Sample Question Paper 3

CHEMISTRY (Unsolved)

(A Highly Simulated Practice Question Paper for CBSE Class XII Examination)

Instructions

1. There are 33 questions in this question paper. All questions are compulsory.
2. **Section A :** Q. no. 1-2 are case-based questions having four MCQs or Assertion-Reason type based on given passage each carrying 1 mark and Question 3 to 16 are MCQs and Assertion-Reason type questions carrying 1 mark each.
3. **Section B :** Q. no. 17 to 25 are short answer type I questions and carry 2 marks each.
4. **Section C :** Q. no. 26 to 30 are short answer type II questions and carry 3 marks each.
5. **Section D :** Q. no. 31 to 33 are long answer questions carrying 5 marks each.
6. There is no overall choice. However, an internal choices have been provided.
7. Use of calculators and log tables is not permitted.

Time : 3 hours ***Max. Marks : 70***

SECTION A : *Objective Questions* *(1 Mark)*

Passage Based Questions

1. *Read the passage given below and answer the following questions :* (1 × 4 = 4 Mark)

The crystal field theory (CFT) is an electrostatic model which considers the metal-ligand bond to the ionic arising purely from electrostatic interactions between the metal ion and the ligand.

In an octahedral coordination entity with six ligands surrounding the metal atom/ion, there will be repulsion between the electrons in metal *d*-orbitals and the electrons (or negative charges) of the ligands. Such a repulsion is more when the metal *d*-orbital is directed towards the ligand than, when it is away from the ligand.

Thus, the $d_{x^2-y^2}$ and d_{z^2}-orbitals which point towards the axes along the direction of the ligand will experience more repulsion and will be raised in energy and the d_{xy}, d_{zx} and d_{yz}-orbitals which are directed between the axes will be lowered in energy relative to the average energy in the spherical crystal field.

Thus, the degeneracy of the *d*-orbitals has been removed due to ligand-metal electron repulsions in the octahedral complex to yield three orbitals of lower energy, t_{2g} set and two orbitals of higher energy, e_g set. This splitting of the degenerate levels due to the presence of ligands in a definite geometry is termed as crystal field splitting.

The difference of energy between the two sets of degenerate orbitals as a result of crystal field splitting is known as **Crystal Field Stabilisation Energy** (CFSE), it is denoted by Δ_o (the subscript *o* is for octahedral). Thus, the energy of the two e_g orbitals will increase by (3/5) Δ_o and that of the three t_{2g} will decrease by (2/5)Δ_o.

The following questions (i-iv) are multiple choice questions. Choose the most appropriate answer :

(i) Which one of these statements about $[Co(CN)_6]^{3-}$ is correct?

(a) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will be in a low-spin configuration.

(b) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a low-spin configuration.

(c) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a high-spin configuration.

(d) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will be in a high-spin configuration.

(ii) Among the ligands NH_3, en, CN^- and CO, the correct order of their increasing field strength, is

(a) $CO < NH_3 < en < CN^-$

(b) $NH_3 < en < CN^- < CO$

(c) $CN^- < NH_3 < CO < en$

(d) $en < CN^- < NH_3 < CO$

(iii) Identify the correct trend given below (Atomic number, Ti= 22, Cr = 24 and Mo = 42)

(a) Δ_o of $[Cr(H_2O)_6]^{2+} < [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{3+} < [Ti(H_2O)_6]^{2+}$

(b) Δ_o of $[Cr(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$

(c) Δ_o of $[Cr(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{2+} < [Mo(H_2O)_6]^{2+}$

(d) Δ_o of $[Cr(H_2O)_6]^{2+} < [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{3+} > [Ti(H_2O)_6]^{2+}$

Or

Crystal field stabilisation energy for high spin d^4 octahedral complex is

(a) $-0.6\,\Delta_o$ (b) $-1.8\,\Delta_o$

(c) $-1.6\,\Delta_o + P$ (d) $-1.2\,\Delta_o$

(iv) The CFSE for octahedral $[CoCl_6]^{4-}$ is 18,000 cm^{-1}. The CFSE for tetrahedral $[CoCl_4]^{2-}$ will be

(a) 18000 cm^{-1} (b) 16000 cm^{-1}

(c) 8000 cm^{-1} (d) 20000 cm^{-1}

2. *Read the passage given below and answer the following questions :* (1×4=4 Mark)

Conductivity always decreases with decrease in concentration (i.e. with dilution) of both the strong and weak electrolytes. This is due to the fact that the number of ions that carry current in a unit volume of solution always decreases with decrease in concentration.

The conductivity of a solution is the conductances of a unit volume of the solution, kept between two platinum electrodes with unit area of cross-section and at a distance of unit length, while the molar conductivity is the conductance of that volume of the solution which contains one mole of the electrolyte.

Conductivity is expressed as :

$$G = \frac{\kappa A}{l} = \kappa$$

(both A and l are unity in their appropriate units in m or cm).

While molar conductivity is expressed is $\Lambda_m = \kappa V$

It is because $\Lambda_m = \frac{\kappa A}{l}$

$\because$ $l = 1$ and $A = V$ [volume containing 1 mole of electrolyte]

Therefore, $\Lambda_m = \kappa V$

Molar conductivity increases with decrease in concentration (i.e. with dilution). This is because the total volume V solution containing one mole of electrolyte also increases.

In these questions (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 incorrect statement.

(d) Assertion is incorrect statement but Reason is correct statement.

(i) **Assertion** Conductivity always increases with decrease in concentration for strong and weak electrolytes.

Reason Number of ions per unit volume decreases on dilution.

(ii) **Assertion** Conductivity of pure water is 3.5×10^{-5} S m^{-1}.

Reason High amounts of hydrogen ions and hydroxyl ions are present in water.

(iii) **Assertion** Conductivity of electrolytes decreases when dissolved in water.

Reason They furnish their own ions.

(iv) **Assertion** Conductivity of strong electrolytes decreases on dilution.

Reason On dilution number of ions per unit volume decreases.

Or **Assertion** Λ_m for weak electrolytes shows a sharp increase, when the electrolytic solution is diluted.

Reason For weak electrolytes degree of dissociation increases with dilution of solution.

Multiple Choice Questions

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

3. Replacement of Cl from chlorobenzene to give phenol requires drastic conditions but chlorine of 2, 4-dinitrochlorobenzene is readily replaced because

(a) makes ring electron rich at *ortho* and *para* position
(b) withdraws electrons from *meta* position
(c) donates electron to *meta* position
(d) withdraws electrons from *ortho* and *para* positions

4. Which of the following does not affect half-life of first order reaction?

(a) Initial concentration (b) Catalyst
(c) Temperature (d) Pressure

5. The reagent(s) used for the reduction of aldehydes and ketones into alcohols is/are

(a) finely divided metals such as Pt/Pd/Ni
(b) sodium borohydride
(c) lithium aluminium hydride
(d) All of the above

Or

The given structures,

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3 \text{ and } CH_3CH_2CH_2CH_3$$

are

(a) conformational isomers
(b) chain isomers
(c) position isomers
(d) functional isomers

6. The standard reduction potentials of several ions are as follows:

S.No.	Ions	E°
1.	Ca^{2+}	−2.87
2.	Fe^{3+}	0.77
3.	Co^{3+}	1.82
4.	Zn^{2+}	−0.76

The strongest reducing agent among the following ions is

(a) Co^{3+} (b) Zn^{2+} (c) Ca^{2+} (d) Fe^{3+}

7. According to IUPAC nomenclature, sodium nitroprusside is named as

(a) sodiumpentacyanonitrosylferrate (II)
(b) sodiumpentacyanonitrosylferrate (III)
(c) sodiumnitroferricyanide
(d) sodiumnitroferrocyanide

Or

Soda lime is a mixture of

(a) $NaOH + Ca(OH)_2$
(b) $NaOH + Mg(OH)_2$
(c) $NaOH + CaO$
(d) $NaOH + MgO$

8. Give IUPAC name of the compound given below :

$$H_3C-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$$

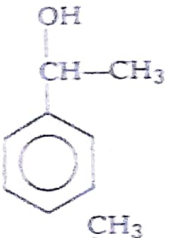
(a) 5-chlorohexan-2-ol
(b) 2-chlorohexan-5-ol
(c) 2-hydroxy-5-chlorohexane
(d) 2-chloro-5-hydroxyhexane

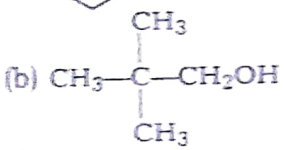
Or Alkenes react with water in the presence of acid as catalyst to form alcohols.

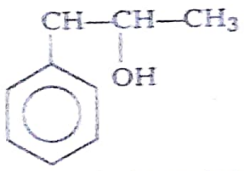
$$CH_3CH{=}CH_2 + H_2O \xrightarrow{H^+} CH_3{-}\underset{\displaystyle OH}{\underset{|}{CH}}{-}CH_3$$

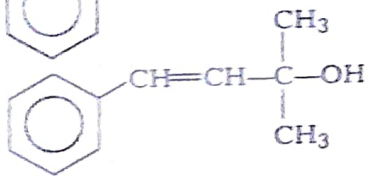
The reaction takes place in accordance with
(a) Hofmann elimination rule
(b) Saytzeff rule
(c) Markownikoff's rule
(d) Anti to Markownikoff's addition

9. Identify the primary alcohol among the given options.

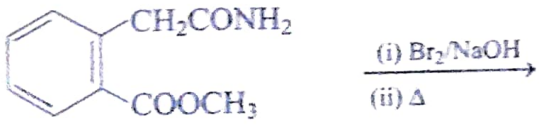
(a) 

(b) 

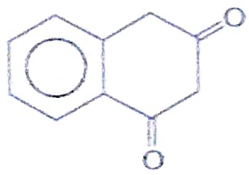
(c) 

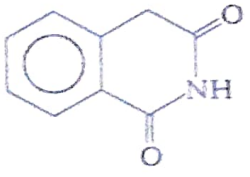
(d) 

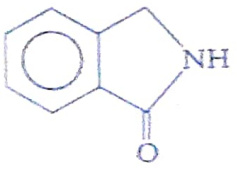
10. In the given reaction,

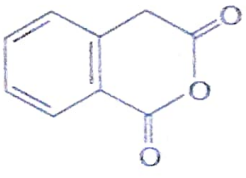


What would be the final product formed?

(a) 

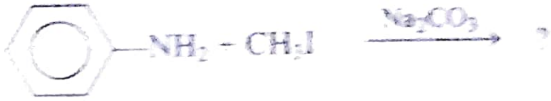
(b) 

(c) 

(d) 

Or

What is the final alkylation product in the given reaction?



(a) N, N, N-trimethylanilinium iodide
(b) N, N, N-trimethylanilinium carbonate
(c) N, N-dimethylanilinium iodide
(d) N, N-dimethylanilinium carbonate

11. Which of the following is the starting material used for the industrial preparation of phenol ?
(a) Anisole
(b) Resorcinol
(c) Cumene
(d) o-cresol

Assertion-Reason

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 incorrect statement.
(d) Assertion is incorrect statement but Reason is correct statement.

12. **Assertion** Benzaldehyde on heating with concentrated alkali gives α,β-unsaturated carbonyl compound.

Reason Benzaldehyde do not have any α-hydrogen atom.

13. **Assertion** All alkylbenzenes yield benzoic acid on vigorous oxidation with alkaline $KMnO_4$.

Reason The entire side chain of the aromatic compound is oxidised to a —COOH group irrespective of the length of the carbon chain.

Or **Assertion** A bright silver mirror is produced during the warming of an aldehyde with freshly prepared ammoniacal silver nitrate solution.

Reason A bright silver mirror is produced due to the formation of silver metal.

14. **Assertion** Molarity of a solution in liquid state changes with temperature.

Reason The volume of a solution changes with change in temperature.

15. **Assertion** Neopentyl chloride is formed when neopentyl alcohol reacts with HCl.

Reason Neopentyl alcohol is a primary alcohol.

16. **Assertion** S_N1 mechanism is ruled out in case of haloarene.

Reason Phenyl cation is formed as a result of self ionisation which is not stabilised by resonance.

SECTION B : *Short Answer Type I Questions (2 Marks)*

17. Compound '*A*' on reaction with $(CH_3CO)_2O$ and NaOH gives acetanilide which on bromination gives compound '*B*' which on hydrolysis gives compound '*C*'. Identify *A*, *B* and *C*.

Or Account for the following:

(i) pK_b of aniline is more than that of methylamine.

(ii) Ethylamine is soluble in water, whereas aniline is not.

18. Explain, why the melting points and solubility of amino acids in water are generally higher than that of the corresponding haloacids ?

19. A 0.200 M KOH solution is electrolysed for 1.5 hr using a current of 8.00 A. How many moles of O_2 were produced at the anode?

20. How will you carry out the following conversion :

(i) Aniline to benzyl alcohol

(ii) Benzene to *m*-bromophenol

21. Calculate the emf for the given cell at 25°C.

$Cr|Cr^{3+}(0.1M)||Fe^{2+}(0.01M)|Fe$

[Given, $E^{\circ}_{Cr^{3+}/Cr} = -0.74$ V

$E^{\circ}_{Fe^{2+}/Fe} = -0.44$ V]

Or Give reason :

(i) Electron gain enthalpies of halogens are largely negative.

(ii) Thermal stability decreases from H_2O to H_2Te.

22. What are interstitial compounds ? Why are such compounds well known for transition metals.

23. $FeSO_4$ solution mixed with $(NH_4)_2SO_4$ solution in 1 : 1 molar ratio gives the test of Fe^{2+} ion but $CuSO_4$ solution mixed with aqueous ammonia in 1 : 4 molar ratio does not give the test of Cu^{2+} ion. Why?

24. Calculate molality and molarity of KI, if the density of 20% *(mass/mass) aq.* KI is 1.202 g mL^{-1}.

Or (i) What prompted Bartlett to the discovery of noble gas compounds?

(ii) State two important uses of noble gases.

25. Write the structures of *A* and *B* in the following.

(a) $CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgBr} A \xrightarrow[Ether]{Na-metal} B$

(b) $CH_3CH_2Br \xrightarrow{NaOH(aq.)} A \xrightarrow{PCC} B$

SECTION C : *Short Answer Type II Questions* (3 Marks)

26. Define the following :

(i) Wurtz-Fittig reaction

(ii) Fittig reaction

(iii) Swarts reaction

Or Complete the following reactions:

(i) $CH_3CH_2Cl \xrightarrow{KCN} (A) \xrightarrow{2H_2O/H^+} (B)$

(ii) $CH_3CH_2CH_2Br \xrightarrow[\Delta]{\text{Alc. KOH}} (A) \xrightarrow{HBr} (B)$

27. For the reaction.

$2NO(g) + Cl_2(g) \longrightarrow 2NOCl(g)$

The following data were collected at 270 K.

Exp No.	Initial [NO] mol L^{-1}	Initial [Cl_2] mol L^{-1}	Initial rate of disappearance of Cl_2 (mol/min)
1.	0.15	0.15	0.60
2.	0.15	0.30	1.20
3.	0.30	0.15	2.40
4.	0.25	0.25	x

(i) Write expression for rate law.

(ii) Calculate rate constant and write its unit.

28. (i) Give chemical tests to distinguish between the following pairs of compounds.

(a) Propanal and propanone

(b) Acetophenone and benzophenone.

(ii) Arrange the following compounds in increasing order of reactivity towards HCN.

Acetaldehyde, acetone, di- *tert*-butylketone, methyl-*tert*-butylketone.

29. (i) What is the order of following reaction?

$$N_2O_5(g) \rightleftharpoons N_2O_4(g) + \frac{1}{2}O_2(g)$$

(ii) Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with $t_{1/2} = 3$ h. What fraction of sample of sucrose remains after 8h ?

Or

(i) What are pseudo first order reactions ? Give one example of such reactions.

(ii) The decomposition of phosphine, PH_3 proceeds according to the following equation.

$$4PH_3(g) \longrightarrow P_4(g) + 6H_2(g)$$

It is found that the reaction follows the following rate equation,

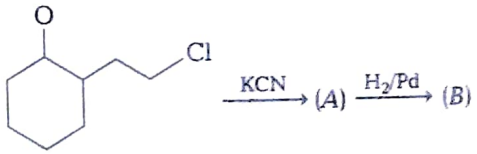
$$\text{Rate} = k[PH_3]$$

The half-life of PH_3 is 37.9 s at 20°C.

(a) What fraction of original sample of PH_3 remains behind after 1 min?

(b) How much time is required of 3/4th of PH_3 to decompose?

30. (i) Write the structure of *A* and *B* in the following reaction.



(ii) Convert the following

(a) Nitrobenzene to benzoic acid

(b) Aniline to benzyl alcohol

SECTION D : *Long Answer Type Questions* *(5 Marks)*

31. (i) A transition metal *A* has "spin only" magnetic moment value of 1.8 BM. When it is reacted with dil. H_2SO_4 in the presence of air, a compound *B* is formed. *B* reacts with compound *C* to give compound *D* with liberation of iodine. Determine metals, *A*, *B*, *C* and *D*.

(ii) Describe the cause of the following variation:

(a) Zn, Cd and Hg normally not regarded as transition elements.

(b) Compounds of transition metals are coloured.

(c) Mn^{2+} compounds are more stable than Fe^{2+} compounds towards oxidation to their + 3 state.

Or

(i) What happens when, Europium shows + 2 oxidation state.

(ii) Explain the following:

(a) Among d^4 species, Cr^{2+} is strongly reducing, while Mn (III) is strongly oxidising.

(b) Cobalt (II) is stable in an aqueous solution but in the presence of complexing reagents it is easily oxidised.

(c) The d^1-configuration is very unstable in ions.

32. Write the reactions of D-glucose which can't be explained by its open-chain structure. How can cyclic structure of glucose explain these reactions ?

Or

Explain the terms primary and secondary structure of proteins. What is the difference between α-helix and β-pleated sheet structure of proteins ?

33. (i) 1000 g of 1 molal aqueous solution of sucrose is cooled and maintained at −3.534° C. Calculate the ice that will separate out at this temperature.

(ii) The solubility of $Ba(OH)_2 \cdot 8H_2O$ in H_2O is 5.6 g per 100 g of H_2O at 288 K. Calculate the molality of hydroxide ion in saturated solution of $Ba(OH)_2 \cdot 8H_2O$ at that temperature.

Or A solution containing 30 g of a non-volatile solute exactly in 90 g of water has a vapour pressure of 2.8 kPa at 298 K. Further, 18 g of water is then added to the solution and the new vapour pressure becomes 2.9 kPa at 298 K. Calculate

(i) molar mass of the solute

(ii) vapour pressure of water at 298 K.