12th STD

PUBLIC EXAM MAY - 2022

CHEMISTRY

PART III (with Answers)

Reg. No. | | | | | | |

Time Allowed : 3.00 Hours] [Maximum Marks : 70

Instructions :

(1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Note : Draw diagrams and write equations wherever necessary.

PART - I

Note : (i) Answer all the questions. **[15 × 1 = 15]**

(ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

1. Which of the following amino acids are achiral?
   (a) Proline (b) Alanine
   (c) Glycine (d) Leucine
2. $HO - CH_2 - CH_2 - OH$ on heating with periodic acid gives :
   (a) Methanal (b) Methanoic acid
   (c) CO_2 (d) Glyoxal
3. An aqueous solution of borax is :
   (a) basic (b) neutral
   (c) amphoteric (d) acidic
4. The crystal with a metal deficiency defect is :
   (a) ZnO (b) NaCl (c) KCl (d) FeO
5. Which one of the following is an example for homogeneous catalysis?
   (a) Hydrogenation of oil
   (b) Manufacture of ammonia by Haber's process
   (c) Hydrolysis of sucrose in presence of dil.HCl
   (d) Manufacture of sulphuric acid by Contact process
6. Which of the following reagent can be used to convert nitrobenzene to aniline?
   (a) ZnHg/NaOH (b) Zn/NH_4Cl
   (c) Sn/HCl (d) All of these
7. Faraday constant is defined as :
   (a) Charge required to deposit one mole of substance
   (b) Charge carried by 1 electron
   (c) Charge carried by 6.22×10^{10} electrons
   (d) Charge carried by one mole of electrons
8. Bauxite has the composition :
   (a) $Al_2O_3.nH_2O$ (b) $Fe_2O_3.2H_2O$
   (c) Al_2O_3
   (d) None of the above
9. If 75% of a first order reaction was completed in 60 min, 50% of the same reaction under the same conditions would be completed in :
   (a) 35 minutes (b) 20 minutes
   (c) 75 minutes (d) 30 minutes
10. Which of the following can act as Lowry-Bronsted acid as well as base?
    (a) HPO_4^{2-} (b) HCl
    (c) Br^- (d) SO_4^{2-}
11. A complex in which the oxidation number of the metal is zero is :
    (a) $K_4[Fe(CN)_6]$ (b) $[Fe(CN)_3(NH_3)_3]$
    (c) $[Fe(CO)_5]$ (d) Both (b) and (c)
12. Which of the following oxidation states is most common among the lanthanoids?
    (a) +5 (b) +4
    (c) +3 (d) +2

13. An element belongs to group- 15 and 3rd period of the periodic table. Its electronic configuration would be :
(a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ (b) $1s^2\ 2s^2\ 2p^4$
(c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$ (d) $1s^2\ 2s^2\ 2p^3$

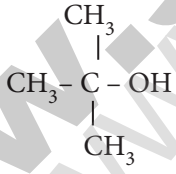
14. Fog is colloidal solution of :
(a) liquid in gas (b) solid in gas
(c) gas in liquid (d) gas in gas

15. The formation of cyanohydrin from acetone is an example of :
(a) electrophilic addition
(b) nucleophilic substitution
(c) nucleophilic addition
(d) electrophilic substitution

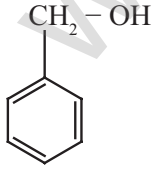
PART - II

Note : Answer **any six** questions. Question No. **24** is **compulsory.** **6 × 2 = 12**

16. What are the differences between minerals and ores?
17. Which is more stable Fe^{3+} or Fe^{2+}? Why?
18. Define Coordination number.
19. Define covalent solids.
20. Give examples for the first order reaction.
21. What are the limitations of Arrhenius concept?
22. Write a note on Electrophoresis.
23. Give the IUPAC names :
a)



b)



24. Identify A and B in the following sequence of reactions.

$$CH_3 - Br \xrightarrow{NaN_3} A \xrightarrow{LiAlH_4} B + N_2$$

PART - III

Note : Answer **any six** questions. Question No. **33** is **Compulsory.** **6 × 3 = 18**

25. What are interhalogen compounds? Give examples.
26. What are the properties of interstitial compounds?
27. Write Arrhenius equation and explain the terms involved.
28. What are the factors that affects electrolytic conductance?
29. What is homogeneous catalysis? Give example.
30. Write any one method of preparation for diethyl ether.
31. Write Haloform reaction.
32. What are Epimers? Give example.
33. Write the following for the complex $[Ag(NH_3)_2]^+$.
(a) Ligand
(b) Central metal ion
(c) IUPAC name

PART - IV

Note : Answer **all** the questions: **5 × 5 = 25**

34. (a) (i) Write a note on gravity separation method.
(ii) Explain the Mond's Process of refining nickel.
(OR)
(b) (i) What is inert pair effect?
(ii) What are the uses of boric acid?

35. (a) (i) What are the uses of oxygen?
(ii) How will you prepare bleaching powder?
(OR)
(b) Write the postulates of Werner's Theory.

36. (a) Differentiate crystalline solids and amorphous solids.
(OR)

(b) (i) Define pH.

(ii) Explain common ion effect with example.

37. (a) Drive an expression for Nernst equation.

(OR)

(b) What are the characteristics of catalyst?

38. (a) Explain the reducing action of formic acid with example.

(OR)

(b) Write a note on :

(i) Carbylamine reaction

(ii) Gabriel phthalimide synthesis.

❁❁❁

ANSWER

PART - I

1. (c) Glycine
2. (a) Methanal
3. (a) basic
4. (d) FeO
5. (c) Hydrolysis of sucrose in presence of dil. HCl
6. (c) Sn/HCl
7. (d) Charge carried by one mole of electrons
8. (a) $Al_2O_3.nH_2O$
9. (d) 30 minutes
10. (a) HPO_4^{2-}
11. (c) $[Fe(CO)_5]$
12. (c) +3
13. (c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
14. (a) liquid in gas
15. (c) nucleophilic addition

PART - II

16.

Minerals	Ores
A naturally occurring substance obtained by mining which contains the metal in free state or in the form of compounds.	Ore contains a high percentage of metal, from which it can be extracted conveniently and economically.
All minerals are not ores	All ores are Minerals
It contains a low percentage of metal.	It contains a high percentage of metals
Ex : Mineral of Al is bauxite and china clay	Ex : Ore of Al is bauxite

17. (i) Electronic configuration of Fe^{3+} is $[Ar]3d^5 4s^0$.
(ii) It consists of 5 unpaired electrons.
(iii) Half-filled and stable.
(iv) Electronic configuration of Fe^{2+} is $[Ar]3d^6$.
(v) It consists of 4 unpaired electrons.
(vi) Partially filled d-subshell is less stable.
(vii) Hence, Fe^{3+} is more stable than Fe^{2+}.

18. The number of ligand donor atoms bonded to a central metal ion in a complex is called the coordination number of the metal.

19. In covalent solids, the constituents (atoms) are bound together in a three dimensional network entirely by covalent bonds. Examples: Diamond, silicon carbide etc.

20. (i) Decomposition of dinitrogen pentoxide

$$N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2} O_2(g)$$

(ii) Decomposition of sulphurylchloride;

$$SO_2Cl_2(l) \longrightarrow SO_2(g) + Cl_2(g)$$

(iii) Isomerisation of cyclopropane to propene.

21. (i) Arrhenius theory does not explain the behaviour of acids and bases in non aqueous solvents such as acetone, Tetrahydrofuran etc...

(ii) This theory does not account for the basic nature of the substances like ammonia (NH_3) which do not possess hydroxyl group.

22. The migration of sol particles under the influence of electric field is called cataphoresis or electrophoresis.

23. (a) 2 - methylpropan-2-ol

(b) Phenylmethanol

24. $CH_3—Br \xrightarrow{NaN_3} CH_3—N_3 \xrightarrow{LiAlH_4} CH_3—NH_2 + N_2$

Methylbromide — Methyl azide — Methylamine

A - $CH_3 – N_3$ – Methyl azide

B - $CH_3 – NH_2$ –Methylamine

PART - III

25. Each halogen combines with other halogens to form a series of compounds known as inter halogen compounds.

Ex: ClF, BrF_3, ClF_3. BrF_5. IF_7.

26. (i) They are hard and show electrical and thermal conductivity.

(ii) They have high melting points higher than those of pure metals.

(iii) Transition metal hydrides are used as powerful reducing agents.

(iv) Metallic carbides are chemically inert.

27. The exact dependence of the rate of a chemical reaction on temperature is given by Arrhenius equation.

$K = Ae^{-E_a/RT}$

Where,

A = Arrhenius factor or the frequency factor

T = Temperature

R = Gas constant

E_a = Activation energy

28. (i) If the interionic attraction between the oppositely charged ions of solutes increases, the conductance will decrease.

(ii) Solvent of higher dielectric constant show high conductance in solution.

(iii) Conductance is inversely proportional to the Viscosity of the medium. i.e., conductivity increases with the decrease in viscosity.

(iv) If the temperature of the electrolytic solution increases, conductance also increases. Increase in temperature increases the kinetic energy of the ions and decreases the attractive force between the oppositely charged ions and hence conductivity increases.

(v) Molar conductance of a solution increases with increase in dilution. This is because, for a strong electrolyte, interionic forces of attraction decrease with dilution. For a weak electrolyte, degree of dissociation increases with dilution.

29. **Homogeneous catalysis :** In a homogeneous catalysed reaction, the reactants, products and catalyst are present in the same phase.

Illustration (1): In this reaction the catalyst NO, reactants, SO_2 and O_2, and product, SO_3 are present in the gaseous form.

$2SO_{2(g)} + O_{2(g)} + [NO]_{(g)} \rightarrow 2SO_{3(g)} + [NO]_{(g)}$

Illustration (2): In the decomposition of acetaldehyde by I_2 catalyst, the reactants and products are all present in the vapour phase.

$CH_3CHO_{(g)} + [I_2]_{(g)} \rightarrow CH_{4(g)} + CO_{(g)} + [I_2]_{(g)}$

30. **Inter molecular dehydration of alcohol :** When ethanol is treated with con.H_2SO_4 at 443K, elimination takes place to form ethene. If the same reaction is carried out at 413K, substitution competes over elimination to form ethers.

$2CH_3\text{-}CH_2\text{-}OH \xrightarrow[413K]{H_2SO_4} CH_3\text{-}CH_2\text{-}O\text{-}CH_2\text{-}CH_3$

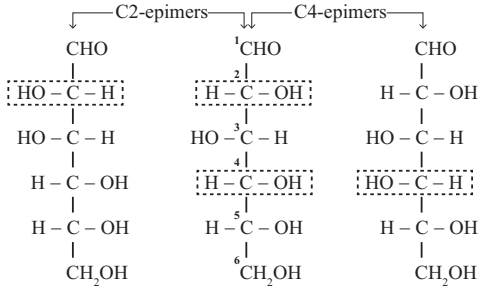
ethanol — diethylether

31. Acetaldehyde and methyl ketones, containing $CH_3-\overset{\overset{O}{\|}}{C}-$ group, when treated with halogen and alkali give the corresponding haloform. This is known as Haloform reaction.

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow[NaOH]{3Cl_2} CCl_3-\overset{\overset{O}{\|}}{C}-CH_3$$

$$\xrightarrow{NaOH} CHCl_3 + CH_3-\overset{\overset{O}{\|}}{C}-ONa$$

32. Sugar differing in configuration at an asymmetric centre is known as **epimers**. **Eg:**



33. $[Ag(NH_3)_2]^+$
   (a) Ligand - NH_3
   (b) Central metal ion - Ag^+
   (c) IUPAC name - Diamminesilver (I) ion

PART - IV

34. (a) (i) **Gravity Separation Method :**
   (1) In gravity separation method, the ore having high specific gravity is separated from the gangue that has low specific gravity by washing with running water.
   (2) Ore is crushed to a finely powdered form and treated with rapidly flowing current of water.
   (3) During this process the lighter gangue particles are washed away by the running water.
   (4) This method is generally applied to concentrate the native ore such as gold and oxide ores such as haematite (Fe_2O_3), tin stone (SnO_2) etc.

(ii) Mond process for refining nickel :

   (1) The impure nickel is heated in a stream of carbon monoxide at around 350K.
   (2) The nickel reacts with the CO to form a highly volatile nickel tetracarbonyl.
   (3) The solid impurities are left behind.
   $Ni_{(s)} + 4CO_{(g)} \xrightarrow{350\ K} [Ni(CO)_4]_{(g)}$
   (4) On heating the nickel tetracarbonyl around 460K, the complex decomposes to give pure metal.
   $[Ni(CO_4)]_{(g)} \xrightarrow{460\ K} Ni_{(s)} + 4CO_{(g)}$

(OR)

(b) (i) In heavier post transition metals, the outer *s* electrons (*ns*) have a tendency to remain inert and show reluctance to take part in the bonding, which is known as inert pair effect. This effect is also observed in groups 14, 15 and 16.

(ii) (1) Boric acid is used in the manufacture of pottery glases, enamels and pigments.
   (2) It is used as an antiseptic and as an eye lotion.
   (3) It is also used as a food preservative.

35. (a) (i)
   1. Oxygen is one of the essential component for the survival of living organisms.
   2. It is used in welding (oxyacetylene welding)
   3. Liquid oxygen is used as fuel in rockets etc...

(ii) Bleaching powder is produced by passing chlorine gas through dry slaked lime (calcium hydroxide).
$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$

(OR)

(b) **Postulates of Werner's theory:**
   1. Most of the elements exhibit two types of valence namely (i) primary valence and (ii) secondary valence. The primary valence is referred as the oxidation state

of the metal atom and the secondary valence as the coordination number. **Eg:** According to Werner, the primary and secondary valences of cobalt are 3 and 6 respectively.

2. The primary valence of a metal ion is positive in most of the cases and zero in certain cases. They are always satisfied by negative ions. **Eg:** In the complex $CoCl_3.6NH_3$, The primary valence of Co is +3 and is satisfied by $3Cl^-$ ions.
3. The secondary valence is satisfied by negative ions, neutral molecules, positive ions or the combination of these. Eg: In $CoCl_3.6NH_3$ the secondary valence of cobalt is 6 and is satisfied by six neutral ammonia molecules, whereas in $CoCl_3.5NH_3$ the secondary valence of cobalt is satisfied by five neutral ammonia molecules and a Cl^- ion.
4. According to Werner, there are two spheres of attraction around a metal atom/ion in a complex.
5. The inner sphere is known as coordination sphere and the groups present in this sphere are firmly attached to the metal. The outer sphere is called ionisation sphere. The groups present in this sphere are loosely bound to the central metal ion and hence can be separated into ions upon dissolving the complex in a suitable solvent.
6. The primary valences are non-directional while the secondary valences are directional. The geometry of the complex is determined by the spacial arrangement of the groups which satisfy the secondary valence. **Eg:** If a metal ion has a secondary valence of six, it has an octahedral geometry. If the secondary valence is 4, it has either tetrahedral or square planar geometry.

The following table illustrates the Werner's postulates

Complex	Groups satisfy the secondary valence (non-ionaisable, inner coordination sphere)	No. of ionisable Cl^- ions in the complex (outer coordination sphere)	No. of moles of AgCl formed = no. of moles of ionisable Cl^-
$CoCl_3.6NH_3$	$6NH_3$	3 Cl^-	3 AgCl
$CoCl_3.5NH3$	$5NH_3$ & 1 Cl^-	2 Cl^-	2 AgCl
$CoCl_3.4NH3$	$4NH_3$ & 2 Cl^-	1 Cl^-	1 AgCl
$CoCl_3.4NH3$	$4NH_3$ & 2 Cl^-	1 Cl^-	1 AgCl

36. (a)

Crystalline Solids	Amorphous Solids
Long range orderly arrangement of constituents.	Short range, random arrangement of constituents.
Definite shape	Irregular shape
Generally crystalline solids are anisotropic in nature	They are isotropic like liquids
They are true solids	They are considered as pseudo solids (or) super cooled liquids
Definite Heat of fusion	Heat of fusion is not definite
They have sharp melting points.	Gradually soften over a range of temperature and so can be moulded.
Eg: NaCl, diamond, etc	**Eg:** Rubber, plastics, glass, etc

(OR)

(b) (i) pH of a solution is defined as the negative logarithm of base 10 of the molar concentration of the hydronium ions present in the solution.

$$pH = -\log_{10}[H_3O^+]$$

(ii) When a salt of a weak acid is added to the acid itself, the dissociation of the weak acid is suppressed further. For example, the addition of sodium acetate to acetic acid solution leads to the suppression in the dissociation of acetic acid which is already weakly dissociated. In this case, CH_3COOH and CH_3COONa have the common ion,CH_3COO^- **Eg:** Acetic acid is a weak acid. It is not completely dissociated in aqueous solution and hence the following equilibrium exists.

$$CH_3COOH_{(aq)} \rightleftharpoons H^+_{(aq)} + CH_3COO^-_{(aq)}$$

However, the added salt, sodium acetate, completely dissociates to produce Na^+ and CH_3COO^- ion.

$$CH_3COONa_{(aq)} \longrightarrow Na^+_{(aq)} + CH_3COO^-_{(aq)}$$

Hence, the overall concentration of CH_3COO^- is increased, and the acid dissociation equilibrium is disturbed. We know from Le chatelier's principle that when a stress is applied to a system at equilibrium, the system adjusts itself to nullify the effect produced by that stress. So, inorder to maintain the equilibrium, the excess CH_3COO^- ions combines with H^+ ions to produce much more unionized CH_3COOH i.e, the equilibrium will shift towards the left. In other words, the dissociation of CH_3COOH is suppressed. Thus, the dissociation of a weak acid (CH_3COOH) is suppressed in the presence of a salt (CH_3COONa) containing an ion common to the weak electrolyte. It is called the common ion effect.

37. (a) **Nernst equation :** Nernst equation is the one which relates the cell potential and the concentration of the species involved in an electrochemical reaction. Let us consider an electrochemical cell for which the overall redox reaction is,

$$xA + yB \rightleftharpoons lC + mD$$

The reaction quotient Q for the above reaction is given below

$$Q = \frac{[C]^l[D]^m}{[A]^x[B]^y} \quad \text{.....(1)}$$

We have already learnt that,

$$\Delta G = \Delta G^\circ + RT \ln Q \quad \text{.....(2)}$$

The Gibbs free energy can be related to the cell emf as follows

$$\Delta G = -nFE_{cell}\ ;\ \Delta G^\circ = -nFE^\circ_{cell}$$

Substitute these values and Q from (1) in the equation (2)

$$(2) \Rightarrow -nFE_{cell} = -nFE^\circ_{cell} + RT \ln \frac{[C]^l[D]^m}{[A]^x[B]^y} \quad \text{.....(3)}$$

Divide the whole equation (3) by (–nF), we get,

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln \frac{[C]^l[D]^m}{[A]^x[B]^y}$$

$$\text{(or) } E_{cell} = E^\circ_{cell} - \frac{2.303RT}{nF} \log \frac{[C]^l[D]^m}{[A]^x[B]^y} \quad \text{.....(4)}$$

The above equation (4) is called the **Nernst equation**

At 25°C (298 K), the above equation (4) becomes,

$$E_{cell} = E^\circ_{cell} - \frac{2.303 \times 8.314 \times 298}{n(96500)} \log \frac{[C]^l[D]^m}{[A]^x[B]^y}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[C]^l[D]^m}{[A]^x[B]^y} \quad \text{.....(5)}$$

(OR)

(b) (i) For a chemical reaction, catalyst is needed in very small quantity.

(ii) There may be some physical changes, but the catalyst remains unchanged in mass and chemical composition in a chemical reaction.

(iii) A catalyst itself cannot initiate a reaction.

(iv) A solid catalyst will be more effective if it is taken in a finely divided form.

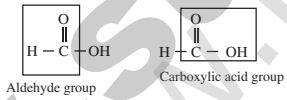
(v) A catalyst are specific in nature.

(vi) In an equilibrium reaction, presence of catalyst reduces the time for attainment of equilibrium and hence it does not affect the position of equilibrium and the value of equilibrium constant.

(vii) A catalyst is highly effective at a particular temperature called as optimum temperature.

(viii) Presence of a catalyst generally does not change the nature of products

38. (a) **Reducing action of Formic acid:** Formic acid contains both an aldehyde as well as an acid group. Hence, like other aldehydes, formic acid can easily be oxidised and therefore acts as a strong reducing agent



(i) Formic acid reduces Tollens reagent (ammonical silver nitrate solution) to metallic silver.

$$HCOO^- + 2Ag^+ + 3OH^- \longrightarrow \underset{\text{Silver mirror}}{2\,Ag} + CO_3^{2-} + 2H_2O$$
(Tollens reagent)

(ii) Formic acid reduces Fehling's solution. It reduces blue coloured cupric ions to red coloured cuprous ions.

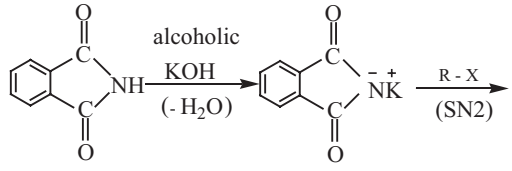
$$HCOO^- + 2Cu^{2+} + 5\,OH^- \longrightarrow \underset{\text{red precipitate}}{Cu_2O} + CO_3^{2-} + 3\,H_2O$$
(Fehlings solution)

(OR)

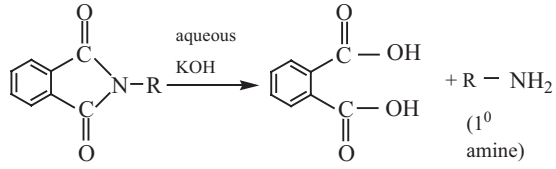
(b) (i) **Carbylamine reaction :** Aliphatic (or) aromatic primary amines react with chloroform and alcoholic KOH to give isocyanides (carbylamines), which has an unpleasant smell. This reaction is known as carbylamines test. This test used to identify the primary amines.

$$\underset{\text{Ethylamine}}{C_2H_5 - NH_2} + \underset{\text{Chloroform}}{CHCl_3} + 3KOH \longrightarrow \underset{\text{Ethylisocyanide}}{C_2H_5 - NC} + 3KCl + 3H_2O$$

(ii) **Gabriel phthalimide synthesis:** Gabriel synthesis is used for the preparation of Aliphatic primary amines. Phthalimide on treatment with ethanolic KOH forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis gives primary amine. Aniline cannot be prepared by this method because the arylhalides do not undergo nucleophilic substitution with the anion formed by phthalimide



Phthalimide Potassium phthalimide



N - alkyl phthalimide phthalic acid

❁❁❁