

## CHEMISTRY PAPER 1 (THEORY)

### PART I (20 Marks)

Answer all questions.

#### Question 1

- (a) Fill in the blanks by choosing the appropriate word/words from those given in the brackets: [5]  
(zero, first, second, increased, decreased, anode, cathode, active, inactive, potassium cyanide, internal, external, dependent, independent, red, benzoic acid, benzoin, common ion effect, salt hydrolysis, alkali, potassium hydroxide.)
- (i) In a galvanic cell, electrons flow from \_\_\_\_\_ to \_\_\_\_\_ through the connecting wires.
- (ii) Racemic mixtures are optically \_\_\_\_\_ because of \_\_\_\_\_ compensation.
- (iii) Half life period of a \_\_\_\_\_ order reaction is \_\_\_\_\_ of the concentration of the reactant.
- (iv) Benzaldehyde when treated with an alcoholic solution of \_\_\_\_\_ forms \_\_\_\_\_.
- (v) Solubility of calcium oxalate is \_\_\_\_\_ in the presence of ammonium oxalate because of \_\_\_\_\_.
- (b) Complete the following statements by selecting the correct alternative from the choices given: [5]
- (i) The compound which is optically active is:
- (1) 1-butanol
  - (2) 2-butanol
  - (3) 1-propanol
  - (4) 2-methyl-1-propanol
- (ii) The salt which will not hydrolyse in aqueous solution is:
- (1) Copper sulphate
  - (2) Sodium sulphate
  - (3) Potassium cyanide
  - (4) Sodium carbonate
- (iii) Copper has the face centred cubic structure. The coordination number of each ion is:
- (1) 4
  - (2) 12

(3) 14

(4) 8

(iv) For the reaction  $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ , the unit of equilibrium constant is:

(1)  $\text{L mol}^{-1}$

(2)  $\text{J mol}^{-1}$

(3)  $\text{mol L}^{-1}$

(4)  $[\text{L mol}^{-1}]^2$

(v) The deficiency of vitamin D causes:

(1) Rickets

(2) Gout

(3) Scurvy

(4) Night blindness.

(c) Answer the following questions:

[5]

(i) Two metallic elements A and B have the following standard oxidation potentials:

$A = 0.40\text{v}$   $B = -0.80\text{v}$ . What would you expect if element A was added to an aqueous salt solution of element B? Give a reason for your answer.

(ii) Two moles of  $\text{NH}_3$  are introduced into one litre flask in which it dissociates at high temperature as follows:  $2\text{NH}_3(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$ . Determine  $K_c$ , if at equilibrium 1 mole of  $\text{NH}_3$  remains.

(iii) Give balanced equation for the preparation of salicylaldehyde from phenol.

(iv) If the half life period for a first order reaction is 69.3 seconds, what is the value of its rate constant?

(v) Define cryoscopic constant.

(d) Match the following:

[5]

(i) Colligative property

(a) Polysaccharide

(ii) Nicol prism

(b) Osmotic pressure

(iii) Activation energy

(c) Aldol condensation

(iv) Starch

(d) Polarimeter

(v) Acetaldehyde

(e) Arrhenius equation

## PART II (50 Marks)

Answer six questions choosing two from Section A, two from Section B and two from Section C.

### SECTION A

Answer any two questions.

#### Question 2

- (a) (i) Ethylene glycol is used as an antifreeze agent. Calculate the amount of ethylene glycol to be added to 4 kg of water to prevent it from freezing at  $-6^{\circ}\text{C}$ . ( $K_f$  for  $\text{H}_2\text{O} = 1.85 \text{ K mole}^{-1} \text{ kg}$ ) [3]
- (ii) The freezing point of a solution containing 0.3gms of acetic acid in 30gms of benzene is lowered by 0.45K. Calculate the Van't Hoff factor. (at. wt. of C = 12, H = 1, O = 16,  $K_f$  for benzene =  $5.12 \text{ K kg mole}^{-1}$ ). [2]
- (b) Name the law or principle confirmed by the following observations: [2]
- (i) When water is added to 0.01M aqueous solution of acetic acid the number of hydrogen ions increase.
- (ii) When 96500 coulombs of electricity is passed through acidulated water, 5.6 litres of oxygen at s.t.p. is liberated at the anode.
- (c) Arrange Ag, Cr and Hg metals in the increasing order of reducing power. Given: [1]
- $$E_{\text{Ag}^+/\text{Ag}}^{\circ} = +0.80\text{V}$$
- $$E_{\text{Cr}^{+3}/\text{Cr}}^{\circ} = -0.74\text{V}$$
- $$E_{\text{Hg}^{+2}/\text{Hg}}^{\circ} = +0.79\text{V}$$
- (d) In a first order reaction, 10% of the reactant is consumed in 25 minutes. Calculate: [2]
- (i) The half life of the reaction.
- (ii) The time required for completing 17% of the reaction.

#### Question 3

- (a) Explain giving reasons why (Give equations in support of your answer): [2]
- (i) A solution of  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$  acts as a buffer.
- (ii) Cu is precipitated as  $\text{CuS}$  while Zn is not precipitated when  $\text{H}_2\text{S}$  is passed through an acidic solution of  $\text{Cu}(\text{NO}_3)_2$  and  $\text{Zn}(\text{NO}_3)_2$  respectively. [2]
- (b) (i) What is Schottky defect in a solid? [1]
- (ii) A bcc element (atomic mass 65) has a cell edge of 420 pm. Calculate its density in  $\text{gms/cm}^3$ . [3]
- (c) The rate of the reaction  $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$  is given by: [2]

$$\text{rate} = 1.7 \times 10^{-19} [\text{H}_2][\text{I}_2] \text{ at } 25^{\circ}\text{C}.$$

The rate of decomposition of gaseous HI to  $\text{H}_2$  and  $\text{I}_2$  is given by:

$$\text{rate} = 2.4 \times 10^{-21} [\text{HI}]^2 \text{ at } 25^{\circ}\text{C}.$$

Calculate the equilibrium constant for the formation of HI from  $\text{H}_2$  and  $\text{I}_2$  at  $25^{\circ}\text{C}$ .

#### Question 4

- (a) (i) Give Lewis' definition for acids and bases. [1]  
(ii) The solubility of  $\text{Ag}_2\text{CrO}_4$  at  $25^\circ\text{C}$  is  $8.0 \times 10^{-5}$  moles/litre. Calculate its solubility product. [1]
- (b) (i) Define molar conductance of a solution. State its unit. How is it related to the specific conductance of a solution? [2]  
(ii) Calculate the value of  $E_{\text{cell}}$  at 298K for the following cell: [3]  
 $\text{Al} / \text{Al}^{3+} (0.01\text{M}) // \text{Sn}^{2+} (0.015\text{M}) / \text{Sn}$   
 $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ volt}$  and  $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14 \text{ volt}$
- (c) (i) Calculate the degree of hydrolysis of 0.2(M) sodium acetate solution. [1]  
(Hydrolysis constant of sodium acetate =  $5.6 \times 10^{-10}$  and ionic product of  $\text{H}_2\text{O} = 10^{-14}$  at  $25^\circ\text{C}$ )  
(ii) Explain why high pressure is used in the manufacture of ammonia by Haber's process. State the law or principle used. [2]

### SECTION B

*Answer any two questions.*

#### Question 5

- (a) Give the IUPAC names of the following coordination compounds: [2]  
(i)  $\text{K}_2[\text{Zn}(\text{OH})_4]$   
(ii)  $[\text{Co}(\text{NH}_3)_5(\text{CO}_3)]\text{Cl}$
- (b) For the complex ion  $[\text{Fe}(\text{CN})_6]^{3-}$  state: [1]  
(i) The geometry of the ion.  
(ii) The magnetic property of the ion.
- (c) What type of structural isomers are  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$  and  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ ? Give a chemical test to distinguish the isomers. [2]

#### Question 6

- (a) For the molecule  $\text{XeF}_2$ : [2]  
(i) Draw the structure of the molecule indicating the lone pairs.  
(ii) State the hybridisation of the central atom.  
(iii) State the geometry of the molecule.
- (b) Give balanced chemical equations for the following reactions: [3]  
(i) Fluorine treated with dilute sodium hydroxide solution.  
(ii) Hydrogen sulphide treated with concentrated sulphuric acid.  
(iii) Potassium iodide treated with acidified potassium permanganate solution.

**Question 7**

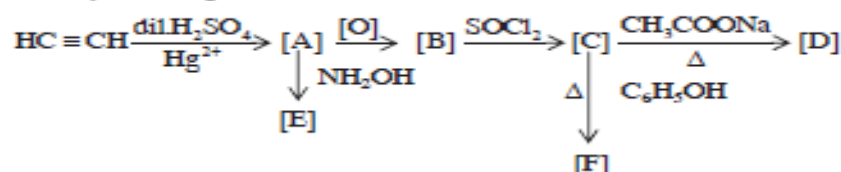
- (a) In the extraction of zinc from zinc blende: [2]
- (i) Give an equation to show how zinc oxide is converted to zinc.
  - (ii) How is impure zinc finally electro-refined?
- (b) Explain why: [3]
- (i) Transition elements form coloured compounds.
  - (ii) Interhalogen compounds are more reactive than their constituent elements.
  - (iii)  $\text{Cu}^+$  is diamagnetic but  $\text{Cu}^{2+}$  is paramagnetic. ( $Z = 29$ )

**SECTION C**

Answer any two questions.

**Question 8**

- (a) How can the following conversions be brought about: [3]
- (i) Nitro benzene to benzene diazoniumchloride. [3]
  - (ii) Propanoic acid to ethylamine. [2]
  - (iii) Benzoic acid to benzaldehyde. [2]
- (b) Identify the compounds A, B, C, D, E and F: [3]

**Question 9**

- (a) Write balanced chemical equations for the following reactions and name the reactions: [3]
- (i) Acetamide is heated with bromine and sodium hydroxide solution.
  - (ii) Benzaldehyde is treated with 50% sodium hydroxide solution.
- (b) Give one chemical test to distinguish between the following pairs of compounds: [3]
- (i) Acetone and phenol.
  - (ii) Formic acid and Acetic acid.
- (c) (i) Name the type of isomerism exhibited by the following pairs of compounds: [2]
- (1)  $(\text{C}_2\text{H}_5)_2\text{NH}$  and  $\text{CH}_3\text{-NH-C}_2\text{H}_5$
  - (2) 1-butanol and 2-methyl-1-propanol
- (ii) Name the type of isomerism that the compound with molecular formula  $\text{C}_3\text{H}_6\text{O}_2$  exhibits. Represent the isomers. [2]

**Question 10**

- (a) Write balanced chemical equations for the following reactions: [4]
- (i) Oxalic acid is treated with acidified potassium permanganate solution.
  - (ii) Benzoic acid is treated with a mixture of concentrated nitric acid and concentrated sulphuric acid.
  - (iii) Methyl magnesium iodide is treated with carbon dioxide and the product hydrolysed in acidic medium.
  - (iv) Ethylacetate is treated with ammonia.