

# CHEMISTRY

## PAPER – 1

### (THEORY)

(Maximum marks: 70)

(Time allowed: Three hours)

(Candidates are allowed additional 15 minutes for **only** reading the paper.

They must NOT start writing during this time.)

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#### All questions are compulsory

Question 1 is of 20 marks having four sub parts, all of which are compulsory.

Question numbers 2 to 8 carry 2 marks each, with **two** questions having internal choice.

Question numbers 9 to 15 carry 3 marks each, with **two** questions having an internal choice.

Question numbers 16 to 18 carry 5 marks each, with an internal choice.

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

Balanced equations must be given wherever possible and diagrams where they are helpful.

When solving numerical problems, all essential working must be shown.

In working out problems, use the following data:

Gas constant  $R = 1987 \text{ cal deg}^{-1} \text{ mol}^{-1} = 8314 \text{ JK}^{-1} \text{ mol}^{-1} = 00821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$

$1 \text{ l atm} = 1 \text{ dm}^3 \text{ atm} = 1013 \text{ J}$ . 1 Faraday = 96500 coulombs.

Avogadro's number =  $6023 \times 10^{23}$ .

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#### Question 1

- (a) Fill in the blanks by choosing the appropriate word/words from those given in the brackets: [4×1]

(more than, primary, cathode, Lucas reagent, two, four, less than, Grignard's reagent, tertiary, anode, zero, equal to, three)

- (i) The elevation of boiling point of 0.5 M  $\text{K}_2\text{SO}_4$  solution is \_\_\_\_\_ that of 0.5 M urea solution. The elevation of boiling point of 0.5 M  $\text{KCl}$  solution is \_\_\_\_\_ that of 0.5 M  $\text{K}_2\text{SO}_4$  solution.
- (ii) A mixture of conc.  $\text{HCl}$  and anhydrous  $\text{ZnCl}_2$  is called \_\_\_\_\_ which shows maximum reactivity with \_\_\_\_\_ alcohol.
- (iii) In electrolytic refining the impure metal is made \_\_\_\_\_ while a thin sheet of pure metal is used as \_\_\_\_\_.
- (iv) When the concentration of a reactant of first order reaction is doubled, the rate of reaction becomes \_\_\_\_\_ times, but for a \_\_\_\_\_ order reaction, the rate of reaction remains the same.

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This Paper consists of 8 printed pages.

(b) Select the correct alternative from the choices given: [4×1]

- (i) The cell reaction is spontaneous or feasible when emf of the cell is:
- (1) negative
  - (2) positive
  - (3) zero
  - (4) either positive or negative
- (ii) Which, among the following polymers, is a polyester:
- (1) melamine
  - (2) bakelite
  - (3) terylene
  - (4) polythene
- (iii) The correct order of increasing acidic strength of the oxoacids of chlorine is:
- (1)  $\text{HClO}_3 < \text{HClO}_4 < \text{HClO}_2 < \text{HClO}$
  - (2)  $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$
  - (3)  $\text{HClO}_2 < \text{HClO} < \text{HClO}_4 < \text{HClO}_3$
  - (4)  $\text{HClO}_3 < \text{HClO}_4 < \text{HClO} < \text{HClO}_2$
- (iv) A catalyst is a substance which:
- (1) changes the equilibrium constant of the reaction.
  - (2) increases the equilibrium constant of the reaction.
  - (3) supplies energy to the reaction.
  - (4) shortens the time to reach equilibrium.

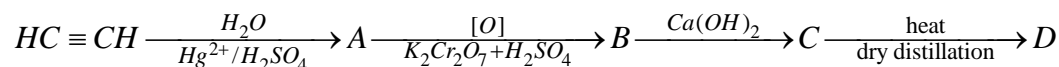
(c) Match the following: [4×1]

- |                        |                             |
|------------------------|-----------------------------|
| (i) Diazotisation      | (a) Anisotropic             |
| (ii) Crystalline solid | (b) Reimer-Tiemann reaction |
| (iii) Phenol           | (c) Diphenyl                |
| (iv) Fittig reaction   | (d) Aniline                 |

(d) Answer the following questions:

[4×2]

- (i) (1) Which trivalent ion has maximum size in the Lanthanoid series i.e. Lanthanum ion ( $\text{La}^{3+}$ ) to Lutetium ion ( $\text{Lu}^{3+}$ )?  
(at. no. of Lanthanum = 57 and Lutetium = 71)
- (2) Explain why  $\text{Cu}^{2+}$  is paramagnetic but  $\text{Cu}^+$  is diamagnetic.  
(at. no. of Cu = 29)
- (ii) When a coordination compound  $\text{CoCl}_3 \cdot 6\text{NH}_3$  is mixed with  $\text{AgNO}_3$ , three moles of  $\text{AgCl}$  are precipitated per mole of the compound. Write the structural formula and IUPAC name of the coordination compound.
- (iii) Calculate the boiling point of urea solution when 6 g of urea is dissolved in 200 g of water.  
( $K_b$  for water =  $0.52 \text{ K kg mol}^{-1}$ , boiling point of pure water = 373 K, mol. wt. of urea = 60)
- (iv) Identify the compounds A, B, C and D in the given reaction:



## Question 2

[2]

- (a) For the reaction  $\text{A} + \text{B} \rightarrow \text{C} + \text{D}$ , the initial rate for different reactions and initial concentration of reactants are given below:

S. No.	Initial Conc.		Initial rate ( $\text{mole L}^{-1} \text{sec}^{-1}$ )
	[A] $\text{mole L}^{-1}$	[B] $\text{mole L}^{-1}$	
1	1.0	1.0	$2 \times 10^{-3}$
2	2.0	1.0	$4 \times 10^{-3}$
3	4.0	1.0	$8 \times 10^{-3}$
4	1.0	2.0	$2 \times 10^{-3}$
5	1.0	4.0	$2 \times 10^{-3}$

- (i) What is the overall order of reaction?
- (ii) Write the rate law equation.

OR

- (b) 25% of a first order reaction is completed in 30 minutes. Calculate the time taken in minutes for the reaction to go to 90% completion.

**Question 3** [2]

- (i) Name the type of drug which lowers the body temperature in high fever condition.
- (ii) What are *tranquilizers*? Give *one* example of a tranquilizer.

**Question 4** [2]

Write the balanced chemical equation for each of the following:

- (i) Chlorobenzene treated with ammonia in the presence of  $\text{Cu}_2\text{O}$  at 475 K and 60 atm.
- (ii) Ethyl chloride treated with alcoholic potassium hydroxide.

**Question 5** [2]

- (i) Name the monomer and the type of polymerisation that takes place when PTFE is formed.
- (ii) Name the monomers of nylon 6, 6.

**Question 6** [2]

Name two water soluble vitamins and the diseases caused by their deficiency in the diet of an individual.

**Question 7** [2]

(a) How will you obtain the following (give balanced chemical equations):

- (i) Benzene from phenol.
- (ii) Iodoform from ethanol.

**OR**

(b) How will you obtain the following (give balanced chemical equations):

- (i) Salicylaldehyde from phenol.
- (ii) Propan-2-ol from Grignard's reagent.

**Question 8** [2]

Show that for a first order reaction the time required to complete 75% of reaction is about 2 times more than that required to complete 50% of the reaction.

**Question 9****[3]**

- (a) When 0.4g of ~~oxalic~~ acetic acid is dissolved in 40g of benzene, the freezing point of the solution is lowered by 0.45K. Calculate the degree of association of acetic acid. Acetic acid forms dimer when dissolved in benzene.  
( $K_f$  for benzene =  $5.12 \text{ K kg mol}^{-1}$ , at. wt. C = 12, H = 1, O = 16)

**OR**

- (b) A solution is prepared by dissolving 9.25g of non-volatile solute in 450ml of water. It has an osmotic pressure of 350mm of Hg at  $27^\circ\text{C}$ . Assuming the solute is non-electrolyte, determine its molecular mass.  
( $R = 0.0821 \text{ lit atm K}^{-1} \text{ mol}^{-1}$ )

**Question 10****[3]**

An element occurs in body centered cubic structure. Its density is  $8.0 \text{ g/cm}^3$ . If the cell edge is 250 pm, calculate the atomic mass of an atom of this element.  
( $N_A = 6.023 \times 10^{23}$ )

**Question 11****[3]**

Describe the role of the following:

- (i) Cryolite in the extraction of aluminium from pure alumina.
- (ii) NaCN in the extraction of silver from a silver ore.
- (iii) Coke in the extraction of iron from its oxides.

**Question 12****[3]**

- (i) Write the IUPAC names of the following:
- (1)  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
  - (2)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$
- (ii)  $[\text{Fe}(\text{CN})_6]^{4-}$  is a coordination complex ion.
- (1) Calculate the oxidation number of iron in the complex.
  - (2) Is the complex ion diamagnetic or paramagnetic?
  - (3) What is the hybridisation state of the central metal atom?
  - (4) Write the IUPAC name of the complex ion.

**Question 13****[3]**

- (a) Explain why:
- (i) Transition elements form alloys.
  - (ii)  $\text{Zn}^{2+}$  salts are white whereas  $\text{Cu}^{2+}$  salts are coloured.
  - (iii) Transition metals and their compounds act as catalyst.

**OR**

- (b) Complete and balance the following chemical equations.

- (i)  $\text{KMnO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{C}_2\text{O}_4 \rightarrow \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$
- (ii)  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 + \text{KI} \rightarrow \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$
- (iii)  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 + \text{FeSO}_4 \rightarrow \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$

**Question 14****[3]**

Give balanced equations for the following:

- (i) Aniline is treated with bromine water.
- (ii) Ethylamine is heated with chloroform and alcoholic solution of potassium hydroxide.
- (iii) Benzene diazonium chloride is treated with ice cold solution of aniline in acidic medium.

**Question 15****[3]**

Define the following terms with suitable examples:

- (i) Peptisation
- (ii) Electrophoresis
- (iii) Dialysis

**Question 16****[5]**

- (a) (i) Calculate the mass of silver deposited at cathode when a current of 2 amperes is passed through a solution of  $\text{AgNO}_3$  for 15 minutes.  
(at. wt. of Ag = 108, 1 F = 96,500 C)
- (ii) Calculate the emf and  $\Delta G$  for the cell reaction at 298 K
- $$\text{Mg}_{(s)} \mid \text{Mg}^{2+}_{(0.1\text{M})} \parallel \text{Cu}^{2+}_{(0.01\text{M})} \mid \text{Cu}_{(s)}$$
- Given  $E^\circ_{\text{cell}} = 2.71\text{V}$   
 $1\text{F} = 96,500\text{C}$

OR

- (b) (i) Define the following terms:
- (1) Specific conductance
  - (2) Kohlrausch's Law
- (ii) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 ohm. What is the cell constant and molar conductivity of 0.001 M KCl solution, if the conductivity of this solution is  $0.146 \times 10^{-3} \text{ ohm}^{-1} \text{ cm}^{-1}$  at 298 K?

**Question 17**

[5]

- (a) (i) Explain why:
- (1) Fluorine has lower electron affinity than chlorine.
  - (2) Red phosphorus is less reactive than white phosphorous.
  - (3) Ozone acts as a powerful oxidising agent.
- (ii) Draw the structures of the following:
- (1)  $\text{XeF}_6$
  - (2)  $\text{IF}_7$

OR

- (b) (i) Explain why:
- (1) Interhalogen compounds are more reactive than the related elemental halogens.
  - (2) Sulphur exhibits tendency for catenation but oxygen does not.
  - (3) On being slowly passed through water,  $\text{PH}_3$  forms bubbles but  $\text{NH}_3$  dissolves.
- (ii) Complete and balance the following reactions:
- (1)  $\text{P}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{_____} + \text{_____} + \text{_____}$
  - (2)  $\text{Ag} + \text{HNO}_3 \rightarrow \text{_____} + \text{_____} + \text{_____}$   
(dilute)

**Question 18**

[5]

- (a) (i) Give balanced chemical equations for the following reactions:
- (1) Acetaldehyde reacts with hydrogen cyanide.
  - (2) Acetone reacts with phenyl hydrazine.
  - (3) Acetic acid is treated with ethanol and a drop of conc.  $\text{H}_2\text{SO}_4$ .

(ii) Give one chemical test each to distinguish between the following pairs of compounds:

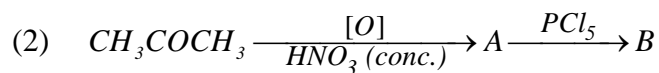
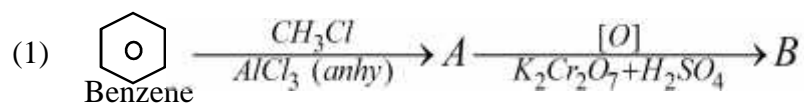
- (1) Acetone and benzaldehyde.
- (2) Phenol and benzoic acid.

**OR**

(b) (i) Write chemical equations to illustrate the following name reactions:

- (1) Aldol condensation.
- (2) Cannizzaro's reaction.
- (3) Benzoin condensation.

(ii) Identify the compounds A and B in the given reactions:



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