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CHEMISTRY

(Theory)

Full Marks : 70

Time : 3 hours

General Instructions :

- (i) Write all answers in the Answer Script.
- (ii) Attempt all parts of a question together in one place.
- (iii) All questions are compulsory.
- (iv) Marks for each question are indicated against it.
- (v) Question No. **1** of Part—I is of Multiple-choice Type, each of $\frac{1}{2}$ mark. Choose and write the correct answer in the Answer Script from the four options given.
- (vi) Question Nos. **2** to **9** of Part—II are very Short-answer Type Questions of 1 mark each. Answer these either in *one* word or in *one* sentence each.
- (vii) Question Nos. **10** to **17** of Part—III are Short-answer Type—I Questions of 2 marks each. Answer these in about 20–30 words each.

(2)

- (viii) Question Nos. **18** to **26** of Part—IV are Short-answer Type—II Questions of 3 marks each. Answer these in about 40–50 words each.
- (ix) Question Nos. **27** to **29** of Part—V are Long-answer Type Questions of 5 marks each. Answer these in about 70–80 words each.
- (x) Use of non-programmable ordinary Scientific Calculators and Log Tables is allowed.
- (xi) Mobile phones and Pagers are not allowed inside the Examination Hall.

PART—I

1. Choose and write the correct answers for the following in the Answer Script : $\frac{1}{2} \times 8 = 4$
- (a) In which pair is the most efficient packing present?
- (i) hcp and bcc
 - (ii) bcc and ccp
 - (iii) hcp and ccp
 - (iv) bcc and simple cubic
- (b) The fraction of the total volume occupied by the atoms present in a simple cubic is
- (i) $\frac{1}{4}$
 - (ii) $\frac{1}{6}$
 - (iii) $\frac{1}{3\sqrt{2}}$
 - (iv) $\frac{1}{4\sqrt{2}}$

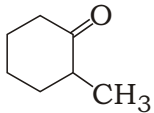
(3)

- (c) Increasing the temperature of an aqueous solution will cause
- (i) decrease in molality
 - (ii) decrease in molarity
 - (iii) decrease in mole fraction
 - (iv) decrease in mass percent
- (d) Colligative properties are those properties which depend on
- (i) shapes of the particles
 - (ii) nature of the particles only
 - (iii) nature of the solvent only
 - (iv) number of particles only
- (e) The most suitable reagent for the conversion of $R-CH_2-OH$ to $RCHO$ is
- (i) $KMnO_4$
 - (ii) $K_2Cr_2O_7$
 - (iii) $LiAlH_4$
 - (iv) PCC
- (f) The strongest acid among the following compounds is
- (i) *o*-nitrophenol
 - (ii) *p*-chlorophenol
 - (iii) *m*-nitrophenol
 - (iv) *p*-nitrophenol

(4)

- (g) Which of the following acids is a vitamin?
- (i) Aspartic acid
 - (ii) Adipic acid
 - (iii) Ascorbic acid
 - (iv) Saccharic acid
- (h) The reason for the double helical structure of DNA is due to the presence of
- (i) van der Waals' forces
 - (ii) dipole-dipole interactions
 - (iii) hydrogen bonding
 - (iv) London forces

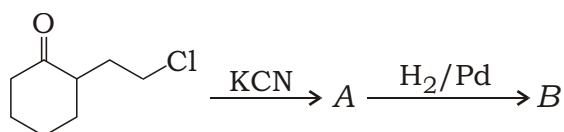
PART—II

2. What is Kraft temperature? 1
3. What are ambidentate ligands? 1
4. Arrange the following in order of decreasing S_N1 reactivity : 1
 $(CH_3)_3CCl$, CH_3Cl , $(CH_3)_2CHCl$, CH_3CH_2Cl
5. Write the IUPAC name of 1
- 
6. Identify the products A and B formed in the following reaction : $\frac{1}{2} + \frac{1}{2} = 1$
- $$CH_3 - CH_2 - CH = CH - CH_3 \quad HCl \quad A \quad B$$

(5)

7. Give one reaction that can be used as a test for primary amines. 1

8. Identify A and B in the following reaction : $\frac{1}{2} + \frac{1}{2} = 1$



9. How does antiferromagnetism differ from ferromagnetism in terms of magnetic domains? 1

PART—III

10. An element has bcc structure with cell edge of 288 pm. The density of the element is 7.2 g cm³. How many atoms are present in 208 g of the element? 2

11. *Either*

(a) What will happen to the boiling point of a solution on mixing two miscible liquids showing negative deviation from Raoult's law? 1

(b) Give two conditions necessary for a solution to be ideal. 1

Or

(c) Derive a relation between relative lowering of vapour pressure and mole fraction of the solute. 2

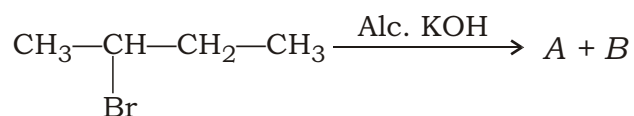
- 12.** The boiling point of benzene is 353·23 K. When 1·80 g of a nonvolatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354·11 K. Calculate the molar mass of the solute. (K_b for benzene is 2·53 K kg mol⁻¹) 2
- 13.** (a) When does the average rate of a reaction become equal to instantaneous rate? 1
- (b) Write any one condition under which a bimolecular reaction may be kinetically of first order. 1
- 14.** (a) Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25. 1
- (b) Predict which of the following will be coloured in aqueous solution : 1
- Sc^3 , Fe^3 , Ti^4 , V^3
- (Atomic nos. of Sc, Fe, Ti and V are 21, 26, 22 and 23 respectively)
- 15.** *Either*
- (a) Write the IUPAC name of the following complex : 1
- $\text{Pt}[\text{Cl}_2(\text{en})_2](\text{NO}_3)_2$
- (b) Name the type of isomerism exhibited by the following pairs of complexes : $\frac{1}{2} \times 2 = 1$
- (i) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ and $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
- (ii) $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ and $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$

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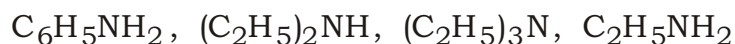
Or

(c) Is the complex $[\text{Ni}(\text{CO})_4]$ a low-spin or a high-spin complex? Explain on the basis of VBT. 2

16. Write the products of the following reaction. Which one is the major product and why? 2



17. (a) Arrange the following substances in increasing order of their basic strength in water : 1



(b) Out of ethylamine and ethyl alcohol, which has higher boiling point and why? 1

PART—IV

18. *Either*

(a) Half-life period of a reaction increases with increase in initial concentration. Predict the order of the reaction. 1

(b) Decomposition of a compound follows first-order kinetics. If it takes 15 minutes for 20% of original substance to decay, calculate—

(i) rate constant;

(ii) the time at which 10% of the reactant remains undecayed. 1+1=2

(8)

Or

- (c) Define activation energy. 1
- (d) The rate of a particular reaction doubles when temperature changes from 27 °C to 37 °C. Calculate the value of activation energy. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$) 2
- 19.** (a) Distinguish between Physical adsorption and Chemical adsorption. 1
- (b) What do you mean by selectivity of a catalyst? 1
- (c) State Hardy-Schulze rule. 1

20.

Either

- (a) What are the two requirements for vapour phase refining? Write the chemical reactions which occur during Mond's process for the refining of nickel. 3

Or

- (b) What is the role of cryolite in the metallurgy of aluminium? 1
- (c) Name the depressant used for the separation of ZnS ore from PbS ore during froth floatation process. 1
- (d) How would you convert pig iron into cast iron? 1

21. Give reason for the following : 1+2=3

(a) O_3 acts as a powerful oxidizing agent.

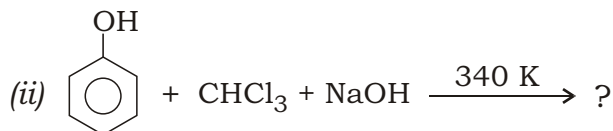
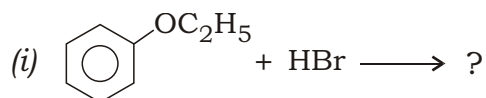
(b) O_2 is a gas but sulphur is a solid.

22. (a) Write the reaction of $KMnO_4$ with $Fe(II)$ ions in acidic medium. 1

(b) Define lanthanoid contraction. Write two consequences of lanthanoid contraction. 1+1=2

23. (a) How would you convert propene to propan-1-ol? 1

(b) Complete the following reactions : 1×2=2



24. *Either*

(a) Name the vitamins whose deficiency is responsible for—

(i) night blindness;

(ii) poor coagulation of blood. $\frac{1}{2} + \frac{1}{2} = 1$

(b) What are essential and nonessential amino acids? Give one example of each type. 1+1=2

(10)

Or

- (c) What is the difference between amylose and amylopectin? 1
- (d) What is a glycosidic linkage? 1
- (e) Name the base that is found in RNA only. 1
- 25.** (a) What is a biodegradable polymer? 1
- (b) Classify the following into addition and condensation polymers : 2
- Terylene, Bakelite, Polyvinyl chloride, Polythene
- 26.** (a) What are tranquilizers? 1
- (b) What are broad-spectrum antibiotics? 1
- (c) Name a substance that can be used as an antiseptic as well as disinfectant. 1

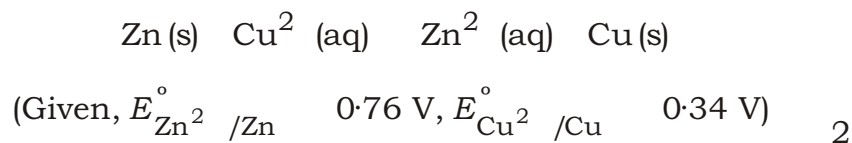
PART—V

- 27.** *Either*
- (a) Why does the conductivity of a solution decrease with dilution? 1
- (b) Write two conditions necessary for the corrosion to occur. 1

- (c) State Kohlrausch's law. Calculate the molar conductivity of an aqueous solution at infinite dilution for BaCl_2 , when ionic conductances of Ba^{2+} and Cl^- ions are $127.30 \text{ S cm}^2 \text{ mol}^{-1}$ and $76.34 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. 1+2=3

Or

- (d) What are fuel cells? 1
- (e) Write all reactions taking place during recharging of lead storage cell. 2
- (f) Calculate the standard Gibbs' energy change for the reaction



28.

Either

- (a) How does ammonia react with a solution of Cu^{2+} ions? 1
- (b) Draw the structure of cyclometaphosphoric acid. 1
- (c) Write the principle and conditions involved giving stepwise reaction for the manufacture of H_2SO_4 by contact process. 3

Or

- (d) HCl reacts with powdered Fe to give FeCl_2 and not FeCl_3 . Why? 1

(12)

(e) When NaBr is heated with conc. H_2SO_4 , Br_2 is produced. But when NaCl is heated with conc. H_2SO_4 , HCl is produced. Explain with chemical equations. 2

(f) Complete the following reactions : 1×2=2

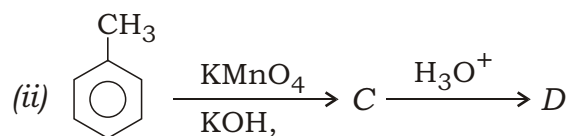
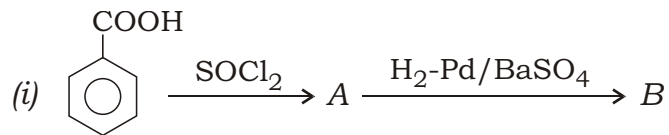
(i) $\text{Cu} + \text{HNO}_3(\text{dilute}) \rightarrow ?$

(ii) $\text{XeF}_4 + \text{O}_2\text{F}_2 \rightarrow ?$

29. (a) Arrange the following in increasing order of acidic strength : 1

ClCH_2COOH , CF_3COOH , HCOOH , CCl_3COOH

(b) Identify the products A, B, C and D in the given reactions : 1×2=2



(c) How will you bring about the following conversions? 1×2=2

(i) Ethyl cyanide to 1-phenyl propanone

(ii) Ethanal to 2-aminoethanoic acid
