

# SAMPLE QUESTION PAPER

## BLUE PRINT

Time Allowed : 3 hours

Maximum Marks : 70

| S. No. | Chapter                                     | Passage based/<br>MCQs/A & R (1 mark) | SA-I<br>(2 marks) | SA-II<br>(3 marks) | LA<br>(5 marks) | Total         |
|--------|---|---------------------------------------|-------------------|--------------------|-----------------|---------------|
| 1.     | The Solid State                             | 1(4)                                  | —                 | —                  | —               | <b>9(23)</b>  |
| 2.     | Solutions                                   | —                                     | 1(2)              | 1(3)               | —               |               |
| 3.     | Electrochemistry                            | 1(1)                                  | —                 | —                  | 1(5)            |               |
| 4.     | Chemical Kinetics                           | —                                     | 1(2)              | 1(3)               | —               |               |
| 5.     | Surface Chemistry                           | 1(1)                                  | 1(2)              | —                  | —               |               |
| 6.     | The <i>p</i> -Block Elements                | 2(2)                                  | 1(2)              | 1(3)               | —               | <b>10(19)</b> |
| 7.     | The <i>d</i> - and <i>f</i> -Block Elements | 1(1)                                  | —                 | —                  | 1(5)            |               |
| 8.     | Coordination Compounds                      | 2(2)                                  | 2(4)              | —                  | —               |               |
| 9.     | Haloalkanes and Haloarenes                  | 2(2)                                  | 1(2)              | 1(3)               | —               | <b>14(28)</b> |
| 10.    | Alcohols, Phenols and Ethers                | 2(2)                                  | —                 | 1(3)               | —               |               |
| 11.    | Aldehydes, Ketones and Carboxylic Acids     | 1(4)                                  | 1(2)              | —                  | —               |               |
| 12.    | Amines                                      | 1(1)                                  | —                 | —                  | 1(5)            |               |
| 13.    | Biomolecules                                | 2(2)                                  | 1(2)              | —                  | —               |               |
|        | <b>Total</b>                                | <b>16(22)</b>                         | <b>9(18)</b>      | <b>5(15)</b>       | <b>3(15)</b>    | <b>33(70)</b> |

# CHEMISTRY

Time allowed : 3 hours

Maximum marks : 70

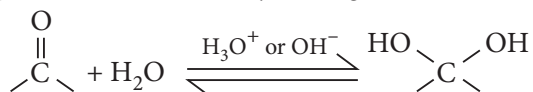
**General Instructions : Read the following instructions carefully.**

- (a) There are 33 questions in this question paper. All questions are compulsory.
- (b) Section A : Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
- (c) Section B : Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- (d) Section C : Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- (e) Section D : Q. No. 31 to 33 are long answer questions carrying 5 marks each.
- (f) There is no overall choice. However, internal choices have been provided.
- (g) Use of calculators and log tables is not permitted.

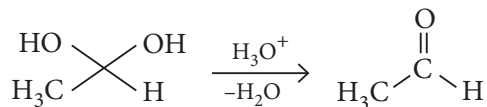
## SECTION - A (OBJECTIVE TYPE)

### 1. Read the passage given below and answer the following questions :

Hydration of aldehydes and ketones to form a hydrate *i.e.*, gem-diol, catalysed in the presence of an acid or a base. There is a reversible equilibrium between a hydrate (gem-diol) and an aldehyde or a ketone.



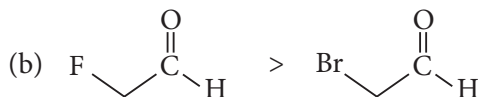
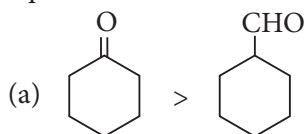
Isolation of gem-diols is difficult because the reaction is reversible. Removal of water during a reaction can cause the conversion of a gem-diol back to the corresponding carbonyl.

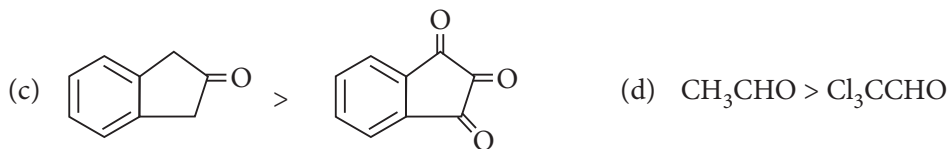


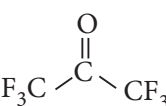
Aldehydes are more easily hydrated than ketones. The addition of electron donating alkyl groups in ketones established the partial positive charge on the carbonyl carbon  $\text{>C}^{\delta+}=\text{O}$  and decreases the amount of gem-dial product at equilibrium. Further the addition of strong electron withdrawing group increases the ease of hydration of a carbonyl compound, by destabilising the carbonyl group and tends to form stable gem-diols.

**The following questions are multiple choice questions. Choose the most appropriate answer :**

- (i) Of the following pairs of molecules, which would you expect to form a larger percentage of gem-diol at equilibrium.





- (ii) Will  molecule form appreciable amount of gem-diol in water and why?
- No, ketones are less likely to form hydrate.
  - No, steric hindrance or two bulky  $-\text{CF}_3$  group
  - Yes, electron donating effects of alkyl group is dominated by the presence of six highly electronegative F-atoms.
  - Yes, formation of  $p\pi-p\pi$  bond between C and F.
- (iii) During the addition of aldehyde with two equivalents of monohydric alcohol in the presence of dry HCl gas to give acetal, the role of dry HCl gas is
- to protonate the O-atom of the carbonyl compound and therefore, increases the electrophilicity of the carbonyl C-atom to facilitate the attack of nucleophile.
  - to absorb the moisture from the attacking substrate
  - to react with alcohol first to form alkyl halide
  - to absorb the water formed at the end of the reaction.

OR

Ketones react with ethylene glycol under similar conditions to form

- ethylene glycol acetal
  - dialkyl ethylene glycol
  - ether
  - ethylene glycol ketal.
- (iv) The reactivity order towards nucleophilic addition reactions would be
- $\text{CH}_3\text{CO Ph} > (\text{CH}_3)_2\text{CO} < \text{PhCHO} < \text{CH}_3\text{CHO}$
  - $(\text{CH}_3)_2\text{CO} > \text{CH}_3\text{CHO} > (\text{CH}_3)\text{COPh} < \text{PhCHO}$
  - $\text{CH}_3\text{COPh} = (\text{CH}_3)_2\text{CO} < \text{PhCHO} = \text{CH}_3\text{CHO}$
  - $\text{PhCHO} < \text{CH}_3\text{COPh} < (\text{CH}_3)_2\text{CO} < \text{CH}_3\text{CHO}$

## 2. Read the passage given below and answer the following questions :

The structure of a crystalline solid, is best described by considering its simplest repeating unit, which is referred to as its unit cell. The entire structure then consists of the unit cell repeating in three dimensions.

Most metal crystals are one of the four major types of unit cells (i) simple cubic (ii) *bcc* (iii) *fcc*

The simplest structure is known as simple cubic structure in which the spheres are not packed closely as they could be, only fill about 52%. Atoms in *bcc* arrangements are more effectively packed than simple cubic structure, occupying 68% volume. *fcc* arrangement are packed as closely together as possible, with 74% occupancy.

In case of ionic complexes structures are little different. In simple ionic structures, we usually find the anions, which are normally larger than cations, arranged in a closest packed array.

The smallest cations commonly occupy one of two types of holes remaining between anions.

- When four anions surrounding the hole are arranged at the corner of the tetrahedron, then the hole is called tetrahedral hole or void.
- The larger type of hole is found at the centre of six anions located at the corners of an octahedron then the hole is called octahedral void/hole.

In these questions (Q. No i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** Coordination number for *hcp* and *fcc* structures is 12.

**Reason :** The number of atoms per unit cell in *hcp* and *fcc* is same.

(ii) **Assertion :** In crystal lattice, size of the cation is larger in a tetrahedral hole than in an octahedral hole.

**Reason :** The cations occupy more space than anions in crystal packing.

(iii) **Assertion :** The packing efficiency is maximum for *fcc* structure.

**Reason :** The coordination number is 12 in *fcc* structure.

(iv) **Assertion :** The total number of atoms present in a simple cubic unit cell is one.

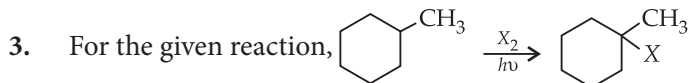
**Reason :** Simple cubic unit cell has atoms at its corners, each of which is shared between eight adjacent unit cell.

OR

**Assertion :** Hexagonal close packing is more closely packed than cubic close packing.

**Reason :** Hexagonal close packing and cubic close packing has coordination number 12.

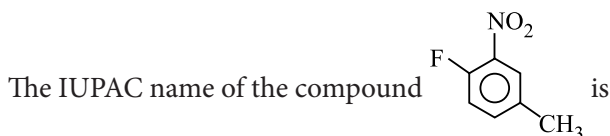
Following questions (Q.No. 3-11) are multiple choice questions carrying 1 mark each :



which halogenation out of the following would give better yield?

- (a) Chlorination
- (b) Bromination
- (c) No such preference
- (d) Both would give very poor yield

OR



- (a) 1-fluoro-4-methyl-2-nitrobenzene
- (b) 4-fluoro-1-methyl-3-nitrobenzene
- (c) 4-methyl-1-fluoro-2-nitrobenzene
- (d) 2-fluoro-5-methyl-1-nitrobenzene.

4. The arsenious sulphite solution is negatively charged. The maximum power of precipitating it, is in

- (a)  $\text{Na}_2\text{SO}_4$
- (b)  $\text{Na}_3\text{PO}_4$
- (c)  $\text{AlCl}_3$
- (d)  $\text{Mg}(\text{NO}_3)_2$

OR

The Brownian motion is due to

- (a) temperature fluctuation within the liquid phase
- (b) attraction and repulsion between charges on the colloidal particles
- (c) impact of molecules of the dispersion medium on the colloidal particles
- (d) none of these.

5. Which of the following elements do not form a complex with EDTA?  
 (a) Ca (b) Mg (c) Be (d) Sr

OR

Primary and secondary valency of platinum in the complex  $[\text{Pt}(\text{en})_2\text{Cl}_2]$  are

- (a) 4, 6 (b) 2, 6 (c) 4, 4 (d) 6, 4

6. Secondary structure of protein refers to  
 (a) mainly denatured proteins and structure of prosthetic groups  
 (b) three-dimensional structure, especially the bond between amino acid residues that are distant from each other in the polypeptide chain  
 (c) linear sequence of amino acid residues in the polypeptide chain  
 (d) regular folding patterns of continuous portions of the polypeptide chain.
7. The ionic conductance of following cations in a given conc. is in the order  
 (a)  $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+$  (b)  $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$   
 (c)  $\text{Li}^+ < \text{Na}^+ > \text{K}^+ > \text{Rb}^+$  (d)  $\text{Li}^+ = \text{Na}^+ < \text{K}^+ < \text{Rb}^+$
8. The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is  
 (a) benzoic acid (b) salicylaldehyde (c) salicylic acid (d) phthalic acid.

OR

When phenol is treated with  $\text{PCl}_5$ , the yield of chlorobenzene is generally poor because of the formation of

- (a) benzoyl chloride (b) *p*-chlorophenol (c) *o*-chlorophenol (d) triphenyl phosphate.

9. Identify the incorrect statement with respect to ozone.  
 (a) Ozone is formed in the upper atmosphere by a photochemical reaction involving dioxygen.  
 (b) Ozone is more reactive involving dioxygen.  
 (c) Ozone is diamagnetic whereas dioxygen is paramagnetic.  
 (d) Ozone protects the earth's inhabitants by absorbing gamma-radiation.
10. Identify A in the following sequence of reactions :  

$$A \xrightarrow[1 \text{ mole}]{\text{NH}_3} B \xrightarrow[\text{Alc. KOH}]{\text{CHCl}_3} C \xrightarrow{\text{Reduction}} (\text{CH}_3)_2\text{CHNHCH}_3$$
  
 (a) Ethyl halide (b) *Iso*-propylamine (c) *n*-Propyl halide (d) *Iso*-propyl halide
11. Which one of the following ions is coloured?  
 (a)  $\text{Sc}^{3+}$  (b)  $\text{Ti}^{4+}$  (c)  $\text{Zn}^{2+}$  (d)  $\text{V}^{2+}$

**In the following questions (Q. No. 12-16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.**

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.  
 (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.  
 (c) Assertion is correct statement but reason is wrong statement.  
 (d) Assertion is wrong statement but reason is correct statement.

12. **Assertion :** Benzyl bromide when kept in acetone water it produces benzyl alcohol.

**Reason :** The reaction follows  $\text{S}_\text{N}2$  mechanism.

13. **Assertion :** Helium is used in diving apparatus.

**Reason :** Solubility of helium is less in blood.

OR

**Assertion :**  $\text{O}_2$  has higher bond length than  $\text{O}_3$ .

**Reason :**  $\text{O}_3$  is paramagnetic.

14. **Assertion :** Phenol is more reactive than benzene towards electrophilic substitution reaction.  
**Reason :** In the case of phenol, the intermediate carbocation is more resonance stabilised.
15. **Assertion :** Alpha ( $\alpha$ )-amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity.  
**Reason :**  $H^+$  ion given by carboxylic group ( $-COOH$ ) is captured by amino group ( $-NH_2$ ) having lone pair of electrons.
16. **Assertion :** In high spin situation, configuration of  $d^5$  ions will be  $t_{2g}^3 e_g^2$ .  
**Reason :** In high spin situation, pairing energy is less than crystal field energy.

## SECTION - B

The following questions, Q. No. 17-25 are short answer type and carry 2 marks each.

17. Explain  
 (a)  $He_2$  does not exist.  
 (b) Electron affinity of all the elements of group 18 are zero.
18. Rate of a reaction  $A + B \rightarrow$  Products, increases two fold when concentration of  $A$  is doubled and by four fold when concentration of  $B$  is doubled. Predict the order of reaction.
19. An aqueous solution of glucose is made by dissolving 10 g of glucose ( $C_6H_{12}O_6$ ) in 90 g of water at 303 K. If the vapour pressure of pure water at 303 K be 32.8 mm Hg, what would be the vapour pressure of the solution?
20. Draw the structure of a carbonyl group and indicate clearly  
 (i) the hybridized state of carbon  
 (ii) the electrophilic and nucleophilic centres in it.

OR

Write the major product(s) in the following :

- (i)  $CH_3-CH=CH-CH_2-CN \xrightarrow[(ii) H_3O^+]{(i) DIBAL-H}$   
 (ii)  $CH_3-CH_2-OH \xrightarrow{CrO_3}$
21. (a) Of physisorption or chemisorption, which has a higher enthalpy of adsorption?  
 (b) What causes Brownian movement in a colloidal solution?

OR

- (a) What is the role of activated charcoal in gas mask?  
 (b) How does chemisorption vary with temperature?
22. (i) What is the difference between fibrous protein and globular protein?  
 (ii) Give one example each for fibrous protein and globular protein.

OR

Define the following with an example of each :

- (a) Denatured protein  
 (b) Essential amino acids
23. Give reasons for the following :  
 (i) Dipole moment of  $CH_3-Cl$  is higher than that of  $CH_3-F$ .  
 (ii) The reactions of primary and secondary alcohols with  $HX$  require presence of  $ZnCl_2$  as catalyst.

24. One mole of  $\text{Co}(\text{NH}_3)_5\text{Cl}_3$  gives three moles of ions on dissociation in water. One mole of this reacts with two moles of  $\text{AgNO}_3$  to give two moles of  $\text{AgCl}$ . Name the complex.
25. Write IUPAC name and explain hybridization and magnetic behaviour of the following complex :  $[\text{Ni}(\text{CO})_4]$

## SECTION - C

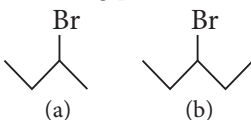
**Q. No. 26-30 are short answer type II carrying 3 marks each.**

26. (a) Give chemical tests to distinguish between the following pairs of compounds :  
 (i) Pentan-2-ol and pentan-3-ol (ii) Ethanol and phenol  
 (b) Which of the following isomers is more volatile : *o*-Nitrophenol or *p*-nitrophenol?
27. (i) What is meant by van't Hoff factor?  
 (ii) The osmotic pressure of a 0.0103 molar solution of an electrolyte is found to be 0.70 atm at  $27^\circ\text{C}$ . Calculate the van't Hoff factor. ( $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$ )  
 What conclusion do you draw about the molecular state of the solute in the solution?
28. (a) For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.  
 (b) A reaction is first order in *A* and second order in *B*.  
 (i) Write differential rate equation.  
 (ii) How is rate affected when concentration of *B* is tripled?
29. Answer the following questions :  
 (i) Sulphur disappears when boiled with sodium sulphite. Why?  
 (ii)  $\text{SF}_6$  is much less reactive than  $\text{SF}_4$ . Why?  
 (iii) Oxygen molecule has the formula  $\text{O}_2$  while sulphur is  $\text{S}_8$ . Give reason.

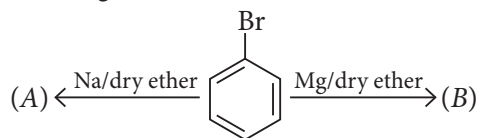
**OR**

Assign reason for the following :

- (i)  $\text{H}_2\text{S}$  is more acidic than  $\text{H}_2\text{O}$   
 (ii) Sulphur has a greater tendency for catenation than oxygen.  
 (iii) Moist  $\text{SO}_2$  gas acts as a reducing agent.
30. (i) Write the structure of major alkene formed by  $\beta$ -elimination of 2, 2, 3-trimethyl-3-bromopentane with sodium ethoxide in ethanol.  
 (ii) Which one of the compounds in the following pairs is chiral?



- (iii) Identify (A) and (B) in the following :



**OR**

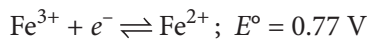
Rearrange the compounds of each of the following sets in order of reactivity towards  $\text{S}_\text{N}2$  displacement :

- (i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane  
 (ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-2-methylbutane  
 (iii) 1-Bromobutane, 1-Bromo-2, 2-dimethyl propane, 1-Bromo-2-methylbutane

## SECTION - D

**Q. No. 31 to 33 are long answer type carrying 5 marks each.**

31. (a) The electrical resistance of a column of 0.05 M NaOH solution of diameter 1 cm and length 50 cm is  $5.50 \times 10^3$  ohm. Calculate its resistivity, conductivity and molar conductivity.  
 (b) Calculate standard electrode potential for the following half cell :  $\text{Fe}^{3+} + 3e^- \rightleftharpoons \text{Fe}$  from the following data.

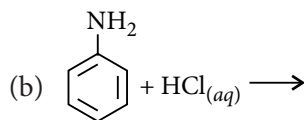


**OR**

- (a) Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity?  
 (b) Out of the following pairs, predict with reason which pair will allow greater conduction of electricity.  
 (i) Silver wire at 30°C or silver wire at 60°C.  
 (ii) 0.1 M  $\text{CH}_3\text{COOH}$  solution or 1 M  $\text{CH}_3\text{COOH}$  solution.  
 (iii) KCl solution at 20°C or KCl solution at 50°C.
32. (a) Write the chemical equations involved when aniline is treated with the following reagents :  
 (i)  $\text{Br}_2$  water      (ii)  $\text{CHCl}_3 + \text{KOH}$       (iii) HCl  
 (b) Account for the following :  
 (i) Ammonolysis of alkyl halides does not give a corresponding amine in pure state.  
 (ii) If  $-\text{NO}_2$  or  $-\text{COOH}$  group is attached to a carbon of benzene ring, electrophilic substitution becomes difficult.

**OR**

- (i) Complete the following reactions :



- (ii) (a) Give one chemical test to distinguish between the compounds of the following pairs:  
 (i)  $\text{CH}_3\text{NH}_2$  and  $(\text{CH}_3)_2\text{NH}$       (ii) Aniline and ethanamine  
 (b) Why aniline does not undergo Friedel-Crafts reaction?

33. (a) Explain why  
 (i)  $E^\circ$  for  $\text{Mn}^{3+}/\text{Mn}^{2+}$  couple is more positive than that for  $\text{Fe}^{3+}/\text{Fe}^{2+}$ . (At. no. Mn = 25, Fe = 26)  
 (ii)  $\text{Ce}^{3+}$  can be easily oxidised to  $\text{Ce}^{4+}$ . (At. no. Ce = 58)  
 (b) Give examples and suggest reasons for the following features of the transition metal chemistry :  
 The highest oxidation state is exhibited in oxoanions of a metal.  
 (c) What may be the possible oxidation states of the transition metals with the following  $d$  electronic configurations in the ground state of their atoms :  $3d^34s^2$ ,  $3d^54s^2$  and  $3d^64s^2$ ? Indicate relative stability of oxidation states in each case.

**OR**

- (a) How is the magnetic moment of a species related to the number of unpaired electrons?  
 (b) Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.  
 (c) For some of the first row transition elements the  $E^\circ$  values are :

|                                   | V     | Cr    | Mn    | Fe    | Co    | Ni    | Cu    |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|
| $E^\circ_{(M^{2+}/M)} (\text{V})$ | -1.81 | -0.91 | -1.18 | -0.44 | -0.28 | -0.25 | +0.34 |

Give suitable explanation for the irregular trend in these values.

- (d) The observed  $E^\circ$  value for Mn, Ni and Zn are more negative than expected. Explain.  
 (e)  $\text{CuI}_2$  is not known. Why ?