
SAMPLE PAPER-03
CHEMISTRY (Theory)
(Questions)
Class – XII

Time allowed: 3 hours

Maximum Marks: 70

General Instructions:

- a) All the questions are compulsory.
 - b) There are **26** questions in total.
 - c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
 - d) Questions **6** to **10** carry **two** marks each.
 - e) Questions **11** to **22** carry **three** marks each.
 - f) Questions **23** is value based question carrying **four** marks.
 - g) Questions **24** to **26** carry **five** marks each.
 - h) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
 - i) Use of calculators is **not** permitted. However, you may use log tables if necessary.
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- 1. Give the IUPAC name of $(\text{CH}_3) - \text{CO} - \text{CO} - \text{CH}_3$.
- 2. Give an example of a) Miscelles system and b) Macromolecular colloid.
- 3. Give reasons: NO_2 is paramagnetic while N_2O_4 is diamagnetic.
- 4. Why it is necessary to wash the precipitate with water before estimating it quantitatively?
- 5. Explain why vitamin C cannot be stored in our body?
- 6. Give reasons:
 - i. Phenol has higher boiling point than toluene.
 - ii. Unlike phenols, alcohols are easily protonated.
- 7. Write a note on:
 - i. Hoffmann bromamide reaction
 - ii. Hunsdiecker reaction
- 8.
 - i. Define co-ordination number.
 - ii. Give the co-ordination number of atoms in ccp and bcc structures.

Or

If three elements A, B and C crystallize in a cubic solid with A atoms at the corners, B atoms at the cube centres and C atoms at the faces of the cube, then give the formula of the compound.

- 9. An organic compound having molecular formula C_8H_{18} on monochlorination gives a single monochloride. Write the structure of the hydrocarbon.
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10. Comment: Raoult's law as a special case of Henry's Law.
 11. Give the mechanism of preparation of ethyl alcohol from ethene by acid catalysed hydration.
 12. Although p-hydroxy benzoic acid is less acidic than benzoic acid, o-hydroxy benzoic acid is 15 times more acidic than benzoic acid. Why?
 13.
 - i. Define thermoplastics and thermosetting polymers with two examples each.
 - ii. How polymers are classified?
 14. Complete the following reactions:
 - a) $\text{XeF}_4 + \text{SbF}_6 \rightarrow$
 - b) $\text{XeF}_4 + \text{O}_2\text{F}_2 \rightarrow$
 - c) $\text{XeF}_4 + \text{H}_2\text{O} \rightarrow$
 15. Differentiate natural and vulcanized rubber.
 16. If N_2 gas is bubbled through water at 293 K, then how many millimoles of N_2 gas would dissolve in 1 litre of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48 kbar.
 17. Differentiate different allotropes of sulphur (six points).
 18.
 - a) Define coordination isomerism.
 - b) What is meant by linkage isomerism?
 - c) What is ionisation isomerism?

Or

Give the biological importance of the existing coordination complexes.

19.
 - a) Why H_2S is less acidic than H_2Te ?
 - b) Ozone is used for purifying air in crowded places such as cinema halls, tunnels, etc.
 20. Calculate the rate constant for the following data obtained during the first order thermal decomposition of N_2O_5 (g) at constant volume: $2 \text{N}_2\text{O}_5(\text{g}) \rightarrow 2 \text{N}_2\text{O}_4(\text{g}) + \text{O}_2(\text{g})$.

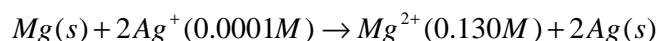
S.No	Time/s	Total pressure/ atm
1.	0	0.5
2.	100	0.512
 21. Give the prosthetic groups of the following proteins: nucleo proteins, glyco proteins, lipo proteins, phospho proteins and chromo proteins.
 22. Define the following term:
 - a) Rate law.
 - b) Order of a reaction.
 23. You work in large University physical plant department, which oversees the day-to-day operations of the buildings on campus. The university currently maintains 14 days-scale-air-conditioning units that still use CFC production. A member of the budget committee comes to you because she is concerned about the potential costs of replacing so many units. She asks you these questions
 - a. Since a cooling unit is sealed. Why does the continued use of CFC pose any risk to the environment?
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- b. Can't the university simply buy a different refrigerant to replace the CFS and use it in the existing units? What would be the concern associated with such refrigerant replacement?

24. Resistance of a conductivity cell filled with 0.1 mol L⁻¹KCl solution is 100 W. If the resistance of the same cell when filled with 0.02 mol L⁻¹KCl solution is 520 W, calculate the conductivity and molar conductivity of 0.02 mol L⁻¹KCl solution. The conductivity of 0.1 mol L⁻¹KCl solution is 1.29 S/m.

Or

Represent the cell in which the following reaction takes place



Calculate its $E_{(cell)}$ if $E_{(cell)}^\theta = 3.17V$

25.

- Why scandium (Z = 21) is a transition element but zinc (Z = 30) is not?
- Why do the transition elements exhibit higher enthalpies of atomisation?
- Differentiate electrochemical cell and electrolytic cell (three points).

Or

- Define corrosion.
- Suggest two materials other than hydrogen that can be used as fuels in fuel cells.
- What are the factors affecting corrosion?

26.

- How is the variability in oxidation states of transition metals different from that of the non-transition metals? Illustrate with examples.
- Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only?

Or

Describe the preparation of potassium dichromate from iron chromite ore. Give the effect of increasing pH on a solution of potassium dichromate.

Answers

1. Butane-2,3-dione.
2.
 - a) Sodium stearate
 - b) Proteins
3. Since NO_2 contains odd number of valence electrons, it is a typical molecule. But in the liquid and solid state, it dimerises to form stable N_2O_4 molecule with even number of electrons. Therefore, NO_2 is paramagnetic while N_2O_4 is diamagnetic.
4. Since the precipitates may be contaminated with the adsorbed particles of some other impurities which may be used or formed during precipitation, it is necessary to wash the precipitate with water before estimating it quantitatively.
5. Vitamin C cannot be stored in our body because it is soluble in water and is readily excreted in urine.
6.
 - i. This is because the phenol forms intermolecular hydrogen bonding leading to association of its molecules. Consequently, additional energy is needed to break hydrogen bonds which raise its boiling point. On the other hand, toluene does not form hydrogen bonds and so have lesser boiling point.
 - ii. This is because, the alcohol group is electron releasing group and it increases electron density on the benzene ring, particularly at the ortho and para positions. Since nitration involves attack of nitronium ion, its attack on phenol will be easier than on benzene where no electron releasing group is present.
7.
 - a) The amides can be converted into primary amines containing one carbon less than the original amide by heating with a mixture of bromine in presence of NaOH or KOH. This reaction is called Hoffmann's degradation reaction.
$$\text{CH}_3\text{CONH}_2 + \text{Br}_2 + 4 \text{KOH} \rightarrow \text{CH}_3\text{NH}_2 + \text{K}_2\text{CO}_3 + 2\text{KBr} + 2\text{H}_2\text{O}$$

AcetamideMethylamine
 - b) Alkyl halides are prepared by decomposing the silver salts of carboxylic acids dissolved in carbon tetrachloride by bromine or chlorine.
$$\text{CH}_3\text{COOAg} + \text{Br}_2 \rightarrow \text{CH}_3\text{Br} + \text{CO}_2 + \text{AgBr}$$

Silver acetateMethylbromide
8.
 - i. The number of nearest neighbours of a particle is called its coordination number.
 - ii. The coordination number for ccp is 12 and that for bcc is 8.

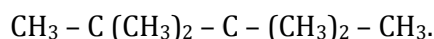
Atom A per unit cell = $8 \times 1/8 = 1$

Atom B per unit cell = 1

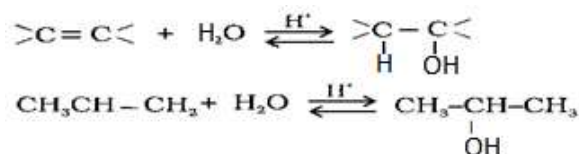
Atom C per unit cell = $6 \times \frac{1}{2} = 3$

Therefore, the formula of the compound is ABC_3 .

9. Since the hydrocarbon gives a single monochloride, all the 18 hydrogen atoms are equivalent. This shows that it has 6 methyl groups attached to the interlinked carbon atoms. Therefore, the structure must be

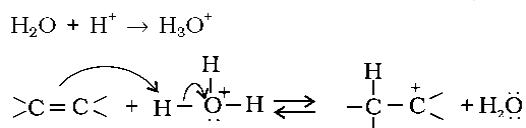


10. According to Raoult's law, the vapour pressure of a volatile component in a given solution is given by $p_i = x_i p_i^0$. In the solution of a gas in a liquid, one of the components is so volatile that it exists as a gas and we have already seen that its solubility is given by Henry's law which states that $p = KH \cdot x$. If we compare the equations for Raoult's law and Henry's law, it can be seen that the partial pressure of the volatile component or gas is directly proportional to its mole fraction in solution. Only the proportionality constant KH differs from p_i^0 . Thus, Raoult's law becomes a special case of Henry's law in which KH becomes equal to p_i^0 .
11. Alkenes react with water in presence of an acid as catalyst to form alcohols. In case of unsymmetrical alkenes, the addition reaction takes place according to Markovnikov's rule.

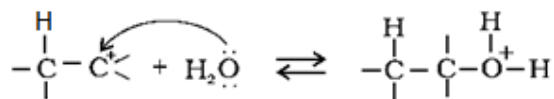


The mechanism of the reaction involves the following three steps:

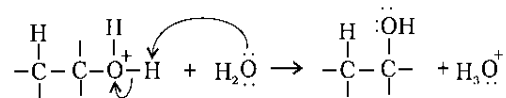
Step 1: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+ .



Step 2: Nucleophilic attack of water on carbocation.



Step 3: Deprotonation to form an alcohol.



12. Here, the $-\text{OH}$ group is electron releasing group and therefore it increases the negative charge on the anion. So, p-hydroxy benzoic acid is less acidic than benzoic acid. However, o-hydroxy benzoic acid is more acidic than benzoic acid. The enhanced acidity of o-isomer is due to very effective intramolecular hydrogen bonding in the carboxylate ion. So, o-hydroxy benzoate ion is stabilized to a greater extent and therefore makes o-isomer more acidic.

13.

- a) Thermoplastics are the polymers which can be easily softened repeatedly on heating and hardened on cooling. So, it can be used again and again. Examples – polythene and PVC.

Thermosetting are the polymers which undergo permanent change and become hard on heating and cannot be softened again. Examples – Bakelite and melamine formaldehyde.

- b) Polymers are classified in number of ways as follows:
- Classification based on source of availability.
 - Classification based on structure.
 - Classification based on molecular forces.
 - Classification based on the mode of synthesis.

14.

- $[\text{XeF}_3]^+ + [\text{SbF}_6]^-$
- $\text{XeF}_6 + \text{O}_2$
- $4\text{XeOF}_2 + 2\text{HF}$

15.

Natural rubber	Vulcanized rubber
It is soft and sticky.	It is hard and non-sticky.
It has low tensile strength and low elasticity.	It has high tensile strength and high elasticity.
It is soluble in non-polar solvents.	It is insoluble in all common solvents.

16. Applying Henry's law,

$$x(\text{Nitrogen}) = \frac{p(\text{Nitrogen})}{K_H} = \frac{0.987\text{bar}}{76.480\text{bar}} = 1.2910^{-5}$$

As 1 litre of water contains 55.5 mol of it. therefore if n represents number of moles of N_2 in solution.

$$x(\text{Nitrogen}) = \frac{n \text{ mol}}{n \text{ mol} + 55.5 \text{ mol}} = \frac{n}{55.5} = 1.29 \cdot 10^{-5}$$

(n in denominator is neglected as it is $\ll 55.5$)

Thus $n = 1.29 \cdot 10^{-5} \cdot 55.5 \text{ mol} = 7.16 \cdot 10^{-4} \text{ mol}$.

$$= \frac{7.16 \times 10^{-4} \text{ mol} \times 1000 \text{ g mol}^{-1}}{1 \text{ mol}} = 0.716 \text{ g}$$

17.

Rhombic sulphur	Monoclinic sulphur	Plastic sulphur
It is formed by slowly evaporating the solution of roll sulphur in carbon disulphide.	It is formed by melting rhombic sulphur in a dish and cooling till a crust is formed. Two holes are made in the crust and the remaining liquid poured out.	It is formed by pouring molten sulphur into cold water when a soft rubber like mass is formed.

	On removing the crust, colourless needle shaped crystals are formed.	
It is readily soluble in carbon disulphide.	It is soluble in carbon disulphide.	It is insoluble in carbon disulphide.
Its M.P is 385.8 K.	Its M.P is 393 K.	It has no sharp M.P.
It has specific gravity 2.07 g/cm ³ .	It has specific gravity 1.98 g/cm ³ .	It has specific gravity 1.95 g/cm ³ .
It is octahedral crystals.	It is puckered with crown shape.	It is an amorphous form of sulphur.
It exists as S ₈ molecules.	It exists as S ₈ molecules.	It exists as S ₆ molecules.

18.

- The type of isomerism occurs in compounds containing both cationic and anionic entities and the isomers differ in the distribution of ligands in the coordination entity of cationic and anionic parts.
- The compounds which have the same molecular formula but differ in the mode of attachment of a ligand to the metal atom or ion are called linkage isomers.
- The compounds which have same molecular formula but gives different ions in solution are called ionisation isomers.

Or

- Chlorophyll
The green pigments in plants, central to photosynthesis are a complex compound of magnesium ions.
- Haemoglobin
The red pigment of blood which acts as oxygen carrier is a complex compound of ferric ions.
- Vitamin B₁₂
It is chemically cyanocobalamine is anti-pernicious anaemia factor, is a complex compound of cobalt ions.

19.

- In H₂Te, the size of central Te is more than that of S in H₂S and so, the distance between the central atom and hydrogen. The bond between Te – H is more than that of S – H. As a result of large bond length, the bond dissociation enthalpy of Te – H is less than that of S – H and bond cleavage of Te – H bond is easy.
- Ozone is an endothermic compound and easily decomposes to produce oxygen and so purifies crowded places.

20. Let the pressure of N₂O₅ (g) decrease by 2x atm. As two moles of N₂O₅ decompose to give two moles of N₂O₄ (g) and one mole of O₂ (g), the pressure of N₂O₄ (g) increases by 2x atm and that of O₂ (g), increases by x atm.



$$P_t = P_{\text{N}_2\text{O}_5} + P_{\text{N}_2\text{O}_4} + P_{\text{O}_2}$$

$$= (0.5 - 2x) + 2x + x = 0.5 + x$$

$$x = p_t - 0.5$$

$$P_{\text{N}_2\text{O}_5} = 0.5 - 2x = 0.5 - 2(p_t - 0.5) = 1.5 - 2p_t$$

$$\text{At } t = 100 \text{ s; } p_t = 0.512 \text{ atm}$$

$$P_{\text{N}_2\text{O}_5} = 1.5 - 2 \times 0.512 = 0.476 \text{ atm}$$

Using equation

$$k = \frac{2.303}{t} \log \frac{p_i}{p_A} = \frac{2.303}{100\text{s}} \log \frac{0.5 \text{ atm}}{0.476 \text{ atm}}$$

$$= \frac{2.303}{100\text{s}} \times 0.0216 = 4.98 \times 10^{-4} \text{ s}^{-1}$$

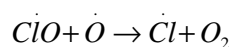
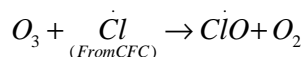
21. NucLeo proteins – nucleic acids, glyco proteins –sugars, lipo proteins – lipids, phospho proteins – phosphoric acid residues and chromo proteins – pigment having metals like Cu, Fe etc.

22.

- a) It may be defined as the mathematical expression which denotes the rate of a reaction in terms of molar concentrations of reactants with each term raised to some power which may or may not be the same as the stoichiometric coefficient of the reacting species in a balanced chemical equation.
- b) The order of a reaction can be defined as the sum of powers to which the concentration terms are raised in the rate law equation to express the observed rate of the reaction.

23.

- a. The Earth's surface has been protected from too much UV light by a layer of ozone. The large scale depletion of O_3 in the layer observed over Antarctica has been attributed mainly sue to "assive Buildup" in the atmosphere of CFS due to their increasing use as refrigerants. The CFC which are stabl in lower atmosphere, float to the stratosphere and decompose releasing atomic chlorine which attacks O_3 .



- b. Urgent research and development programs have resulted in a series of replacement refrigerants that are already being incorporated in new refrigeration system, but they cannot be used in existing systems. The most prominent materials are



24. Resistance of a conductivity cell filled with $0.1 \text{ mol L}^{-1}\text{KCl}$ solution is 100 W . If the resistance of the same cell when filled with $0.02 \text{ mol L}^{-1}\text{KCl}$ solution is 520 W , calculate the conductivity

and molar conductivity of 0.02 mol L⁻¹KCl solution. The conductivity of 0.1 mol L⁻¹KCl solution is 1.29 S/m.

Ans:

The cell constant is given by the equation:

Cell constant = G^* - conductivity x resistance

$$= 1.29 \text{ S/m} \times 100 \Omega = 129 \text{ m}^{-1} = 1.29 \text{ cm}^{-1}$$

Conductivity of 0.02 mol L⁻¹KCl solution = cell constant / resistance

$$= \frac{G^*}{R} = \frac{129 \text{ m}^{-1}}{520 \Omega} = 0.248 \text{ S m}^{-1}$$

Concentration = 0.02 mol L⁻¹

$$= 1000 \times 0.02 \text{ mol m}^{-3} = 20 \text{ mol m}^{-3}$$

$$\text{Molar conductivity} = \wedge_m = \frac{k}{c} = \frac{248 \times 10^{-3} \text{ S m}^{-1}}{20 \text{ mol m}^{-3}} = 124 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

Or

The cell can be written as $\text{Mg}|\text{Mg}^{2+} (0.130\text{M})||\text{Ag}^+(0.0001\text{M})|\text{Ag}$

$$\begin{aligned} E_{(\text{cell})} &= E_{(\text{cell})}^{\theta} - \frac{RT}{2F} \ln \frac{[\text{Mg}^{2+}]}{[\text{Ag}^+]^2} \\ &= 3.17\text{V} - \frac{0.059\text{V}}{2} \log \frac{0.130}{(0.0001)^2} \\ &= 3.17\text{V} - 0.21\text{V} = 2.96\text{V} \end{aligned}$$

25.

- On the basis of incompletely filled 3d orbitals in case of scandium atom in its ground state (3d¹), it is regarded as a transition element. On the other hand, zinc atom has completely filled d orbitals (3d¹⁰) in its ground state as well as in its oxidised state, hence it is not regarded as a transition element.
- Because of large number of unpaired electrons in their atoms they have stronger interatomic interaction and hence stronger bonding between atoms resulting in higher enthalpies of atomisation.
-

Electrochemical cell	Electrolytic cell
It is a device which converts chemical energy into electrical energy.	It is device which converts electrical energy into chemical energy.
The redox reaction is spontaneous.	The redox reaction is non-spontaneous.
Here, the anode is negative and the cathode is positive.	Here, the anode is positive and the cathode is negative.

Or

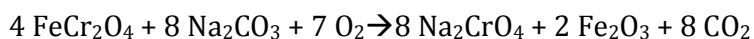
- a. It is a process of deterioration of a metal as a result of its reaction with air or water surrounding in it.
- b.
 - i. Methane
 - ii. Ethane
- c.
 - i. Position of metals in EMF series.
 - ii. Presence of impurities in metals.
 - iii. Presence of electrolytes.
 - iv. Presence of carbon dioxide in water.
 - v. Presence of protective coatings.

26.

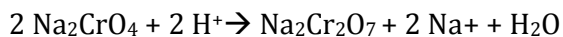
- a) The variability of oxidation states in transition elements arise because of the participation of (n – 1) d-orbitals and ns orbitals. These different oxidation states of transition elements differ by unity. Example – Vanadium show oxidation states of +2, +3, +4 and +5, manganese shows oxidation states of +2, +3, +4, +5, +6 and +7. On the other hand, some non-transition elements of p-block show variable oxidation states which differ by unit of two. Example – tin has oxidation states +2 and +4 and indium shows oxidation states of +1 and +3.
- b) This is because the oxygen and fluorine have small size and high electronegativity, so they can easily oxidize the metal to its highest oxidation state.

Or

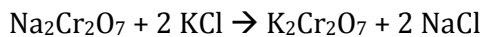
Potassium dichromate is a very important chemical used in leather industry and as an oxidant for preparation of many azo compounds. Dichromates are generally prepared from chromate, which in turn are obtained by the fusion of chromite ore (FeCr_2O_4) with sodium or potassium carbonate in free access of air. The reaction with sodium carbonate occurs as follows:



The yellow solution of sodium chromate is filtered and acidified with sulphuric acid to give a solution from which orange sodium dichromate, $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ can be crystallised.



Sodium dichromate is more soluble than potassium dichromate. The latter is therefore, prepared by treating the solution of sodium dichromate with potassium chloride.



Orange crystals of potassium dichromate crystallise out. The chromates and dichromates are interconvertible in aqueous solution depending upon pH of the solution.
