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CHEMISTRY

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* sentence or in *one* word 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.
- (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.

(2)

- (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) To get *p*-type semiconductor, impurity to be added to silicon should have which of the following numbers of valence electrons?

(i) 2

(ii) 3

(iii) 1

(iv) 5

(b) In a face-centred cubic unit cell, the edge length is

(i) $\frac{4}{\sqrt{3}} r$

(ii) $\frac{4}{\sqrt{2}} r$

(iii) $2 r$

(iv) $\frac{\sqrt{3}}{2} r$

(3)

(c) What is the oxidation state of Fe in $K_3[Fe(CN)_6]$?

(i) 2

(ii) 3

(iii) 4

(iv) 1

(d) Which of the following is not a complex compound?

(i) Potassium ferrocyanide

(ii) Potassium ferricyanide

(iii) Ferrous ammonium sulphate

(iv) Cuprammonium sulphate

(e) How many chiral compounds are possible on monochlorination of 2-methyl butane?

(i) 2

(ii) 4

(iii) 6

(iv) 8

(f) S_N2 mechanism proceeds through the intervention of

(i) carbonium ion

(ii) transition state

(iii) free radical

(iv) carbanion

(4)

(g) Gabriel phthalimide reaction is used for the preparation of

- (i) primary aromatic amines
- (ii) secondary amines
- (iii) aliphatic primary amines
- (iv) tertiary amines

(h) Which of the following compounds gives dye test?

- (i) Aniline
- (ii) Methylamine
- (iii) Diphenylamine
- (iv) Ethylamine

PART—II

2. Why is Frenkel defect not found in pure alkali metal halides? 1
3. What will happen if a patient is given hypertonic solution of glucose? 1
4. Give one example each of oil in water emulsion and water in oil emulsion. $\frac{1}{2} + \frac{1}{2} = 1$
5. Arrange the following alkyl halides in order of increasing reactivity towards the nucleophilic substitution (S_N2): 1



(5)

6. Give the name with chemical formula of the reagent used for the distinction between primary, secondary and tertiary alcohols. $\frac{1}{2} + \frac{1}{2} = 1$
7. Write the structure of 5-chloro-4-methoxy-2-nitrobenzoic acid. 1
8. Primary amines have higher boiling points than tertiary amines. Why? 1
9. Which -amino acid is not optically active? 1

PART—III

10. (a) Aluminium crystallizes in a cubic close-packed structure. Its metallic radius is 125 pm. What is the length of the side of the unit cell? 1
- (b) Why is potassium chloride sometimes violet instead of pure white? 1
11. What is reverse osmosis? Mention one of its applications. $1 + 1 = 2$
12. *Either*
- (a) The freezing point of 0.1 molal solution of CH_3COOH in benzene is 0.256 K ($K_f = 5.12 \text{ K m}^{-1}$). What conclusion will you draw about molecular state of CH_3COOH in C_6H_6 ? 2

(6)

Or

- (b) A solution containing 18 g of a non-volatile solute in 200 g of H₂O freezes at 272.07 K. Find the molecular mass of the solute. ($K_f = 1.86 \text{ K m}^{-1}$) 2

13. (a) Calculate the overall order of a reaction which has the rate expression

$$\text{Rate} = k[A]^{1/2}[B]^{3/2} \quad 1$$

- (b) What is the rate determining step of a reaction? 1

14. *Either*

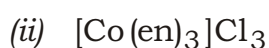
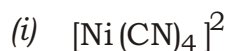
- (a) Explain why Ce⁴⁺ is a good oxidizing agent whereas Sm²⁺ is a good reducing agent. 2

Or

- (b) You are supplied with a concentrated solution of Na₂CrO₄. How will you obtain K₂Cr₂O₇ from this? Write the equation involved. 2

15. (a) What do you mean by crystal field splitting? 1

- (b) Write the IUPAC names of the following : $\frac{1}{2} + \frac{1}{2} = 1$



(7)

16. (a) Explain why thionyl chloride (SOCl_2) method is preferred for preparing alkyl chlorides from alcohols. 1
- (b) For isomeric haloalkanes, the boiling point decreases with branching of chain. Why? 1

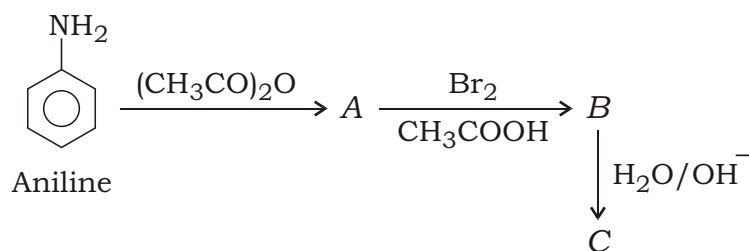
17. *Either*

- (a) Explain, with the help of chemical equations, how the following compounds would be obtained from benzene diazonium chloride : 1+1=2

- (i) Iodobenzene
- (ii) 4-Aminoazobenzene

Or

- (b) Complete the following reaction :



What will happen if aniline is treated with aqueous bromine? $1\frac{1}{2}+1\frac{1}{2}=2$

PART—IV

- 18.** (a) What is the order of reaction whose rate constant has the same unit as the rate of reaction? 1
- (b) Thermal decomposition of a compound is of first order. 50% decomposes in 120 minutes. How long will it take for 90% to decompose? 2
- 19.** (a) Indicate a chemical reaction involving homogeneous catalyst. 1
- (b) What is Brownian movement? 1
- (c) Comment on the following statement : 1
Colloid is not a substance but a state of substance.
- 20.** *Either*
- (a) What is the principle of zone refining? 1
- (b) What is flux? Give one example each of an acidic flux and a basic flux. 2
- Or*
- (c) Why are metallic ores converted into oxide usually? 1
- (d) Discuss the process of leaching with reference to the extraction of aluminium. 2

21.

Either

- (a) N_2 is known whereas P_2 is not known. Why? 1
- (b) Bleaching of flowers by chlorine is permanent while that by sulphur dioxide is temporary. Explain. 2

Or

- (c) OF_2 should be called oxygen difluoride and not fluorine oxide. Why? 1
- (d) H_2S acts only as a reducing agent but SO_2 acts both as a reducing agent as well as an oxidizing agent. Why? 2

22. (a) Why are Zn^{2+} salts white while Cu^{2+} salts are blue? 1

(b) What is meant by 'disproportionation'? Write the disproportionation reaction of Cu in aqueous solution. 2

23. (a) Give the chemical equation for the reaction of ethanol with conc. H_2SO_4 at 440 K. 1

(b) Convert phenol to salicylic acid (2-hydroxybenzoic acid). 2

(10)

- 24.** (a) Name one fibrous protein and one globular protein. 1
- (b) What are the products obtained on hydrolysis of sucrose? 1
- (c) What is the structural feature characterizing reducing sugars? 1
- 25.** *Either*
- (a) Give the common and IUPAC name of the monomer of natural rubber. 1
- (b) How is high density polythene obtained? What structural difference it has from low density polythene? 2
- Or*
- (c) Name a copolymer which is used for making non-breakable plastic crockery. 1
- (d) Write the names and give the structures of the monomers of Nylon-66. 2
- 26.** (a) What is an antiseptic? Give one example. 1
- (b) Name one narcotic and one non-narcotic analgesic. 1
- (c) Name any two main categories of food additives. 1

PART—V

27. (a) Why limiting molar conductivity of CH_3COOH cannot be determined experimentally? 1
- (b) How many coulombs of charge are required to produce 20.0 g of calcium from calcium chloride? 2
- (c) What is a salt bridge? Give two functions of salt bridge. 1+1=2

28. *Either*

- (a) F-atom is more electronegative than I-atom, yet HF has lower acid strength than HI. Why? 1
- (b) Explain why oxygen is a gas while other members of the same group are solids. 2
- (c) For interhalogens of the type AX_n ($A, X =$ halogen atoms; $n = 1$ or 3 or 5 or 7), what relation exists between A and X ? How does their reactivity vary with individual halogens? 1+1=2

Or

- (d) Why does NO_2 dimerize? 1
- (e) Draw the structure of $\text{H}_2\text{S}_2\text{O}_7$. What is the oxidation state of sulphur in it? 1+1=2
- (f) Write the balanced chemical equations of the following : 1+1=2
- (i) Excess of ammonia with chlorine
- (ii) Conc. H_2SO_4 with calcium fluoride

(12)

29.

Either

- (a) Name one reagent used to distinguish acetaldehyde from acetone. 1
- (b) Bring out the following conversions : 1+1=2
- (i) But-2-ene to ethanal
- (ii) Acetic acid to ethanal
- (c) Why carboxylic acids do not give the characteristic reactions of carbonyl group? 2

Or

- (d) What type of aldehydes and ketones undergo aldol condensation? 1
- (e) Why does benzoic acid not undergo Friedel-Crafts reaction? 1
- (f) Convert toluene to 3-nitrobenzoic acid. 1
- (g) Identify the products A, B, C and D from the following reactions : $\frac{1}{2} \times 4 = 2$

