Chemistry

Academic Year: 2015-2016 Marks: 70
Date & Time: 29th February 2016, 11:00 am
Duration: 3h

CHEMISTRY

(PHYSICAL AND INORGANIC CHEMISTRY)

Notes:

1. All questions are compulsory.
2. Answers of both the sections should be written in same answer book.
3. Draw well labelled diagrams and write balanced equations wherever necessary.
4. Figures to the right indicate full marks.
5. Use of logarithmic table is allowed.
6. Every new question must be started on a new page.

Question 1: Answer any six of the following **[12]**

Question 1.1.i: What is ferromagnetism? **[2]**

Solution 1: The substances which can be permanently magnetised even in the absence of a magnetic field are called ferromagnetic substances, and the mechanism is called ferromagnetism.

Solution 2: Ferromagnetism: The substances that are strongly attracted by a magnetic field are called ferromagnetic substances. Ferromagnetic substances can be permanently magnetised even in the absence of a magnetic field. Some examples of ferromagnetic substances are iron, cobalt, nickel, gadolinium, and CrO_2.

In solid state, the metal ions of ferromagnetic substances are grouped together into small regions called domains and each domain acts as a tiny magnet. In an un-magnetised piece of a ferromagnetic substance, the domains are randomly-oriented and so, their magnetic moments get cancelled. However, when the substance is placed in a magnetic field, all the domains get oriented in the direction of the magnetic field. As a result, a strong magnetic effect is produced. This ordering of domains persists even after the removal of the magnetic field. Thus, the ferromagnetic substance becomes a permanent magnet.

Schematic alignment of magnetic moments in ferromagnetic substances

Question 1.1.ii:

Iron (z=26) is highly ferromagnetic. Explain.

Solution: Iron (z = 26), with electronic configuration [Ar] $3d^6$ $4s^2$, contains four unpaired electrons. Hence, iron is strongly ferromagnetic.

Question 1.2.i: Define boiling point **[2]**

Solution: The boiling point is the temperature at which the vapour pressure of a liquid becomes equal to the atmospheric pressure.

Question 1.2.ii: Write the formula to determine the molar mass of a solute using freezing point depression method.

Solution: Depression of freezing point and molar mass of the solute:
When W2 gram of solute with molar mass M2 is dissolved in W1 gram of solvent, the molality m is given by

$$\Delta T_f \propto m$$

$$m = \frac{\text{Mass of solute in kg}}{\text{Molar mass of solue in kg} \times \text{Mass of solvent in kg}}$$

$$m = \frac{W_2}{M_2 \cdot W_1}$$

∴ The molar mass of a solute using freezing depression method is givenby,

$$\Delta T_f \propto m$$

$$\Delta T_f = k_f . \frac{\mathrm{W_2}}{\mathrm{M_2}} \times \frac{1000}{\mathrm{W_1}}$$

Where K_f - Cryoscopic constant

$\mathrm{W_2}$ - mass of solute

$\mathrm{W_1}$ - mass of solvent

$\mathrm{M_2}$ - molecular mass of non-volatile solute

Question 1.3: Write mathematical equation of first law of thermodynamics [2]

Question 1.3.1: Write mathematical equation of first law of thermodynamics for the following processes : [1]
Adiabatic process.

Solution: The mathematical expression for the first law of thermodynamics is,
ΔU = q + w
When ΔU = change in energy
q = heat absorbed by the system
w = Amount of work done
Adiabatic Process : A process in which heat is not allowed to enter or leave the system at any stage the process is called adiabatic process.
∴ q = 0

The mathematical expression for first law of thermodynamics is,
ΔU = q + w
∴ ΔU = + w

Question 1.3.2: Write mathematical equation of first law of thermodynamics for Isochoric process **[1]**

Solution:

By substituting equation $W = -p_{ex}.\triangle V$ in the equation $\triangle U = q + W$, we get

$$\triangle U = q - p_{ex}.\triangle V.....(1)$$

If the reaction is carried out in a closed container so that the volume of the system is constant, then ΔV = 0. In such a case, no work is involved.

The equation (1) becomes $\triangle U = q_v.$

Equation (1) suggests that the change in internal energy of the system is due to heat transfer. The subscript v indicates a constant volume process. As U is a state function, qv is also a state function. We see that an increase in the internal energy of a system is numerically equal to the heat absorbed by the system in a constant volume (isochoric) process.

Question 1.4: Explain a graphical method to determine activation energy of a reaction. **[2]**

Solution:

The Arrhenius equation is given by

$$k = Ae^{\frac{-E_a}{RT}}$$

On taking logarithms of both sides, we get

$$\log_n k = \log_n A - \frac{E_a}{RT}$$

or

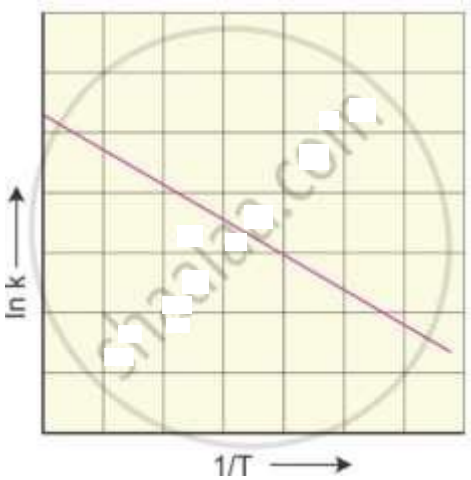
$$\log_{10} k = -\frac{E_a}{2.303RT} + \log_{10} A$$

$$\log_{10} k = -\frac{E_a}{2.303R} \times \left(\frac{1}{T}\right) + \log_{10} A$$

The rate constant of a reaction is determined at various temperatures.

$\log_{10}$ k is plotted against the reciprocal of temperature. The graphical

representation is



The slope of the straight line graph is

$$-\frac{Ea}{2.303R}$$

From which the activation energy can be calculated.

Question 1.5: Write the names and chemical formulae **[2]**

Question 1.5.1: Write the names and chemical formulae of any one ore of iron. **[1]**

Solution: The important ores of iron are

Haematite Fe_2O_3,

Limonite $2Fe_2O_3.3H_2O$,

Magnetite Fe_3O_4,

Siderite $FeCO_3$ and

Pyrite FeS_2.

Question 1.5.2: Write the names and chemical formulae of any one ore of zinc. **[1]**

Solution: The important ores of zinc are

zinc blende ZnS,

Calamine $ZnCO_3$,

Zincite ZnO and

Willemite Zn_2SiO_4.

Question 1.6.i: What is the action of sodium on arsenic. **[1]**

Solution: $3\,NA + AS \longrightarrow Na_3AS$

Question 1.6.ii: What is the action of Magnesium on bismuth.

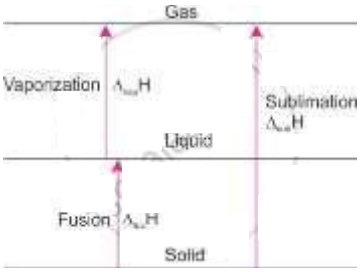
Solution: $2\,Bi + 3\,Mg \longrightarrow Mg_3\,Bi_2$

Question 1.7.i: Define enthalpy of sublimation. **[2]**

Solution: The enthalpy change which accompanies the conversion of one mole of solid directly into its vapour at constant temperature and pressure is called its enthalpy of sublimation. It is denoted by $\Delta_{sub}H$.

Question 1.7.ii: How is enthalpy of sublimation related to enthalpy of fusion and enthalpy of vaporization?

Solution: Relation of enthalpy of sublimation with enthalpy of fusion and enthalpy of vaporisation:



The enthalpy of sublimation of ice at 0^0C and 1 atm pressure is 51.08 kJ mol^{-1}.$H_2O(s) \rightarrow H_2O(g)$, ΔH = 51.08 kJ mol^{-1} at 0^0C.

When solid is converted to vapour, either in one step or two steps, the solid first gets converted to the liquid state and then to the vapour state. The enthalpy change remains the same. This is because enthalpy is a state function.

For example,
$H_2O(s) \rightarrow H_2O(l)$, Δ_{fus} H = +6.01 kJ mol^{-1} at 0°C
$H_2O(l) \rightarrow H_2O(g)$, Δ_{vap} H = +45.07 kJ mol^{-1} at 0°C

$H_2O(s) \rightarrow H_2O(g)$, Δ H = 51.08 kJ mol^{-1} at 0°C

Therefore, it follows that
Δ_{sub} H = Δ_{fus} H + Δ_{vap} H

Question 1.8.i: What are Ellingham's diagrams? Write 2 features of it. **[2]**

Solution: Ellingham diagrams:
The plots between Δ_fG^Θ of formation of oxides of elements and temperature are called Ellingham diagrams. It provides a sound idea about selecting a reducing agent in the reduction of oxides. Such diagrams help in predicting the feasibility of a thermal reduction of an ore. ΔG must be negative at a given temperature for a reaction to be feasible.

Question 1.8.ii: Write features of Ellingham's diagrams

Solution: Features of Ellingham diagram:
(a) The graph for the formation of a metal oxide is a straight line with an upward slope.
(b) There is a sudden change in the slopes for some metal oxides, such as MgO, ZnO and HgO.
(c) For a few metal oxides of silver and mercury (Ag_2O and HgO), the graph is at the upper part in the Ellingham diagram.

Question 2: Answer any 3 of the following **[9]**

Question 2.1: Silver crystallises in FCC structure. If density of silver is 10.51 gcm^{-3}, calculate the volume of unit cell. [Atomic mass of slive (Ag) = 108 gm^{-1}] **[3]**

Solution: Density of Ag = 10.51 g/cm^3

Vol. of unit cell = ?

Mass of one atom of silver

$$= \frac{\text{molar mass of silver}}{N_A}$$

$$= \frac{108}{6.022 \times 10^{23}}$$

$$= 17.93 \times 10^{-23}$$

Mass of unit cell of silver = Atoms in unit cell × Mass of 1 atom

$$= 4 \times 17.93 \times 10^{-23}$$

$$= 71.72 \times 10^{-23}$$

$$\therefore \text{Density of Ag} = \frac{\text{mass of unit cell}}{\text{Vol.of unit cell}}$$

$$\therefore \text{Vol of unit cell} = \frac{\text{mass of unit cell}}{\text{density of Ag}}$$

$$= \frac{71.72 \times 10^{-23}}{10.51}$$

col.of.unit cell = 68.24×10^{-23} cm^3

Question 2.2: The vapour pressure of pure benzene is 640mm og Hg. 2.175×10^{-3}kg of non-vloatile solute is added to 39 gram of benzene the vapour pressure of solution is 600mm of HG. Calculate molar mass of solute. **[3]**

[C = 12, H = 1]

Solution: Molar mass of benzene C_6H_6 = $(6 \times 12 + 6 \times 1) \times 10^{-3}$ kg mol^{-1}

p_1^0 = 640mm Hg, p = 600mm Hg

$W_1 = 39 \times 10^{-3}$ kg

$W_2 = 2.175 \times 10^{-3}$ kg mol^{-1}

$M_1 = 78 \times 10^{-3}$ kg mol^{-1}

M_2 = ?

$$\frac{p_1^0 - p}{p_1^0} = \frac{W_2}{M_2}\frac{M_1}{W_1}$$

$$\frac{640mm - 600mm}{640mm} = \frac{2.175 \times 10^{-3}\text{kg} \times 78.0 \times 10^{-3}\text{kg mol}^{-1}}{39.0 \times 10^{-3}\text{kg} \times M_2}$$

$$M_2 = \frac{2.175 \times 10^{-3}\text{kg} \times 78.0 \times 10^{-3}\text{kg mol}^{-1} \times 640\text{mm}}{39.0 \times 10^{-3}\text{kg} \times 40\text{mm}}$$

$$M_2 = 69.6 \times 10^{-3}\text{kg mol}^{-1}$$

$$\text{Molecular mass} = 69.6\text{g mol}^{-1}$$

Question 2.3: Calculate C-Cl bond enthalpy from following reaction: **[3]**

$CH_3Cl_{(g)} + Cl_{2(g)} \rightarrow Ch_2Cl_{2(g)} + HCl_{(g)}$ $\Delta H° = -104$KJ
If C-H, Cl-Cl and H-Cl bond enthalpies are 414, 243 and 431 KJ-Mol^{-1} respectively.

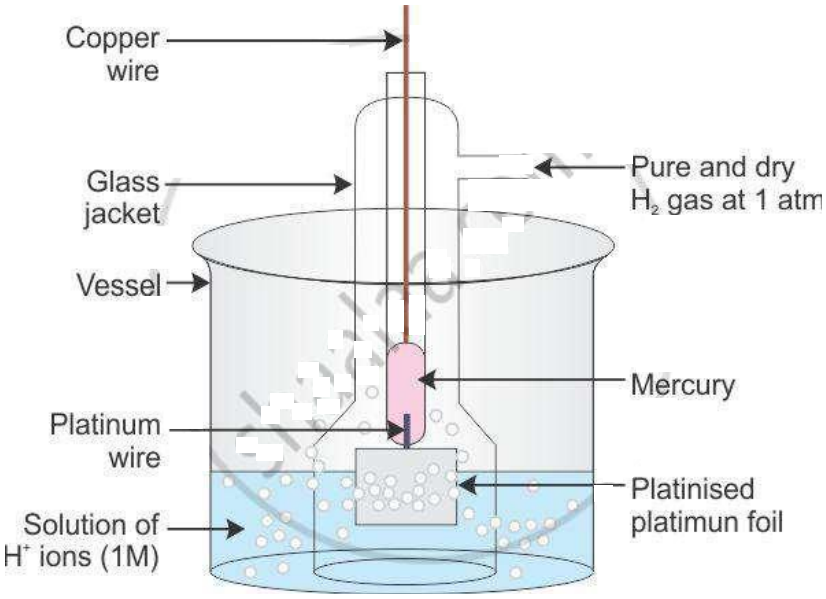
Solution: $CH_3Cl_{(g)}+Cl_{2(g)} \rightarrow CH_2Cl_{2(g)}HCl_{(g)}$
C—H =414 kJ /mol
Cl—Cl =243 kJ /mol
H—Cl =431 kJ /mol
$\Delta H°$ =-104 kJ
$\Delta H° = \sum\Delta H°$ (reactant bond) $-\sum\Delta H°$ (product bond)
=[3*$\Delta H°$(C-H)+$\Delta H°$ (C-Cl)+$\Delta H°$ (Cl-Cl)] - [2 H (C H) 2 H (C Cl) H (H Cl)]
=[3*414+$\Delta H°$(C-Cl)+243] - [2*414+2*$\Delta H°$ (C-Cl)+431]
-104 = 1242+$\Delta H°$ (C-Cl)+243-828-2*$\Delta H°$ (C-Cl) 431
$\Delta H°$ (C-Cl) = 330 kJ

Question 2.4.i: Define cell constant. **[3]**

Solution: Cell constant is the ratio of the distance between the electrodes divided by the area of cross-section of the electrode. It is denoted by b.
Thus, Cell constant = b = l/a. It is expressed in unit m^{-1}.

Question 2.4.ii: Draw a neat and well labelled diagram of primary reference electrode. **[3]**

Solution:

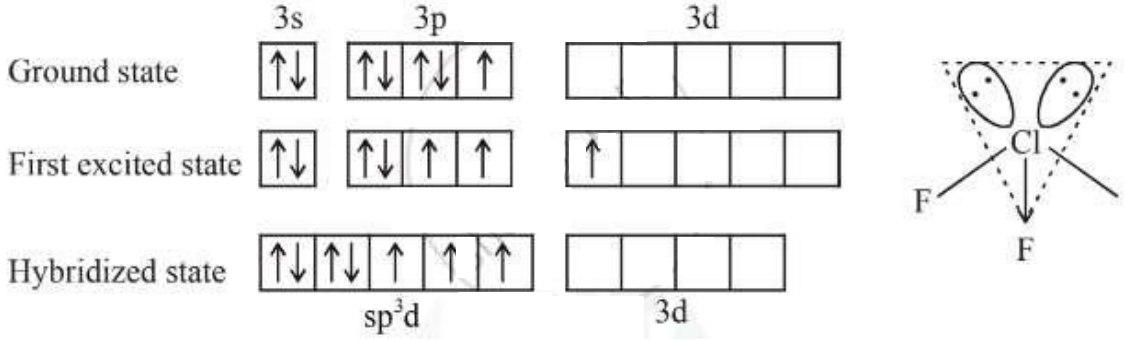


Question 3.1.1: Write four points of differences between properties of nitrogen and other elements of group 15. **[2]**

Solution: Differences between properties of nitrogen and other elements of group 15:
(i) Nitrogen molecule is diatomic, whereas other elements form tetratomic molecules.
(ii) Catenation property is more pronouncedly shown by nitrogen than the other elements of group 15.
(iii) Nitrogen is in the gaseous state, while the others are in the solid state at room temperature.
(iv) Hydride of nitrogen is stable, while the hydrides of other elements are not stable.

Question 3.1.2: Explain the structure of ClF_3 **[2]**

Solution: Structure of ClF_3 :
Interhalogen ClF_3 possess T-shaped or trigonal bipyramidal structure. It is formed by sp^3d hybridization of the central atom Cl in its first excited state.



Question 3.1.3: Conductivity of a solution is 6.23×10^{-5} $\Omega^{-1}cm^{-1}$ and its resistance is 13710Ω. If the electrodes are 0.7cm apart, calculate the cross-sectional area of electrode. **[3]**

Solution:

ross-sectional area of electrode:

$$k = \frac{1}{R} \cdot \frac{l}{a}$$

$$a = \frac{1}{R} \cdot \frac{l}{k}$$

$$a = \frac{1}{13710} \cdot \frac{0.7}{6.23 \cdot 10^{-5}}$$

$$a = 0.82 cm^2$$

Question 3.1.4: Why is molality of a solution independent of temperature? **[1]**

Solution: Molality:
Molality is amount of solute per mass of solvent. So, the concentration of solvent is expressed in terms of mass, and the mass of a substance is not affected by the change in temperature. Hence, molality is independent of temperature.

Question 3.2.1: What are neutral oxides? **[1]**

Solution: Neutral oxides:
These are the oxides which show neither basic nor acidic properties, i.e. they are non-metal oxides which do not react with acids or bases.

Question 3.2.2: Explain the nature of zinc oxide with the help of the reactions. **[2]**

Solution: Zinc oxide is an amphoteric oxide which shows both basic and acidic properties.

$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$ (basic nature)
Zinc chloride

$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$ (acidic nature)
Sodium zincate

Question 3.2.3: Define "Molar conductivity". **[1]**

Solution: Molar conductivity:
Molar conductivity is the conductance of a volume of solution containing 1 mole of dissolved electrolyte when placed between two parallel electrodes 1 cm apart and large enough to contain between them all the solution.

Question 3.2.4: Define "zero order reaction". **[1]**

Solution: Zero order reaction:
Zero order reaction is the reaction whose rate is independent of the reactant concentration and remains constant throughout the course of the reaction.

Question 3.2.5: In a first order reaction x → y, 40% of the given sample of compound remains unreacted in 45 minutes. Calculate rate constant of the reaction. **[2]**

Solution:

$$k = \frac{2.303}{t} \log_{10} \frac{[A]_o}{[A]_t}$$

$$k = \frac{2.303}{t} \log_{10} \frac{100}{40}$$

$$k = \frac{2.303}{45} \log_{10} \frac{100}{40}$$

$$k = \frac{2.303}{45} \log_{10} 2.5$$

$$k = \frac{2.303}{45} \cdot 0.3979$$

$$k = 0.0204 \text{min}^{-1}$$

Question 4: Select and write the most appropriate answer from the given alternatives for each sub-question **[7]**

Question 4.1: The molecular formula $H_2S_2O_2$ represents which oxoacid? **[1]**

- Hydrosulphurous acid
- Thiosulphurous acid
- Sulphuric acid
- Pyrosulphurous acid

Solution: Thiosulphurous acid

Thiosulphurous acid has chemical formula $H_2S_2O_2$

Question 4.2: Iodine exists as **[1]**

- polar molecular solid
- ionic solid
- nonpolar molecular solid
- hydrogen bonded molecular solid

Solution: Non-polar molecular solid
In case of iodine, the atoms are held together by weak London forces or van der Waal forces, so it exists as a non-polar molecular solid.

Question 4.3: Absolute entropies of solids, liquids and gases can be determined by **[1]**

- Measuring heat capacity of substance at various temperatures
- Subtracting standard entropy of reactants from products
- Measuring vibrational motion of molecules
- Using formula $\Delta S° = S_T° - S_O°$

Solution: Measuring heat capacity of substance at various temperatures.

The value of S_T can be determined by measuring heat capacity of the solid at various temperatures and using the expression

$$\Delta S = S_T - S_0 = S_T = \int_0^T \frac{Cp.dT}{T}$$

Question 4.4: The determination of molar mass from elevation in boiling point is called as **[1]**

- cryoscopy
- colorimetry
- ebullioscopy
- spectroscopy

Solution: ebullioscopy

Determination of molar mass from elevation in boiling point is called ebullioscopy.

Question 4.5: The process of leaching alumina, using sodium carbonate is called **[1]**

- Bayer's process
- Decomposition
- Cyanide process
- Hall's process

Solution: Hall's process
In Hall's process, the ore and sodium carbonate are fused to convert aluminium oxide into soluble sodium meta aluminate.

Question 4.6: On calculating the strength of current in amperes if a charge of 840C (coulomb) passes through an electrolyte in 7 minutes, it will be **[1]**

- 1
- 2
- 3
- 4

Solution: type 1

A = C/s

∴ A = 840/(7 × 60)

∴ A = 840/420

∴ A = 2

type 2

2
Q =I × t

840= I × 420
I =2 A

Question 4.7: A → B is a first order reaction with rate $6.6 \times 10^{-5} m\text{-}s^{-1}$. When [A] is 0.6m, rate constant of the reaction is **[1]**

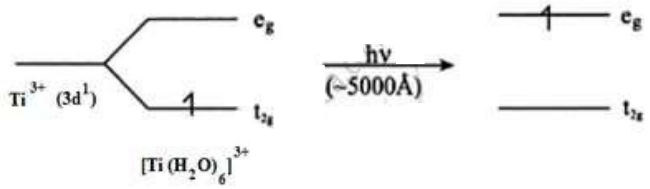
- $1.1 \times 10^{-5} s^{-1}$
- $1.1 \times 10^{-4} s^{-1}$
- $9 \times 10^{-5} s^{-1}$
- $9 \times 10^{-4} s^{-1}$

Solution: $1.1 \times 10^{-4}\ s^{-1}$
Rate law for the reaction,
Rate =k [A]
6.6×10^{-5} =k × 0.6
k 1.1×10^{-4}

Question 5: Answer any SIX of the following [12]

Question 5.1: Why is Sc^{3+} colourless while Ti^{3+} coloured? (Atomic number Sc = 21, Ti =22) **[2]**

Solution: Ti^{3+} is a $3d^1$ system. The colour is due to d–d transition. There is one d electron present in the 3d subshell. When light falls on the Ti^{3+} complex, the t_{2g} electron is excited to the eg level. This excitation takes place in the greenish yellow region (≈5000 A°) and the rest is transmitted. The complementary colour is transmitted which is violet.



Sc^{3+} is a $3d^0$ system. There are no d electrons; hence, d–d transition is not possible. Hence, Sc^{3+} is colourless.

Question 5.2: Illustrate with example, the difference between a double salt and a co-ordination compound **[2]**

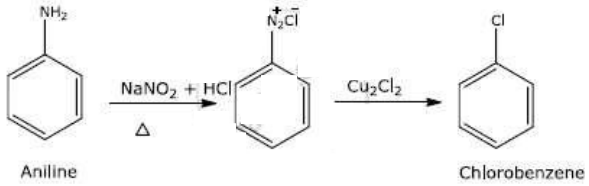
Solution:

Double salt	Complex compound
They contain two simple salt in equimolar proportion.	They contain a complex of salt which may or may not be in equimolar proportion.
In aqueous solution, they dissociate completely into ions.	In aqueous solution complex ion does not dissociation into ions.
They are ionic compound and contain ionic bonds.	They may or may not be ionic complex part always contains coordinate bonds.

Properties of the salt is same as its constituent compounds.	The properties of the compound are different from its constituents due to complex formation.
Example : Potash alum $K_2SO_4.Al_2SO_3.24H_2O$	**Example :** Potassium hexachloroplatinate (IV) $K_2[PtCl_6]$.

Question 5.3.i: How is chlorobenzene prepared from aniline? **[2]**

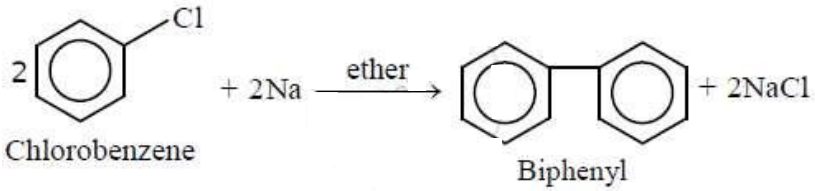
Solution: Aniline reacts with nitrous acid to give benzene diazonium chloride which on treatment with cuprous chloride gives chlorobenzene



Question 5.3.ii:

How is chlorobenzene converted into diphenyl/biphenyl?

Solution:



Question 5.4.i: What is metamerism? **[2]**

Solution 1: The ethers with the same molecular formula but different alkyl groups attached on either side of the oxygen atom are called metamers of each other, and the phenomenon is called metamerism

Solution 2: Metamerism (positional isomerism): Ethers having same molecular formula but different alkyl groups attached on either side of the oxygen atom are called metamers of each other. This phenomenon is called metamerism (positional isomerism).

Question 5.4.ii: Explain metamerism with suitable examples of ethers

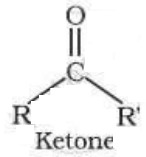
Solution: The property in which ethers have same molecular formula but different alkyl groups in their structures is called metamerism and the isomers obtained are called as metamers.

Examples :
e.g. C_2H_5 - O - C_2H_5 - Diethyl ether;
CH_3 - O - C_3H_7 - Methyl n-propyl ether

In the above example both ethers are having same molecular formula i.e. C_4H_{10} but different alkyl groups in their structure, so they are metamers of each other.

Question 5.5.i: What are ketones? **[2]**

Solution: Ketones are the organic compounds in which the carbonyl group is attached to two alkyl groups or aryl groups or both alkyl and aryl groups.
General formula:



R, R' may be an alkyl or aryl group.

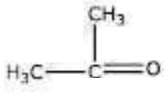
Question 5.5.ii:

How are ketones classified?

Solution: On the basis of types of alkyl groups attached to the carbonyl carbon, ketones are classified as

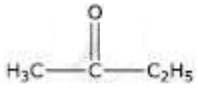
Simple or symmetrical ketones: The ketones in which both alkyl groups attached to the carbonyl carbon are identical are called simple ketones (R =R').

Example:



Acetone

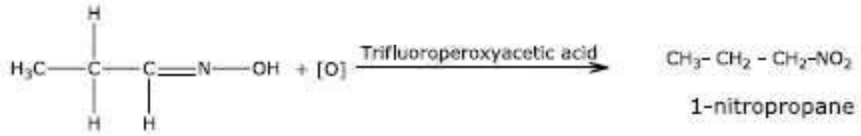
Mixed or unsymmetrical ketones: The ketones in which the two alkyl groups attached to the carbonyl carbon are different are called mixed ketones (R ≠ R').



Ethyl methyl ketone

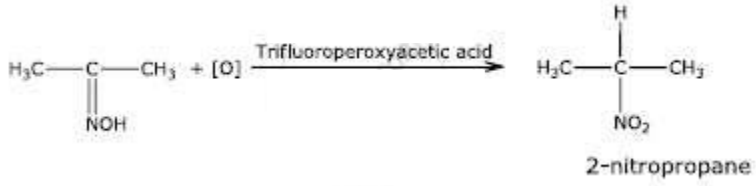
Question 5.6.i: How is 1-nitropropane prepared from suitable oxime? **[2]**

Solution: 1-nitropropane and 2-nitropropane are prepared by oxidising propionaldehyde oxime and propan-2-one oxime with the help of trifluoroacetic acid.



Question 5.6.ii: How are 2 - nitropropane prepared from suitable oxime?

Solution: 1-nitropropane and 2-nitropropane are prepared by oxidising propionaldehyde oxime and propan-2-one oxime with the help of trifluoroacetic acid.



Question 5.7.i: Define antioxidants? **[2]**

Solution 1: Antioxidant is a substance which when added to food retards or prevents the oxidative deterioration of food.

Examples:
BHA, BHT

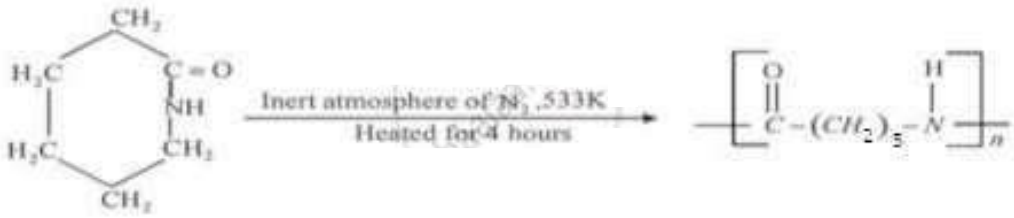
Solution 2: Antioxidant: is a substance which when added to food, retards or prevents oxidative deterioration of food. Fats and oils are oxidized easily, turn rancid and becomes unpalatable.

Question 5.8.i: Define carbohydrates. **[2]**

Solution: Carbohydrates are optically active polyhydroxy aldehydes or polyhydroxy ketones or the compounds which can be hydrolysed to polyhydroxy aldehydes or polyhydroxy ketones.

Question 5.8.ii: Write the reaction for the preparation of Nylon-6.

Solution: Nylon-6: It is obtained by heating caprolactam with water at a high temperature.



Question 6: Answer any THREE of the following **[9]**

Question 6.1.i: What are f-block elements? **[3]**

Solution: The elements in which the differentiating electron (last electron) enters (n-2) f orbital are known as f-block elements. The differentiating electron enters the pre-penultimate shell. The f-block elements are the lanthanides and actinides and are also called inner transition elements. All 28 elements from atomic numbers 58 to 71 and from atomic numbers 90 to 103 are collectively called f-block elements.

Question 6.1.ii: Distinguish between lanthanoid and actinoids.

Solution:

Lanthanoids	Actinoids
Differentiating electron enters 4f orbitals	Differentiating electron enters 5f orbitals
Belong to the sixth period and form part of the third transition series. They constitute the first inner transition series.	Belong to the seventh period and form part of the fourth transition series. They constitute the second inner transition series.
Binding energy of 4f orbitals is higher.	Binding energy of 5f orbitals is lower.
Besides the +3 oxidation state, lanthanoids show +2 and + 4 oxidation states in few cases.	Besides the +3 oxidation state, actinoids show higher oxidation states such as +4, +5 and +7.
They show lesser tendency to form complexes.	They show greater tendency to form complexes.
Some of the lanthanoids are fairly coloured.	Most of the ions of actinoids are deeply coloured. Examples: U3+ (red), U4+ (green)
Only promethium is radioactive.	All the members of this series are radioactive.

Question 6.2.1: Explain Optical activity **[1]**

Solution: Optical activity:
Optical activity is the property of certain organic substances to rotate the plane of plane polarised light towards the right (clockwise) or towards the left (anticlockwise).

Question 6.2.2: Explain Ligand **[1]**

Solution 1: Ligands:
Ligands are ions or neutral molecules which bind to a central metal atom or ion. They act as Lewis bases (electron pair donors). They have at least one donor atom with an electron pair used to form covalent bonds with the central atom.

Solution 2: Ligands:
The molecules or ions which are coordinated to the central atom or ion in the coordination compound are called ligands or donor groups.

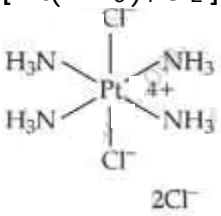
Question 6.2.3: What are interstitial compounds? **[1]**

Solution 1: Interstitial compounds :
Interstitial compounds are formed when small atoms such as H, C or N are trapped inside the crystal lattices of metals. They are usually nonstoichiometric and are neither typically ionic nor covalent.

Solution 2: (a) Interstitial compounds are those which are formed when small atoms like H, C, N, B etc. are trapped inside the crystal lattice of metals.
(b) They have melting point higher than metals due to stronger metal-non metal bonds or compared to metal-metal bonds in pure metals.

Question 6.3: Write the formula of Tetraminodichloroplatinum (IV) chloridex. **[3]**

Solution: The formula of tetraminodichloroplatinum (IV)chloride is
$[\ Pt(\ NH_3\ )_4\ Cl_2\ ]\ Cl_2$



Question 6.4.i: Define Broad-spectrum antibiotics with a suitable example? **[3]**

Solution 1: The antibiotics which are effective against a wide range of gram-positive and gram-negative bacteria are known as broad spectrum antibiotics.
Examples: Chloramphenicol, ampicillin, amoxicillin

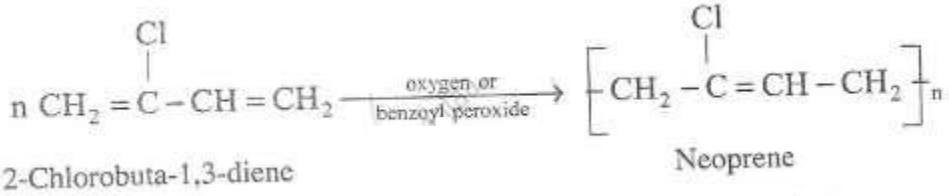
Solution 2: Limited spectrum antibiotics: Antibiotics which are effective against a single organism or disease are called limited-spectrum antibiotics

Question 6.4.ii: How are polythene and neoprene prepared?

Solution: The antibiotic which is effective against a wide range of gram positive and gram negative bacteria known as broad spectrum antibiotic.
Preparating polyethene : The monomer used is ethene. It is an addition polymer. It is of two types.

$$n\,CH_2 = CH_2 \xrightarrow{\Delta} [-CH_2 - CH_2^{-}]_n$$

Preparating of Neoprne : The monomer used is chloroprene (2-chlorobuta-1,3-diene). It is superior to natural rubber and resistant to chemical action. It is used in the manufacture of chemical containers, conveyor belts, gaskets etc.



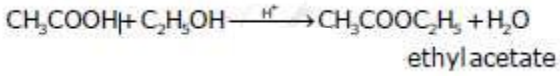
2-Chlorobuta-1,3-diene

Neoprene

Question 7: Answer any ONE of the following : **[7]**

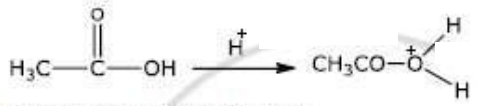
Question 7.1.i: Explain the mechanism of esterification **[7]**

Solution: Carboxylic acid reacts with alcohols in the presence of mineral acid as a catalyst and forms esters. This reaction is called esterification.
Consider the following reaction for the preparation of ethyl acetate from ethanoic acid.

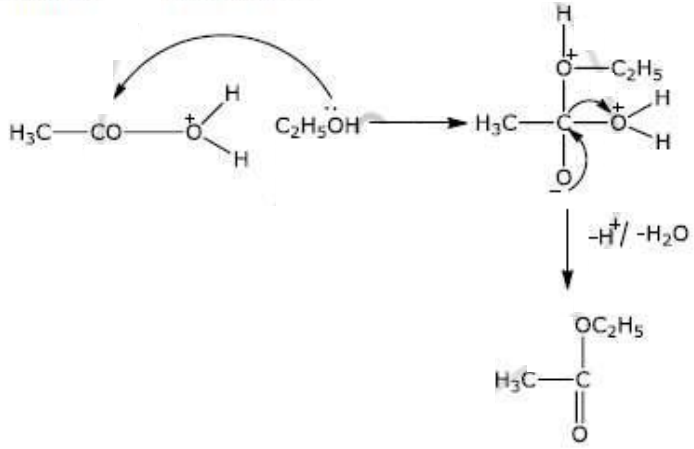


The mechanism involved in the above esterification reaction can be explained as follows:
Protonation of the –OH group of the acid enhances the nucleophilic attack by alcohol to give the ester.

Step 1: Protonation of carboxylic acid



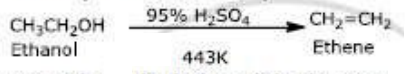
Step 2: Attack by nucleophile



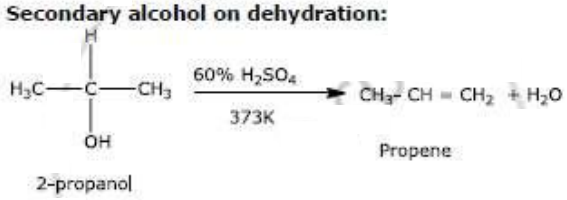
Question 7.1.ii: Write the reactions involved in dehydration of 1°, 2° and 3° alcohols.

Solution:

Primary alcohol on dehydration:

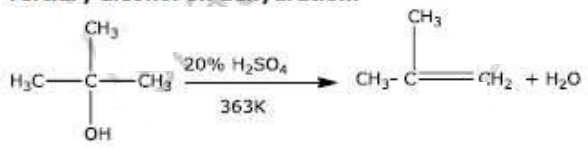


Secondary alcohol on dehydration:



2-propanol

Tertiary alcohol on dehydration:



2-methylpropan-2-ol 2-methylpropene

Question 7.2.i: What are vitamins? **[7]**

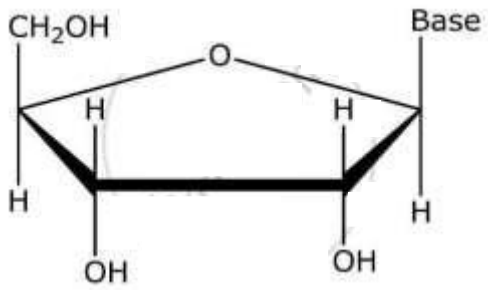
Solution: Vitamins are organic substances which must be supplied to permit growth in living beings or for the maintenance of structure.

Question 7.2.ii: Name any two diseases caused by deficiency of Vitamin A

Solution: Diseases caused by deficiency of Vitamin A are night blindness and dryness of skin and hair.

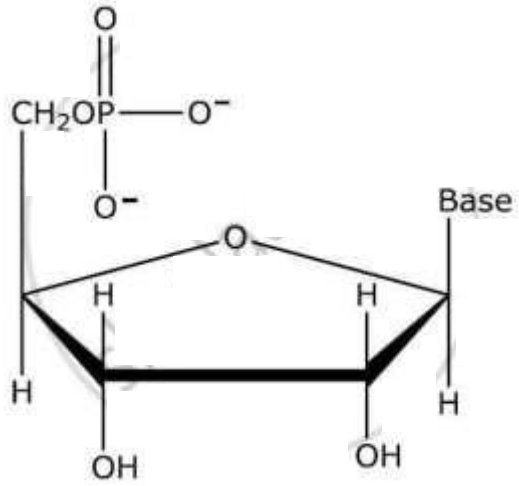
Question 7.2.iii: Write the structure of a nucleoside

Solution:



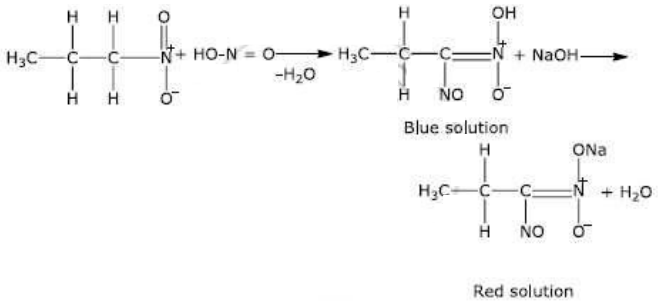
Question 7.2.iv: Write the structure of a nucleotide

Solution:

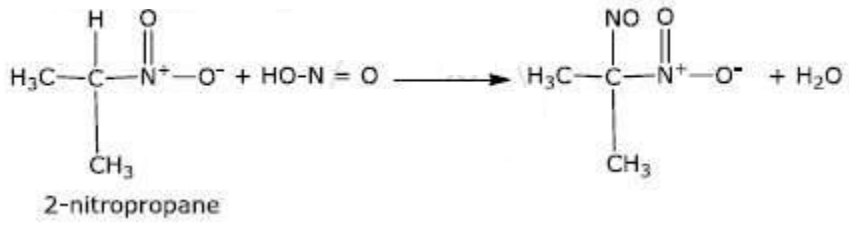


Question 7.2.v: How are 1 - nitropropane, 2-nitropropane and 2-methyl 2- nitropropane are distinguished from each other using nitrous acid?

Solution: 1-Nitropropane reacts with nitrous acid to form blue-coloured nitro so nitro alkanes which dissolve in NaOH to give red solution.



2-Nitropropane reacts with nitrous acid to form blue-coloured nitro so nitro alkanes which are further insoluble in NaOH because of the absence of the alpha hydrogen atom.



2-Methyl2-nitropropane does not react with nitrous acid because it has no alpha-hydrogen atom.

Question 8: Select and write the most appropriate answers from the given alternatives [7]

Question 8.1: The preparation of alkyl fluoride from alkyl chloride, in presence of metallic fluorides is known as _____. **[1]**

Williamson's reaction
Finkelstein reaction
Swarts reaction
Wurtz reaction

Solution: Swarts reaction
Preparation of alkyl fluorides from alkyl chlorides or bromides in presence of metallic fluorides like AgF, Hg_2F_2 reaction is known as Swarts reaction.
R - X + AgF → R - F + AgX

Question 8.2: Identify the weakest acidic compound amongst the following **[1]**

(a) p-nitrophenol
(b) p-chlorophenol
(c) p-cresol
(d) p-raminophenol

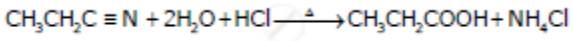
Solution:

(d) p-Aminophenol
Electron-withdrawing substituents make the phenol more acidic, while electron-releasing substituents make the phenol less acidic. p-amino phenol < p-cresol < p-chloro phenol < p-nitro phenol

Question 8.3: On acid hydrolysis, propane nitrile gives **[1]**

(a) propanal
(b) acetic acid
(c) propionamide
(d) propanoic acid

Solution: (d) Propanoic acid



Question 8.4: Which of the following amines yields foul smelling product with holoform and alcoholic KOH? **[1]**

(a) Ethyl amine
(b) Diethyl amine
(c) Triethyi amine
(d) Ethyl methyl amine

Solution: (a) Ethyl amine
Ethyl amine on heating with chloroform and alcoholic KOH gives foul smelling ethyl isocyanide.

Question 8.5: Which of the following NOT present in DNA? **[1]**

(a) adenine
(b) Guanine
(c) Thymine
(d) Uracil

Solution: (d) Uracil
The heterocyclic bases in DNA are adenine, guanine, cytosine and thymine.

Question 8.6: Amongst the followings, identify a copolymer? **[1]**

(a) Orion
(b) PVC
(c) PHBV
(d) Teflon

Solution: (c) PHBV
It is a copolymer and the monomers used are 3-hydroxy butanoic acid and 3-hydroxy pentanoic acid

Question 8.7: Phenelzine is used as an **[1]**

(a) analgesic
(b) antiseptic
(c) antipyretic
(d) antidepressant

Solution: (d) Antidepressant
Phenelzine is used as an antidepressant