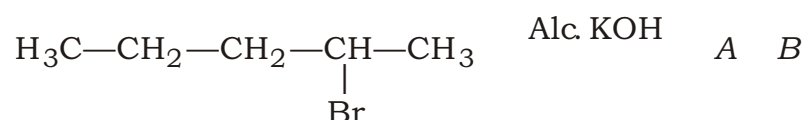
(b) Give one example of coordination isomerism. 1

(8)

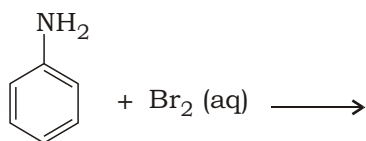
20. (a) Arrange the following set of compounds in order of increasing boiling points : 1

1-chloropropane, isopropyl chloride, 1-chlorobutane

- (b) Write the products of the following reaction : 1



21. (a) Complete the following reaction : 1



- (b) Why is methanamine a stronger base than ammonia? 1

SECTION—C

(Marks : 21)

Question Nos. 22 to 28 are short answer-type questions carrying 3 marks each.

22. *Either*

- (a) What type of deviation from Raoult's law is observed by mixing chloroform and acetone? What causes this deviation? 1+1=2
- (b) What is the value of van't Hoff factor, i , for aqueous K_2SO_4 solution, assuming that it undergoes complete dissociation in solution? 1

(9)

Or

(c) What is meant by elevation of boiling point? 1

(d) The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. [K_b for benzene is 2.53 K kg mol⁻¹] 2

23. (a) The cell in which the following reaction occurs



has $E^\circ_{\text{cell}} = 0.236$ V at 298 K. Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction. [Given, $1F = 96500$ C] 2

(b) What is the meaning of the negative sign in the expression $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76$ V? 1

24. Either

(a) Give one point of difference between order and molecularity of a reaction. 1

(b) The decomposition of HI is expressed by the equation $2\text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$. If during a certain time interval, the rate of disappearance of HI is 1.8×10^{-3} mol L⁻¹ s⁻¹, then what will be the rate of appearance of H₂ during the same time interval? 2

(10)

Or

- (c) For the reaction, $2\text{NO(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{NO}_2\text{(g)}$, the rate equation is given by, $r = k[\text{NO(g)}]^2[\text{O}_2\text{(g)}]$. Calculate the overall order of this reaction. Is this reaction an elementary reaction? Justify your answer. $1+1=2$
- (d) What is the order of the reaction if its unit of rate constant, k is (i) s^{-1} and (ii) $\text{mol L}^{-1} \text{s}^{-1}$? 1

25.

Either

- (a) Write the mechanism of the following $\text{S}_{\text{N}}1$ reaction : 2
 $(\text{CH}_3)_3\text{C}-\text{Br} \xrightarrow{\text{aq. NaOH}} (\text{CH}_3)_3\text{C}-\text{OH} + \text{NaBr}$
- (b) Why is *t*-butyl bromide more reactive towards $\text{S}_{\text{N}}1$ reaction as compared to *n*-butyl bromide? 1

Or

- (c) How would you carry out the following conversions? $1 \times 3 = 3$
- (i) Aniline to chlorobenzene
- (ii) Benzene to diphenyl
- (iii) But-1-ene to but-2-ene

26.

Either

- (a) Write the chemical equation for the preparation of ethoxybenzene by Williamson's synthesis. 1
- (b) How do you carry out the following conversions? $1+1=2$
- (i) Aniline to phenol
- (ii) Formaldehyde to ethanol

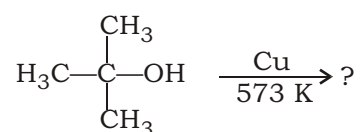
(11)

Or

- (c) Arrange the following alcohols in decreasing order of acid strength : 1

2-methylpropan-2-ol, propanol, propan-2-ol

- (d) Predict the product of the following reaction : 1

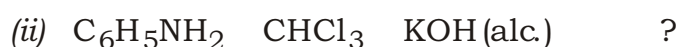


- (e) Give the equations only for the conversion of benzene to phenol. 1

27. (a) Arrange the following in decreasing order of their basic strength : 1

$\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $(\text{C}_2\text{H}_5)_3\text{N}$, $\text{C}_6\text{H}_5\text{NH}_2$

- (b) Identify the products of the following : $1 \times 2 = 2$



28. Either

- (a) Name four complimentary bases present in a DNA molecule. 1
- (b) Name the vitamin whose deficiency causes muscular weakness. 1
- (c) Write the structure of products formed when D-glucose is treated with NH_2OH . 1

(12)

Or

- (d) What do you mean by denaturation of proteins? 1
- (e) What are essential and non-essential amino acids?
Give one example of each type. 2

SECTION—D

(Marks : 8)

Question Nos. **29** and **30** carrying 4 marks each.

- 29.** (a) What is the oxidation number of Fe in $[\text{Fe}(\text{CN})_6]^{4-}$? 1
- (b) Give one example of a complex having tetrahedral geometry and paramagnetic in nature. 1
- (c) Which one is an inner-orbital complex? 1
 $[\text{Co}(\text{NH}_3)_6]^{3+}$ or $[\text{CoF}_6]^{3-}$
- (d) According to VBT, which one has the highest paramagnetic character? 1
 $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ or $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- 30.** (a) What are reducing and non-reducing sugars? 1
- (b) What are epimers? 1
- (c) Name one optically active amino acid and one optically inactive amino acid. 1
- (d) Why are carbohydrates generally optically active? 1

(13)

SECTION—E

(Marks : 15)

Question Nos. **31** to **33** are long answer-type questions carrying 5 marks each.

31. *Either*

(a) Write two functions of salt bridge. 1

(b) Calculate the EMF of the cell in which the following reaction takes place : 2



(Given that $E^\circ_{\text{cell}} = 1.05\text{ V}$)

(c) How much electricity in terms of Faraday is required to produce 40 g of Al from Al_2O_3 ? 2

(F = 96500 C, Atomic mass of Al = 27)

Or

(d) Why does conductivity of a solution decrease with dilution? 1

(e) What is cathodic protection? 1

(f) (i) State Kohlrausch's law. 1

(ii) Given molar conductivities at infinite dilution :

$$\Lambda^\circ_{\text{Ba(OH)}_2} = 457.6\text{ Scm}^2\text{ mol}^{-1}$$

$$\Lambda^\circ_{\text{BaCl}_2} = 240.6\text{ Scm}^2\text{ mol}^{-1}$$

$$\Lambda^\circ_{\text{NH}_4\text{Cl}} = 129.8\text{ Scm}^2\text{ mol}^{-1}$$

Calculate $\Lambda^\circ_{\text{NH}_4\text{OH}}$. 2

(14)

32.

Either

- (a) Why do transition metals generally form coloured compounds? 1
- (b) Draw the structures of permanganate ion. 1
- (c) Why Cr^{3+} is reducing and Mn^{3+} is oxidizing when both have d^4 -configuration? 1
- (d) Give the reaction of potassium dichromate with (i) KI and (ii) H_2S (in acidic medium). 2

Or

- (e) Why do transition metals easily form alloys with other transition metals? 1
- (f) Why is silver (Atomic number 47) considered to be a transition element whereas zinc (Atomic number 30) is not? 1
- (g) Write the balanced chemical equation for the reaction of KMnO_4 with oxalic acid in acidic medium. 1
- (h) Write all the reactions occurring during the preparation of potassium permanganate from pyrolusite ore. 2

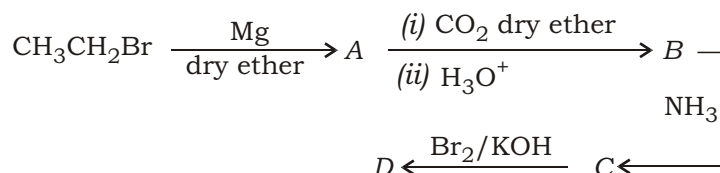
33.

Either

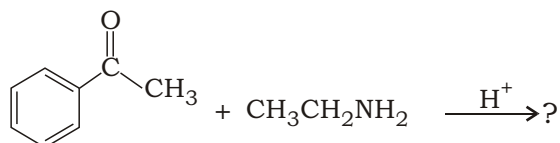
- (a) Would you expect benzaldehyde to be more reactive or less reactive in nucleophilic addition reactions than propanal? Explain your answer. 2

(15)

- (b) Identify the products A, B, C and D from the following sequence of reactions : 2



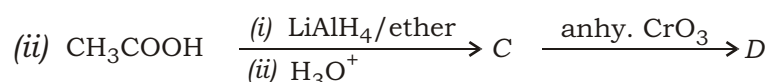
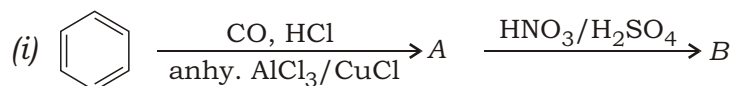
- (c) Predict the product of the following reaction : 1



Or

- (d) Write the structures of pentan-2-one and pentan-3-one and give a simple chemical test to distinguish between them. 2

- (e) Predict the structures of the products A, B, C and D from the following reactions : 1×2=2



- (f) The pK_a values of 4-methoxybenzoic acid 4-nitrobenzoic acid and benzoic acid are 4.46, 3.41 and 4.19 respectively. Which of these aromatic carboxylic acids is the most acidic and why? 1

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