Sample Paper-03
Chemistry (Theory)
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 $(CH_3)_3 - C - COOH$.
2. What is meant by protective colloid?
3. Define coagulation value.
4. Give the role of desorption in the process of catalysis.
5. What is an isoelectric point?
6. How is cast iron different from pig iron?
7. Give reasons:
   (i) Aldehydes do not form stable hydrates but chloral exists as chloral hydrate.
   (ii) Acetic acid can be halogenated in presence of red phosphorus and chlorine but formic acid cannot be halogenated.
8. Give the application of Henry's law on scuba drivers.
9. Explain Frenkel defect.

   Or

   Silver forms ccplattice and X-ray studies of its crystals show that the edge length of its unit cell is 408.6 pm. Calculate the density of silver (Atomic mass = 107.9 u).
10. Write a note on order of a reaction.
11. (a) Identify all the possible monochloro structural isomers expected to be formed on free radical monochlorination of $(CH_3)_2CHCH_2CH_3$.
    (b) During the reaction of alcohols with KI, sulphuric acid is not used. Give reason.
    (c) Alkyl halides though polar, are immiscible with water. Why?
12. How the presence of sulphur dioxide is detected?
13. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively.

(a) Calculate the vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K.

(b) The mole fractions of each component in vapour phase.

14. Complete the following reactions:

(a) $HgCl_2 + PH_3 \rightarrow$

(b) $NaClO_3 + I_2 \rightarrow$

(c) $SCl_2 + NaF \rightarrow$

15. Define the term:

(a) Monosaccharides

(b) Oligosaccharides

(c) Polysaccharides

16. Calculate the mole fraction of ethylene glycol ($C_2H_6O_2$) in a solution containing 20% of $C_2H_6O_2$by mass.

17. (a) Why noble gases have low boiling points?

(b) Why are the elements of group 18 known as noble gases?

(c) Why He is used in diving apparatus?

18. What are the factors which determine the magnitude of the orbital splitting energy?

Or

How the nature of the ligand affect the stability of a complex ion?

19. Differentiate addition and condensation polymers.

20. Calculate the number of active hydrogen atoms in the molecule of an organiccompound, if an ex cess of methyl magnesium iodide reacts with 0.6 g of an organic compound $C_3H_6O_3$ to evolve 295.7 mL of methane gas at STP.

21. The decomposition of N_2O_5 in CCl4 at 318K has been studied by monitoring the concentration of N_2O_5 in the solution. Initially the concentration of N_2O_5 is 2.33 mol L^{-1} and after 184 minutes, it is reduced to 2.08 mol L^{-1}. The reaction takes place according to the equation

$2N_2O_5\ (g) \rightarrow 4\ NO_2\ (g) + O_2\ (g)$

(a) Calculate the average rate of this reaction in terms of hours, minutes and seconds.

(b) What is the rate of production of NO_2 during this period?

22. Why F shows only one oxidation state whereas other halogens show more than two positive oxidation states?

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?

(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. Calculate the equivalent conductivity of 1 M H_2SO_4 solution whose conductivity is 26×10^{-2} $ohm^{-1}\ cm^{-1}$.

Or

How long will it take to deposit 1.0 g of Cr when a current of 1.25 A flows through a solution of chromium (III) sulphate? [Molar mass of Cr = 52].

25. (a) Give the structures of chromate ion and dichromate ion.

(b) Give the preparation of potassium permanganate.

Or

(a) Give the structure of manganite ion and permanganate ion.

(b) Give the schematic representation of chemical reactions of lanthanoids.

26. Convert the following into benzoic acid:

(a) Ethylbenzene

(b) Acetophenone

(c) Bromobenzene

(d) Styrene

Or

An organic compound X contains 69.77% C, 11.63% H and rest Oxygen. The molecular mass of the compound is 86. The compound X does not reduce Tollen's reagent, but forms an addition compound with sodium hydrogen sulphite and gives positive iodoform test. On vigorous oxidation, X gives ethanoic and propanoic acids. Identify the possible structure of X.

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Answers

1. Triamethyl acetic acid.
2. When lyophilic sol is added to lyophobic sol to make it stable and prevent its coagulation, it is called protective colloid.
3. It is defined as the minimum number of millimoles of electrolyte required to coagulate 1 litre of colloidal solution.
4. In the process of catalysis, when desorption occurs from the surface of the catalyst, the surface becomes ready to adsorb fresh reactants and act as a catalyst.
5. The pH at which no net migration of amino acid takes place under the influence of an applied electric field is called isoelectric point.
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, it 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.

   $$\underset{Acetamide}{CH_3CONH_2} + Br_2 + 4KOH \rightarrow \underset{Methylamine}{CH_3NH_2} + K_2CO_3 + 2KBr + 2H_2O$$

   (b) Alkyl halides are prepared by decomposing the silver salts of carboxylic acids dissolved in carbontetrachloride by bromine or chlorine.

   $$\underset{Silver\ acetate}{CH_3COOAg} + Br_2 \rightarrow \underset{Methylbromide}{CH_3Br} + CO_2 + AgBr$$

8. (i) The number of nearest neighbours of a particle is called its coordinationnumber.
   (ii) The coordination number for ccp is 12 and that for bcc is 8.

   Or

   Atom A per unit cell = 8 x 1/8 = 1
   Atom B per unit cell = 1
   Atom C per unit cell = 6 x 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
   $CH_3 - C(CH_3)_2 - C - (CH_3)_2 - CH_3$.
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 $p = K_H x$. 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 *K*H differs from p_1^0. Thus, Raoult's law becomes a special case of Henry's law in which *K*H becomes equal to p_1^0.

11. (a)In the given molecule, there are four different types of hydrogen atoms, so the replacement of these hydrogen atoms will give the following isomers, $(CH_3)_2CHCH_2CH_2Cl$ $(CH_3)_2CHCH(Cl)CH_3$ $(CH_3)_2C(Cl)CH_2CH_3CH_3CH(CH_2Cl)CH_2CH_3$
    (b) Since sulphuric acid is an oxidizing agent, it oxidizes HI produced during the reaction, thereby preventing the reaction to form alkyl iodide.
    (c) Alkyl halides are polar molecules and so their molecules are held together by dipole – dipole forces. But the molecules of water are held together by hydrogen bonds. When alkyl halides are added to water, the force of attraction between water and alkyl halide molecules are weaker than the forces of attraction already existing between alkyl halide-alkyl halide molecules and water – water molecules. Hence alkyl halides are immiscible with water.
12. Sulphur dioxide can be detected by the following tests:
    (a) It has a pungent characteristic smell.
    (b) It decolourises acidified potassium permanganate solution.
    (c) It turns blue litmus to red.
    (d) It turns acidified potassium dichromate solution green.
13. Molar mass of CH_2Cl_2 = 12 x 1 + 1 x 2 + 35.5 2 = 85 g mol^{-1}
    Molar mass of $CHCl_3$ = 12 x 1 + 1 x 1 + 35.5 3 = 119.5 g mol^{-1}
    Moles of $CH_2Cl_2 = \frac{40}{85} = 0.47$ mol
    Moles of $CHCl_3 = \frac{25.5}{119.5} = 0.213$ mol
    Total number of moles = 0.683 mol
    $x_{CH_2Cl_2} = \frac{0.47}{0.683} = 0.688$
    x_{CHCl_3} = 1.00 – 0.688 = 0.312
    Using equation,
    $\rho_{total} = \rho_1^0 + (\rho_2^0 - \rho_1^0)x_2$ = 200 + (415 – 200) 0.688 = 347.9 mm Hg
14. (a) 3 $HgCl_2$ + 2 PH_3 → Hg_3P_2 + 6 HCl
    (b) 2 $NaClO_3$ + I_2 → 2 $NaIO_3$ + Cl_2
    (c) 2 SCl_2+ 4 NaF → SF_4 + 4 NaCl + S
15. (a) A carbohydrate that cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone is called a monosaccharide.
    (b) Carbohydrates that yield two to ten monosaccharide units, on hydrolysis, are called oligosaccharides. They are further classified as disaccharides, trisaccharides, tetrasaccharides, etc., depending upon the number of monosaccharides, they provide on hydrolysis.
    (c) Carbohydrates which yield a large number of monosaccharide units on hydrolysis are called polysaccharides.
16. Assume that we have 100 g of solution. Solution will contain 20 g of ethylene glycol and 80 g of water.
    Molar Mass of $C_2H_6O_2$ = 12 2 + 1 6 + 16 2 = 62 g mol^{-1}
    Moles of $C_2H_6O_2 = \frac{20g}{62gmol^{-1}} = 0.322mol$

Moles of water= $\frac{80g}{18gmol^{-1}}$ =4.444mol

$x_{glycol} = \frac{\text{moles of } C_2H_6O_2}{\text{moles of } C_2H_6O_2 + \text{moles of } H_2O}$

$= \frac{0.322mol}{0.322mol + 4.444mol} = 0.068$

Similarly $x_{water} = \frac{4.444 \text{ mol}}{0.322 \text{ mol} + 4.444 \text{ mol}} = 0.932$

17. (i) Noble gases are monoatomic gases and are held together by weak vander Waals forces. Therefore, they are liquefied at very low temperatures. Hence they have low boiling points.
    (ii) The elements in group 18 have completely filled valence shell except He. So, they have neither any tendency to lose nor to gain electrons. However, they react with few elements only under certain conditions and so are called noble gases.
    (iii) He is used as a diluent for oxygen in diving apparatus because of its low solubility in blood.
18. (a) Nature of the ligand.
    (b) Oxidation state of the metal ion.
    (c) Nature of the metal ion.
    (d) Geometry of coordination entity.

Or

The more basic a ligand, the greater is the ease with which it can donate its lone pairs of electrons and therefore, the greater is the stability of the complexes formed by it. For anionic ligands, the higher the charge and the smaller the size, the more stable is the complex formed.

19.

S. No	Addition polymers	Condensation polymers
1.	It involves one monomer.	It involves two monomers.
2.	The monomers are unsaturated compounds.	The monomers contain two functional groups.
3.	Different monomers add to form a polymer having same molecular formula of the repeating structural unit as that of starting monomer.	A large number of monomers combine with the loss of simple molecules to form a polymer having molecular formula of the repeating structural unit different than that of starting monomers.
4.	Egs – PVC, polythene etc.	Egs – Bakelite, nylon etc.

20. Molecular mass of $C_3H_6O_3$ = 12 x 3 + 6 x 1 + 3 x 16 = 90 g
    Now, 0.6 g of the compound evolve methane at STP = 295.7 mL
    90 g of compound evolve methane at STP = 295.7/0.6 x 90 = 44355
    Moles of methane produced = 44355/22400 = 1.98 or 2 approx.
    Therefore, one mole of compound produces two moles of methane gas. There are two active hydrogen atoms present in one molecule of compound.
21. Average Rate = $\frac{1}{2}\left\{-\frac{\Delta[N_2O_5]}{\Delta t}\right\}$

    Substituting the values, we get 1.13 x 10^{-5}mol/L/s

    Rate = Average Rate = $\frac{1}{4}\left\{-\frac{\Delta[NO_2]}{\Delta t}\right\}$

Substituting the values,

$\frac{\Delta[NO_2]}{\Delta t}$ = 2.72 x 10^{-3}mol/L/min

22. F is most electronegative element and so cannot show positive oxidation states whereas the other halogens are less electronegative and so show various positive oxidation states. They also have vacant d-orbitals and hence can expand their octets and show +1, +3, +5 and +7 oxidation states.
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.

$$O_3 + \underset{(From CFC)}{\dot{Cl}} \rightarrow \dot{ClO} + O_2$$

$$\dot{ClO} + \dot{O} \rightarrow \dot{Cl} + O_2$$

(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

HFC – 134 a $(CF_3 – CH_2F)$

HCFC – 141 b $(CH_3 – CCl_2F)$

24. Conductivity = 26 x 10^{-2} ohm^{-1} cm^{-1}

Resistance of solution = 31.6 ohm

Concentration = 1 M H_2SO_4 = 98 g/L

Equivalent weight of sulphuric acid = 49

Gram equivalents per litre = 98/49 = 2

Equivalent conductivity = k x 1000/C

= 26 x 10^{-2} x 1000/2 = 130 ohm^{-1} cm^2 $equiv^{-1}$.

Or

Cr^{3+} + $3e^-$ → Cr(s)

3 mol of electricity are required to deposit 1 mol of Cr.

52 g of Cr require current of 3 x 96500 C

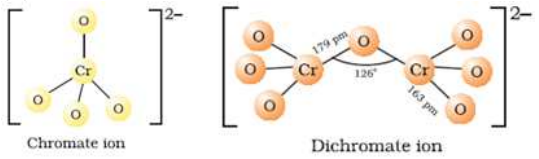
1 g of Cr will require current = 3 x 96500/52 = 5567.3 C

The number of coulombs = current x time

Time = no. of coloumbs/ current

= 5567.3/1.25 = 4453.8 sec or 1.24 hrs.

25. (a)



Chromate ion Dichromate ion

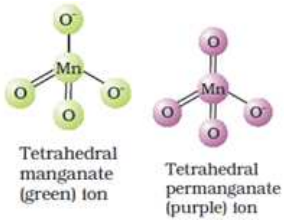
(b) Potassium permanganate is prepared by fusion of MnO2 with an alkali metal hydroxide and an oxidising agent like KNO3. This produces the dark green K2MnO4 which disproportionates in a neutral or acidic solution to give permanganate.

$$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$$

$$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

Or

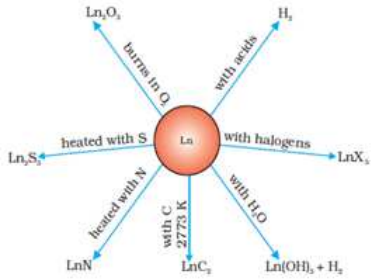
(a)



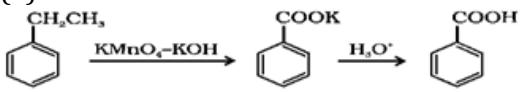
Tetrahedral manganate (green) ion

Tetrahedral permanganate (purple) ion

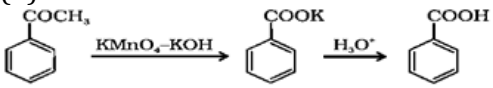
(b)



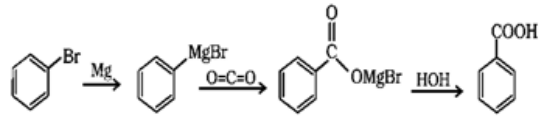
26. (a)



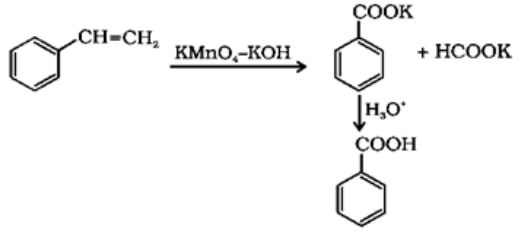
(b)



(c)



(d)

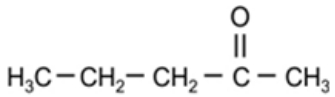


Or

Since the compound X does not reduce Tollen's reagent, the compound X must belong to ketone group.

The compound X forming an addition compound with sodium hydrogen sulphite and giving positive iodoform test confirms that the compound is methyl ketone.

Also, compound X on oxidation gives ethanoic and propanoic acid, so the compound can be



Since this compound is unsymmetrical ketone, the compound is Pentan-2-one with molecular mass 86.