Chemistry

Class – XII: Sample Paper

Source: myCBSEguide.com

Sample Paper - 05 Chemistry (Theory)

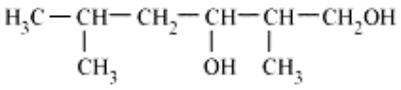
Class – XII

Time allowed: 3 hours

General Instructions: **Maximum Marks: 70**

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.

1. What is the coordination number of each type of ions in a rock-salt type crystal structure?
2. Write the IUPAC name of the following compound:



3. State the formula relating pressure of a gas with its mole fraction in a liquid solution in contact with it.
4. What are point defects? Mention its types.
5. Why the process of adsorption is always exothermic?
6. Explain brown ring test.
7. Explain:
   (i) Electrophoresis
   (ii) Dialysis
8. A compound is formed by two elements X and Y. If the atoms of the element Y (as anions) make ccpand those of the element X (as cations) occupy all the octahedral voids, then what is the formula of the compound?

Or

An element has a body-centred cubic structure with a cell edge of 288 pm. The density of the element is 7.2 g/cm^3. How many atoms are present in 208 g of the element?

9. The initial concentration of N_2O_5 in the following first order reaction: $N_2O_5(g) \rightarrow 2\ NO_2(g) + 1/2\ O_2(g)$ was 1.24 x 10^{-2}mol/L at 318K. The concentration of N_2O_5 after 60 minutes was 0.20 x 10^{-2}mol/L. Calculate the rate constant of the reaction at 318 K.
10. What conclusions can be drawn from the equation: $P = p^0 + \left(p^0 - p^0 \right) x$?
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?

(i) Define thermoplastics and thermosetting polymers with two examples each. How polymers are classified?

13. Complete the following reactions:

(a) $XeF_4 + SbF_6$⊚

(b) $XeF_4 + O_2F_2$⊚

(c) $XeF_4 + H_2O$ ⊚

14. Differentiate natural and vulcanized rubber.
15. 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 0.987bar. Given that Henry's law constant for N_2 at 293 K is 76.48 *k*bar.
16. Under what conditions VantHoffs factor 'i' is equal to unity and less than one and greater than one?
17. Explain Brownian movement.
18. Give the application of colloids in electrical precipitation of smoke.
19. Give reasons:
    (i) HI is better reagent than HBr for cleavage of ether.
    (ii) Highly branched carboxylic acids are less acidic than unbranched acids.
20. Give reason: Phosphorus has more tendency for catenation than nitrogen.
21. Give the reason for the following:
    (a) Ethyl iodide undergoes S_N 2 reaction faster than ethyl bromide
    (b) $(\pm)$ 2-Butanol is optically inactive.
    (c) C – X bond length in halobenzene is smaller than C – X bond length in CH_3 – X.
22. Ethanol is used for drinking purpose. But to refrain people from drinking industrial alcohol, it is denatured. Now a day's some countries use ethanol as an additive in gasoline since it is cleaner fuel.
    (a) What is denatured alcohol? Why it is denatured?
    (b) Would you support the use of ethanol as an additive in gasoline for India?
    (c) What are the values associated with your decision?
23. Give the cause of lanthanoid contraction.

Or

Give five chemical characteristics of lanthanoids.

24. An organic compound (A) with molecular formula C_8H_8O forms an orange-red precipitate with 2,4-DNP reagent and gives yellow precipitate on heating with iodine in the presence of sodium hydroxide. It neither reduces Tollens' or Fehlings' reagent, nor does it decolourise bromine water or Baeyer's reagent. On drastic oxidation with chromic acid, it gives a carboxylic acid (B) having molecular formula $C_7H_6O_2$. Identify the compounds (A) and (B) and explain the reactions involved.

Or

Write chemical equations for the following conversions:

(i) $CH_3–CH_2–Cl$ into $CH_3–CH_2–CH_2–NH_2$

(ii) $C_6H_5–CH2–Cl$ into $C_6H_5–CH_2–CH_2–NH$

(iii) Benzyl alcohol to phenylethanoic acid

(iv) 4-Methylacetophenone to benzene-1,4-dicarboxylic acid

25. Calculate its resistivity, conductivity and molar conductivity, if the electrical resistance of a column of 0.05 mol L^{-1}NaOHsolution of diameter 1 cm and length 50 cm is 5.55 × 10 ohm.

Or

(a) A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode?

(b) What are the observations made in a galvanic cell after the circuit is completed?

Answer

1. In rock salt or common salt, every Na^+ ion is surrounded by 6 Cl^- ions and each Cl^- ion is surrounded by 6 Na^+ ions. Thus, the coordination number of each type of ion in rock salt is 6.
2. 2, 5-Di-methyl-hexane-1, 3-di-ol.
3. The required formula is $p = K_H x$
4. The imperfections in a crystal are caused by a departure from the periodic arrangement in the vicinity of an atom or group of atoms, the imperfections are called point defects. These arise from an error at a single point. Point defects are classified into three types namely, stoichiometric defects, impurity defects and non-stoichiometric defects.
5. This is because there is a force of attraction between adsorbate and adsorbent due to which there is decrease in surface energy which appears as heat.
6. The familiar brown ring test for nitrates depends on the ability of Fe^{2+} to reduce nitrates to nitric oxide, which reacts with Fe^{2+} to form a brown coloured complex. The test is usually carried out by adding dilute ferrous sulphate solution to an aqueous solution containing nitrate ion, and then carefully adding concentrated sulphuric acid along the sides of the test tube. A brown ring at the interface between the solution and sulphuric acid layers indicates the presence of nitrate ion in solution.

$$NO_3^- + 3Fe^{2+} + 4H^+ \rightarrow NO + 2H_2O + 3Fe^{3+}$$

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow \underset{\text{Brown}}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

7. (i) The existence of charge on colloidal particles is confirmed by electrophoresis experiment. When electric potential is applied across two platinum electrodes dipping in a colloidal solution, the colloidal particles move towards one or the other electrode. The movement of colloidal particles under an applied electric potential is called electrophoresis.

   (ii) It is a process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane. Since particles (ions or smaller molecules) in a true solution can pass through animal membrane (bladder) or parchment paper or cellophane sheet but not the colloidal particles, the membrane can be used for dialysis. The apparatus used for this purpose is called dialyser.
8. The plattice is formed by the element Y. The number of octahedral voids generated would be equal to the number of atoms of Y present in it. Since all the octahedral voids are occupied by the atoms of X, their number would also be equal to that of the element Y. Thus, the atoms of elements X and Y are present in equal numbers or 1:1 ratio. Therefore, the formula of the compound is XY.

Or

Volume of the unit cell = $(288\ pm)^3$
$= (288\times10^{-12}\ m)^3 = (288\times10^{-10}\ cm)^3$
$= 2.39\times10^{-23}\ cm^3$

Volume of 208 g of the element,
= mass/ density = $208/7.2 = 28.88\ cm^3$ Number of unit cells in this volume,
$= 28.88/2.39 \times 10^{-23} = 12.08 \times 10^{23}$ unit cells

Since each bcccubic unit cell contains 2 atoms, therefore, the total number of atoms in 208 g

= 2 (atoms/unit cell) × 12.08 × 10^{23}unit cells = 24.16×10^{23} atoms.

9. For a first order reaction,

$$\log \frac{[R]_1}{[R]_2} = \frac{k(t_2 - t_1)}{2.303}$$

$$k = \frac{2.303}{(t_2 - t_1)} \log \frac{[R]_1}{[R]_2}$$

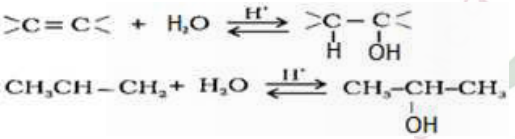
$$= \frac{2.303}{(60\,\text{min}\,0\;0\,\text{min})} \log \frac{1.24\ x\ 10^{-2}\ mol\ L^{-1}}{0.20\ x10^{-2}\ mol\ L^{-1}}$$

$$= \frac{2.303}{60} \log 6.2\,\text{min}^{-1}$$

k =0.0304 min^{-1}

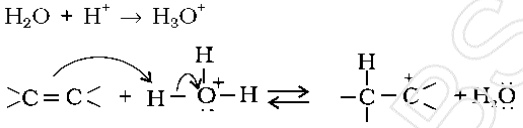
10. (i) Total vapour pressure over the solution can be related to the mole fraction of any one component.
    (ii) Total vapour pressure over the solution varies linearly with the mole fraction of component 2.
    (iii) Depending on the vapour pressures of the pure components 1 and 2, total vapour pressure over the solution decreases or increases with the increase of the mole fraction of component 1.

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.

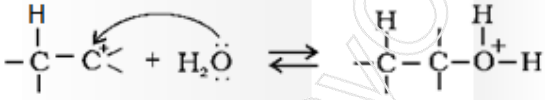


The mechanism of the reaction involves the following three steps:

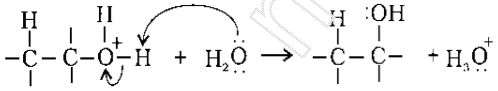
Step 1: Protonation of alkene to form carbocation by electrophilic attack of H_3O .



Step 2: Nucleophilic attack of water on carbocation.



Step 3: Deprotonation of form an alcohol.



12. Here, the –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:

(i) Classification based on source of availability.
(ii) Classification based on structure.
(iii) Classification based on molecular forces.
(iv) Classification based on the mode of synthesis.

14. (a) $[XeF_3]^+ + [SbF_6]^-$
(b) $XeF_6 + O_2$
(c) $4XeOF_2 + 2HF$

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,

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

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

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

(n in denominator is negelated as it is << 55.5)
Thus n =$1.29\ 10^{-5}$ 55.5 mol = $7.16\ 10^{-4}$ mol.

$$= \frac{7.16 x 10^{-4} mol\ x 1000\ m\ mol}{1\ mol} = 0.716\ mol$$

17. (i) When the solute does not undergo any dissociation or association in the solution, it is equal to unity.
(ii) When the solute undergoes association in the solution, it is less than one.
(iii) When the solute undergoes dissociation in the solution, it is greater than one.
18. When colloidal solutions are viewed under a powerful ultra-microscope, the colloidal particles appear to be in a state of continuous zig-zag motion all over the field of view. This motion was first observed by the British botanist, Robert Brown, and is known as Brownian movement. This motion is independent of the nature of the colloid but depends on the size of the particles and viscosity of the solution. Smaller the size and lesser the viscosity, faster is the motion.
19. Smoke is a colloidal solution of solid particles such as carbon, arsenic compounds, dust, etc., in air. The smoke, before it comes out from the chimney, is led through a chamber containing plates having a charge opposite to that carried by smoke particles. The particles on coming in contact with these plates lose their charge and get precipitated. The particles thus settle down on the floor of the chamber. The precipitator is called Cottrell precipitator.
20. (i) HI is a stronger acid than HBr and therefore, oxonium ions are produced. I^- is also a better nucleophile than Br for nucleophilic substitution reaction.
(ii) The carboxylate ($RCOO^-$) of branched chain acids is shielded from solvent molecules and therefore cannot be stabilized by solvation as effectively as the carboxylate ion of unbranched acids.

21. Nitrogen has little tendency for catenation because N – N single bond is weak due to the small size and the lone pairs on two nitrogen atom which repel each other. the other hand, On phosphorus is comparatively large in size and so the atoms do not repel each other. Due to this P – P bond is stronger than N – N bond. Thus, phosphorus has tendency for catenation because of high bond enthalpy of P – P bond.

22. (a) Iodide is a better leaving group because of its larger size, than bromide, therefore, ethyl iodide undergoes S_N2 reaction faster than ethyl bromide

(b) $(\pm)$ 2-butanol is a racemic mixture. It is a mixture which contains two enantiomers in equal proportion and thus, has zero optical rotation. Therefore it is optically inactive.

(c) Due to the delocalization of lone pairs of electrons of the X atom over the benzene ring C – X bond in halobenzene acquires some duble bond character while in CH_3 – X , C – X bond is a pure single bond. Therefore C – X bond in halobenzene is shorter than in CH_3 – X

23. (a) Industrial alcohol is made unfit for drinking by adding methyl alcohol $CuSO_4$ and pyridine. This alcohol is called denatured alcohol.

Ethanol is an excellent solvent and if taken in large quantity it is harmful for humans. So in order to supply ethanol and to refrain people from drinking it is denatured.

(b) Yes, because it will help in meeting energy crisis and reduce our fiscal deficit which is created due to import of gasoline.

(c) Values – Concern for energy crisis and Concern for economy of country.

24. In the lanthanoid series, as we move from one element to another, the nuclear charge increases by one unit and one electron is added. The new electrons are added to the same inner 4f-subshells. However, the 4f-electrons shield each other from the nuclear charge quite poorly because of the very diffused shapes of f-orbitals. The nuclear charge increases by one step. Hence, with increasing atomic number and nuclear charge, the effective nuclear charge experienced by each 4f-electron also increases. As a result, there is a gradual decrease in size of lanthanoids with increase in atomic number.

Or

(a) The hardness of lanthanoids increases with increasing atomic number.

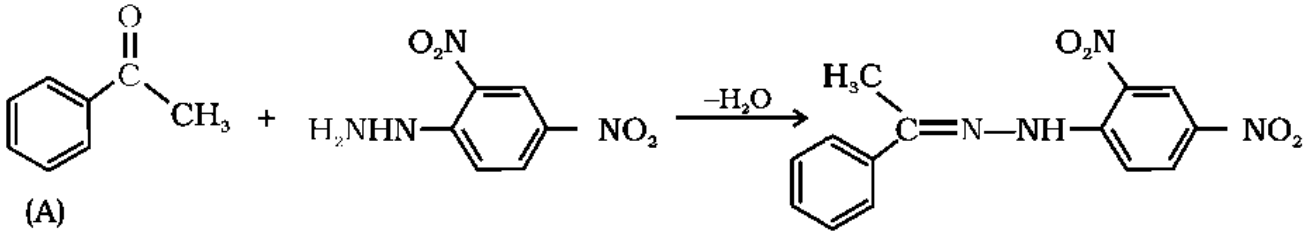
(b) In their chemical behaviour, the earlier members of the series are quite reactive but with increase in atomic number they behave like aluminium.

(c) They combine with nitrogen to form nitrides.

(d) They liberate hydrogen from dilute acids.

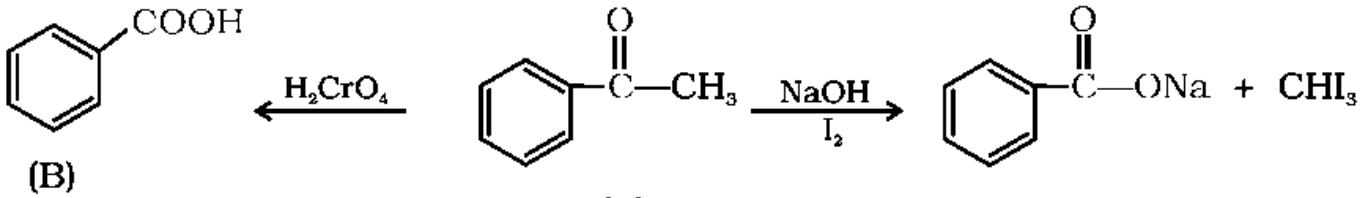
(e) When the metals are heated with carbon, they form carbides of the formula Ln_3C, Ln_2C_3 and LnC_2.

(A) forms 2,4-DNP derivative. Therefore, it is an aldehyde or a ketone. Since it does not reduce Tollens' or Fehling reagent, (A) must be a ketone. (A) responds to iodoform test. Therefore, it should be a methyl ketone. The molecular formula of (A) indicates high degree of unsaturation, yet it does not decolourise bromine water or Baeyer's reagent. This indicates the presence of unsaturation due to an aromatic ring. Compound (B), being an oxidation product of a ketone should be a carboxylic acid. The molecular formula of (B) indicates that it should be benzoic acid and compound (A) should, therefore, be a monosubstituted aromatic methyl ketone. The molecular formula of (A) indicates that it should be phenyl methyl ketone (acetophenone). Reactions:



(A)

C_8H_8O 2, 4-Dinitrophenylhydrazine 2, 4-DNP derivative



(B)

$C_7H_6O_2$

(A)

Or

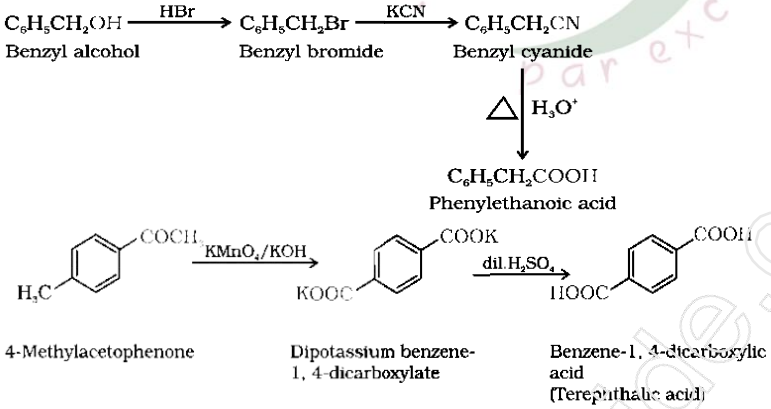
(i) $CH_3-CH_2-Cl \xrightarrow{Ethanolic\ NaCN} CH_3-CH_2-C\equiv N \xrightarrow{Reduction} CH_3-CH_2-CH_2-NH_2$

Chloroethane Propanenitrile Propan–1–amine

(ii) $C_6H_5-CH_2-Cl \xrightarrow{Ethanolic\ NaCN} C_6H_5-CH_2-C\equiv N \xrightarrow{H_2/Ni} C_6H_5-CH_2-CH_2-NH_2$

Chlorophenylmethane Phenylethanehitrile 2–Phenylethanamine

(iii)



26. A = $r^2 = 3.14 \times 0.5^2\ cm^2 = 0.785\ cm^2 = 0.785 \times 10^{-4}\ m^2$

$l = 50\ cm = 0.5\ m$

$$R = \frac{\rho l}{A} \text{ or } \rho = \frac{RA}{l} = \frac{5.55 \times 10^3 \Omega \times 0.785}{50 cm} \frac{cm^2}{} = 87.135\ \Omega\ cm$$

$$\text{Conductivity} = k = \frac{1}{\rho} = \frac{1}{87.135} S\ cm^{-1} = 0.01148\ S\ cm^{-1}$$

Molar conductivity $\wedge = \frac{kx1000}{cm^3L^{-1}}$

$= \frac{0.01148\ S\ cm^{-1}x\ 1000\ cm^3L^{-1}}{0.05\ molL^{-1}}$

= 229.6 S cm^2 mol^{-1}

Or

(a) T = 600 sec, charge = current x time = 1.5 x 600 = 900 C

According to the reaction,

$Cu^{2+} + 2e^- = Cu$

We need, 2F = 2 x 96487 C to deposit 1 mol or 63 g of Cu.

For 900 C, the mass of Cu deposited = 63 x 900/ 2 x 96487 = 0.2938 g.

(b) It is observed that the electric current flows through external circuit as indicated by the ammeter. The following observations are made:

(i) Zn rod gradually loses its weight.

(ii) The concentration of Zn ions in the zinc sulphate solution increases.

(iii) Cu gets deposited on the electrode.

(iv) The concentration of Cu ions in copper sulphate solution decreases.

There is flow of electrons from Zn rod to Cu rod and so current flows from Cu to Zn rod.