

Solid state

5 MARKS QUESTION

- Q1.i. What is photovoltaic cell?
ii. What do you mean by the term Doping?
iii. What the term 12 – 16 compounds stand for?
iv. What is the number of tetrahedral voids in a ccp structure of solid?
v. Crystalline solids are anisotropic in nature. Comment on this statement.

Ans: 1 device which converts sunlight into electrical energy.
2 Introduction of defects in solid by incorporating foreign particles.
3 compounds formed by combination of group 12 elements and group 16 elements e.g ZnS
4 2N or 8
5 A single property differs in different direction in solids.

- Q 2. i. What is the percentage efficiency of a solid whose particles are having ccp structure?
ii. LiCl crystal appears to be pink in colour .Why?
iii. When Ge is doped with slight amount of In, what type of semiconductor will be formed?
iv. Metal deficiency defect with extra anions in interstitial sites can't be produced in solids. Why?
v. The electrical conductivity of semiconductors increases with increase in temperature but in case of metals conductivity decreases with rise in temp. Why?

ANS: i. 74%
ii. Presence of F – centre .
iii. p – type semiconductor
iv. Usually anions are larger in size and hence do not fit into interstitial sites
v. kernels makes vibration and creates obstacles in the motion of electrons in case of metals.

Solid State 5 Marks

1. Explain the following with suitable examples:

- (i) Ferromagnetism
- (ii) Paramagnetism
- (iii) Ferrimagnetism
- (iv) Antiferromagnetism
- (v) 12-16 and 13-15 group compounds.

Answer.

(i) 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

(ii) Paramagnetism: The substances that are attracted by a magnetic field are called paramagnetic substances. Some examples of paramagnetic substances are O_2 , Cu^{2+} , Fe^{3+} , and Cr^{3+} .

Paramagnetic substances get magnetised in a magnetic field in the same direction, but lose magnetism when the magnetic field is removed. To undergo paramagnetism, a substance must have one or more unpaired electrons. This is because the unpaired electrons are attracted by a magnetic field, thereby causing paramagnetism.

(iii) Ferrimagnetism: The substances in which the magnetic moments of the domains are aligned in parallel and anti-parallel directions, in unequal numbers, are said to have ferrimagnetism.

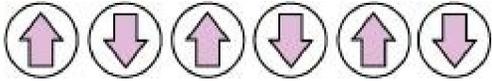
Examples include Fe_3O_4 (magnetite), ferrites such as MgFe_2O_4 and ZnFe_2O_4 .

Ferrimagnetic substances are weakly attracted by a magnetic field as compared to ferromagnetic substances. On heating, these substances become paramagnetic.



Schematic alignment of magnetic moments in ferrimagnetic substances

(iv) Antiferromagnetism: Antiferromagnetic substances have domain structures similar to ferromagnetic substances, but are oppositely-oriented. The oppositely-oriented domains cancel out each other's magnetic moments.



Schematic alignment of magnetic moments in antiferromagnetic substances

(v) 12-16 and 13-15 group compounds: The 12-16 group compounds are prepared by combining group 12 and group 16 elements and the 13-15 group compounds are prepared by combining group 13 and group 15 elements. These compounds are prepared to stimulate average valence of four as in Ge or Si. Indium (III) antimonide (IrSb), aluminium phosphide (AlP), and gallium arsenide (GaAs) are typical compounds of groups 13-15. GaAs semiconductors have a very fast response time and have revolutionised the designing of semiconductor devices. Examples of group 12-16 compounds include zinc sulphide (ZnS), cadmium sulphide (CdS), cadmium selenide (CdSe), and mercury (II) telluride (HgTe). The bonds in these compounds are not perfectly covalent. The ionic character of the bonds depends on the electronegativities of the two elements.

2. Explain the following terms with suitable examples:

(i) Schottky defect

(ii) Frenkel defect

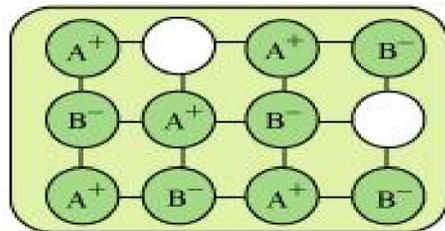
(iii) Interstitials and

(iv) F-centres

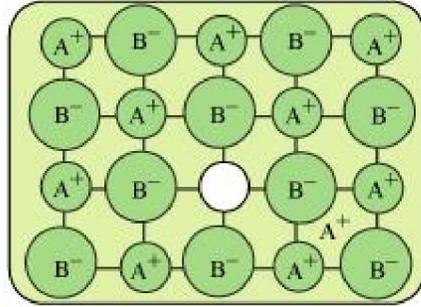
(v) Doping

Ans.

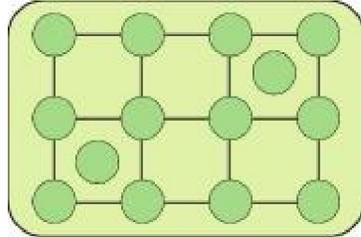
(i) Schottky defect: Schottky defect is basically a vacancy defect shown by ionic solids. In this defect, an equal number of cations and anions are missing to maintain electrical neutrality. It decreases the density of a substance. Significant number of Schottky defects is present in ionic solids. For example, in NaCl, there are approximately 10^6 Schottky pairs per cm^3 at room temperature. Ionic substances containing similar-sized cations and anions show this type of defect. For example: NaCl, KCl, CsCl, AgBr, etc.



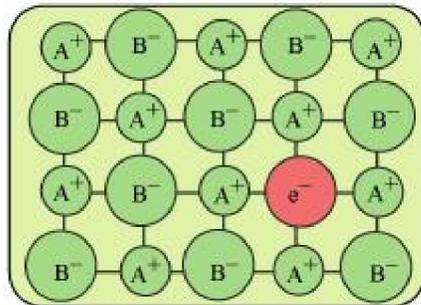
(ii) Frenkel defect: Ionic solids containing large differences in the sizes of ions show this type of defect. When the smaller ion (usually cation) is dislocated from its normal site to an interstitial site, Frenkel defect is created. It creates a vacancy defect as well as an interstitial defect. Frenkel defect is also known as dislocation defect. Ionic solids such as AgCl, AgBr, AgI, and ZnS show this type of defect.



(iii) Interstitials: Interstitial defect is shown by non-ionic solids. This type of defect is created when some constituent particles (atoms or molecules) occupy an interstitial site of the crystal. The density of a substance increases because of this defect.



(iv) F-centres: When the anionic sites of a crystal are occupied by unpaired electrons, the ionic sites are called F-centres. These unpaired electrons impart colour to the crystals. For example, when crystals of NaCl are heated in an atmosphere of sodium vapour, the sodium atoms are deposited on the surface of the crystal. The Cl ions diffuse from the crystal to its surface and combine with Na atoms, forming NaCl. During this process, the Na atoms on the surface of the crystal lose electrons. These released electrons diffuse into the crystal and occupy the vacant anionic sites, creating F-centres.



(V) Addition of suitable impurities to a semiconductor to enhance its conductivity.
Eg.- Ge doped with B

3. (A) Explain why?

(i) Conductivity of metals decreases with increase in temperature.

(ii) Conductivity of semiconductors increases with increase in temperature.

(B) Ferric oxide crystallises in a hexagonal close-packed array of oxide ions with two out of every three octahedral holes occupied by ferric ions. Derive the formula of the ferric oxide.

[Answer](#)

(i) The conductivity of metals is due to the migration of free mobile electrons under the influence of applied potential difference. This migration of electrons is hindered to some extent by the lattice vibrations. At low temperature, lattice vibrations are quite insignificant, and as such metals are excellent electric conductors at low temperature. But with the rise of temperature lattice vibrations increase due to thermal energy and as such migration of electrons is hindered.

Therefore, electrical conductivity of metals decreases with rise in temperature.

(ii) Electrons and holes produced by the ionisation or defects contribute to the electronic conduction of semiconductors. Unlike metals, the conductivity of semiconductors increases with increase in temperature. This can be explained as follows. In semiconductors electrons are bound rather tightly to local centres at room temperature. When temperature is raised these electrons are freed and are now able to move through the crystal. The higher the temperature, the greater the number of electrons freed. Due to greater number of free electrons the conductivity increases even though lattice vibrations offer more resistance at the higher temperature.

(B) Let the number of oxide (O^{2-}) ions be x .

So, number of octahedral voids = x

It is given that two out of every three octahedral holes are occupied by ferric ions.

So, number of ferric (Fe^{3+}) ions = $\frac{2}{3}x$

Therefore, ratio of the number of Fe^{3+} ions to the number of O^{2-} ions,

$$Fe^{3+} : O^{2-} = \frac{2}{3}x : x$$

$$= \frac{2}{3} : 1$$

$$= 2 : 3$$

Hence, the formula of the ferric oxide is Fe_2O_3 .

4. (A) In the mineral spinel; having the formula $MgAl_2O_4$. The oxide ions are arranged in CCP, Mg^{2+} ions occupy the tetrahedral voids. While Al^{3+} ions occupy the octahedral voids.

(i) What percentage of tetrahedral voids is occupied by Mg^{2+} ions ?

(ii) What percentage of octahedral voids is occupied by Al^{3+} ions ?

(B) A metal crystallises into two cubic phases, fcc and bcc, whose unit lengths are 3.5 \AA and 3.0 \AA respectively. Calculate the ratio of the densities of fcc and bcc.

5. (A) What is the difference between Schottky and Frankel defect?

(B) Gold (atomic radius = 0.144 nm) crystallises in a face-centred unit cell. What is the length of a side of the cell?

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Solid State
CLASS - XII
Sub.-Chemistry

Q.1:- Give reason for -

- (i) Why Solids are rigid ?
- (ii) Why glass is considered a super cooled liquid ?
- (iii) Ionic solids conduct electricity in molten state but not in solid state, why ?
- (iv) Ionic solids are hard and brittle, why ?
- (v) LiCl becomes pink when heated in Lithium vapour.

Ans= 1) Because atoms are tightly packed in solid, and bind by strong force of attraction.
2) Because after long time glass pane becomes thicker at bottom.
3) Because ionic solid produces ions in molten state.
4) Because they are bound by strong force of attraction of cation and anion.
5) Due to F centre.

Q.2:- Define with example -

- (i) Paramagnetic substances
- (ii) Diamagnetic substance
- (iii) Curie temperature
- (iv) Intrinsic semiconductors
- (v) Anti ferromagnetic substances.

Ans= 1) Paramagnetic substances – They are attracted by magnetic field but lose their magnetism in the absence of electric field. They are called paramagnetic substances.
Eg O₂, Cr³⁺
2) Diamagnetic substances – They are repelled by the magnetic field. eg. Zn
3) A temperature at which a ferromagnetic substance loses its ferromagnetism and attains paramagnetism is called Curie temperature.
4) An intrinsic semiconductor is an insulator but conducts electricity as temperature increases. eg. pure silicon
5) The substances like MnO their domains are oppositely oriented and cancel their magnetic moments.

Q.3:- (a) Copper crystallizes into a fcc lattice with edge length 3.61×10^{-8} cm. Show that calculated density is in agreement with its measured value of 8.92 g cm^{-3} .

Ans (a) $d = \frac{z \times M}{a^3 \times N_0}$
 $= 8.97 \text{ g cm}^{-3}$

Q3 (b) Analysis shows that nickel oxide has formula Ni_{0.98}O_{1.00}. What fractions of the nickel exist as Ni²⁺ and Ni³⁺ ions?

Ans (b) Fractions Ni^{2+} and Ni^{3+} ions are 96% and 4% respectively.

Q.4:- (a) In term of band theory differentiate conductors, semiconductors and insulators.

Conductors	semiconductors	insulators.
There is small gap b/w valence band and conduction band.	There is always a very small gap b/w valence band and conduction band .Some electrons by acquiring extra thermal energy jump to the conduction band.	There is a large gap b/w valence band and conduction band.

(b) Gold crystallies in a fcc. What is the length of edge(a) of the cell?(atomic radius=0.144nm)

Ans $a = 2\sqrt{2} \times \text{radius of atom}$
 $= 2 \times 1.414 \times 0.144$
 $= 0.407 \text{ nm.}$

Q.5:- Answer the following -

- (i) Crystalline solids are anisotropic in nature ? What does this mean explain.
 - (ii) Schottky defect lowers the density of solid, why ?
 - (iii) What are super cooled liquids ?
 - (iv) What are points defects ?
 - (v) Define covalent solid, Give example.
- 1) Ans= Because they have different physical properties in different directions
 - 2) Ans= Because mass deceases so density decreases.
 - 3) Super cooled liquids are psudo solids.eg glass.
 - 4) The defect which arises due to irregularity of atms are called points defects.
 - 5) Solids which are formed by covalent bonds are called covalent solids. Eg graphite and diamonds .

KENDRIYA VIDYALAYA G.C.F.-1

Solid State

CLASS - XII

Sub.-Chemistry

5 Marks questions

KENDRIYA VIDYALAYA G.C.F.-1

Solid State

CLASS - XII

Sub.-Chemistry

4 Marks questions

Value Based Questions -

Q.1:- Raman and Rajan were studying the properties of solids. A solid 'X' showed same physical properties (thermal conductivity and refractive index) in all directions while another solid 'Y' showed different physical properties in different directions. Raman

classified the solid 'X' as crystalline and solid 'Y' as amorphous. Rajan did not agree with Raman's classification. Answer the following questions -

- (i) Whom do you favour, Raman or Rajan and why ?
- (ii) What is the name of the property exhibited by solid 'X' ?
- (iii) Will liquids show behaviour similar to solid 'X' or solid 'Y' ?

Ans (i) Rajan because Y is anisotropic in nature.
(ii) X is isotropic in nature.
(iii) Super cooled liquids behaves as X.

Q.2:- Pure silicon is a poor conductor of electricity because it has a network structure of four strong covalent bonds. The conductivity of pure silicon can be increased by adding an appropriate amount of a suitable impurity and the process is called doping. These produce n-type and p-type semiconductors. The desired conducting power can be achieved by adjusting the proportion and type of impurity. The combination of n-type and p-type semiconductors known as n-p junctions find interesting applications in electronic devices. Answer the following questions -

- (i) When silicon is doped with arsenic, what type of semiconductor is obtained ?
- (ii) What type of semiconductor is obtained when silicon is doped with boron .
- (iii) List any two applications of these types of semiconductors.

Ans (i) n-type semiconductors.
(ii) p-type semiconductors
(iii) Used for making transistor, rectifiers etc.

Q.3:- Diamond and Graphite are two allotropic forms of carbon. Both are covalent solids. These two forms have different structures and hence differ in physical properties. Both have their own importance in being used in everyday life. Diamond is popularly used in jewellery and graphite is extensively used as electrodes in many industrial processes. Answer the following questions -

- (i) Which of two allotropes is a good conductor of electricity.
- (ii) Besides the above uses of diamond and graphite, give one other use of these.
- (iii) Give hybridization state of c in diamond and graphite.

Ans (i) Graphite
(ii) Graphite is used as a lubricant and diamond is used as abrasive.
(iii) Diamond ; sp^3 , graphite ; sp^2 .

SOLUTION

5 MARKS QUESTION

Q.1.(a) explain the following:

1. Henry's law about dissolution of a gas in a liquid. (3)
2. Boiling point elevation constant for a solvent

(b) A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. The solution has a boiling point of $100.42^\circ C$. What mass of glycerol was dissolved to make this solution? (2)

K_b for water = $0.512 K kg mol^{-1}$

(hint: $\Delta T_B = \frac{K_b \cdot w_b \cdot 1000}{M_b \cdot W_a}$)

Ans. 37.73 gm

Q.2 (a) Explain the colligative property depression of freezing point? (2)

(b) 2g of benzoic acid (C_6H_5COOH) dissolved in 25g of benzene shows a depression in freezing point equal to 1.62 K. K_f for benzene is $4.9 K kg mol^{-1}$. What is the percentage association of acid if it forms dimer in solution?

Ans. 99.2%

Q.3 (a) What is osmotic pressure? write its any two applications (3)

(b) Osmotic pressure of a 0.0103 molar solution of an electrolyte is found to be 0.70 atm at $27^\circ C$. Calculate Vant Hoff factor. ($R = 0.082 L atm mol^{-1} K^{-1}$)

Ans. 2.76

Q.4, (a) With the help of diagram: show the elevation in boiling point is a colligative property?

(b) How many grams of KCl should be added to 1 kg of water to lower its freezing point to $-8.0^\circ C$ ($k_f = 1.86 K kg / mol$)

Ans. Since KCl dissociates in water completely $i = 2$

$$\Delta T_f = i k_f \times m = m \frac{\Delta T_f}{i k_f}$$

$$m = \frac{8}{2 \times 1.86} = 2.15 \text{ mol/kg.}$$

$$\text{Grams of KCl} = 2.15 \times 74.5 = 160.2 \text{ g/kg.}$$

Q.5. Write short notes on following

(a) Isotonic solution

(b) Vontt hoff factor

(c) azeotropes

SOLUTION - Question Bank Solutions

5 Marks Questions

1. Answer the following

(a) What are Ideal solutions? Give example.

(b) What are positive and negative deviations? Explain giving one example of each.

Ans: Refer NCERT

2. (a) What are colligative properties?

(b) Explain elevation of boiling point and draw appropriate graph also.

(c) Explain depression in freezing point with the help of graph.

Ans: refer NCERT

3. (a) The temperature at hill station is -10°C . Will it be suitable to add ethylene glycol to water in the radiator solution to get 30% solution by mass. Why?

Ans:

$\Delta T_f = \frac{k_f \times W_B \times 1000}{M_B \times W_A}$	<i>This temperature is lower than desired temperature, hence the solution will not get freeze at this temp. Hence it is suitable for radiator.</i>
$= \frac{1.86 \times 30 \times 1000}{62 \times 70}$	
$\Delta T_f = 12.857^{\circ}\text{C}$	
$T_f = -12.857^{\circ}\text{C}$	

(b) Calculate values of depression in freezing point of the following solutions-

(a) 1 m solution of AB which is 50% ionized

(b) 1 m solution of AB_2 which is 25% ionized

Ans:

$(a) i = 1 - 0.5 + (2 \times 0.5) = 1.5$
$\Delta T_f = i \times k_f \times m = 1.5 \times 1.86 \times 1 = 2.79^{\circ}\text{C}$
$(b) i = 1 - 0.25 + (3 \times 0.25) = 1.5$
$\Delta T_f = 1.5 \times 1.86 \times 1 = 2.79^{\circ}\text{C}$
$M_B = \frac{k_f \times W_B \times 1000}{\Delta T_f \times W_A}$

4. (a) A solution of 3.8 g of sulphur in 100 g of CS_2 (boiling point = 46.31°C), boils at 46.66°C . Predict the molecular formula of sulphur. (K_b for $\text{CS}_2 = 2.34 \text{ K/m}$)

Ans:

$$M_A = \frac{k_b \times W_B \times 1000}{\Delta T_b \times W_A}$$

$$M_A = \frac{0.34 \times 3.8 \times 1000}{0.35 \times 100} = 256$$

$$M_A = 32 \times x = 256$$

$$x = \frac{256}{32} = 8$$

Hence, it is $\boxed{S_8}$

(c) Why does a mixture of alcohol and water show positive deviation? How does the temperature of this mixture differ from its components?

Ans: Refer NCERT

5. (a) A battery contains 38% H_2SO_4 by mass. Van't Hoff factor is 2.5. At what temperature will the battery material freeze? (K_f for water = 1.86 K/m)

Ans:

$$\Delta T_f = \frac{i \times K_f \times W_B \times 1000}{M_B \times W_A}$$

$$= \frac{2.5 \times 1.86 \times 1000}{98 \times 62}$$

$$\Delta T_f = 0.765$$

$$T_f = 0^\circ - 0.765 = \boxed{-0.765^\circ C}$$

(c) what is Van't Hoff factor? What is its importance?

Ans: Refer NCERT

Value Based Questions

1. Bharath went to his grandfather's house in winter this year. As usual he went for fishing. His grandmother told him there will be no fishes in the lake. He noticed that it was more difficult to find fishes in winter. The fishes were deep inside the river. Whereas in summer they were on the surface and hence he was able to catch fishes.

a) Why are fishes on the surface in water than in the depth in summer? (2)

b) What value can be derived from this? (1)

Ans: a) According to Henry's law at low temperature gases are more soluble and hence as more oxygen gets dissolved in water fishes survive better even in depth of the river. In summer as the oxygen is less in water the fishes come to the surface. b) The value that I derive from this is wisdom is superior to knowledge

2. Shubham's father is suffering from high blood pressure. Shubham's mother cooks food with very little salt in it.

a. Why?

b. Doctor did not advise him not to consume salt at all. Why?

c. What value do you get from this?

Ans: a. As salt ionizes the ionic balance is disturbed and the blood pressure rises.

b. Salt acts as a cofactor in enzyme action. Hence some amount of salt is required in our diet.

c. Caring for your kith and kin.

3. Srisha wanted to keep ice creams without melting. So he had to keep it on ice taken in a container. His grandmother advised him to pour salt on the ice.

a. Why?

b. What is the value in this?

Ans: a. Adding salt to ice decreases the melting point of ice. Hence the decrease in temperature of ice.

b. Obey your elders.

4. Sneha's grandmother lives in Simla. In winter there is lot of snow in front of the house. She asked Sneha to clear the snow from the front of the house. Sneha added salt to snow to clear it.

a. Why?

b. What is the value in this?

Ans: a) Adding salt to ice decreases the melting point of snow. The snow melts. Hence snow can be removed.

b) Keep your surroundings clean

5. Swapnesh, living in Ooty, was washing clothes in cold water. He found that the clothes were not getting clean. Geeta, his niece, suggested that he wash the clothes in warm water. Washing of clothes with soaps or detergents is easier in Luke warm water than cold water.

a. Why?

b. What value do you derive from this?

Ans: a) Action of soaps is due to formation of micelles. But the formation of micelles takes place at a minimum temperature called 'Kraft temperature'. This temperature is reached in lukewarm water. b) Be humble to accept a scientific fact from a younger person

SOLUTION - Long answer type questions (5marks)

1.a) Explain the following:

i) Raoult's Law

ii) Boiling point elevation constant for a solvent.

b) A solution of glycerol ($C_3H_8O_3$) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of $100.42^\circ C$. What mass of glycerol was dissolved to make this solution? (K_b for water = $0.512 \text{ K kg mol}^{-1}$)?

Ans.a) i) It states that for a solution of volatile solute the partial pressure of each component is directly proportional to its mole fraction.

ii) the elevation in boiling point when one mole of a non volatile solute is dissolved in 1 kg of solvent.

$$b) \quad \Delta T_b = 100.42^\circ C - 100^\circ C = 0.42^\circ C \text{ or } 0.42 \text{ K}$$

$$\Rightarrow W_B = M_B \times \Delta T_b \times W_A / K_b \times 1000$$

$$\Rightarrow W_B = 92 \times 0.42 \times 500 / 0.512 \times 1000 = 37.73 \text{ g}$$

2 a) 6.2% solution of menthol in cyclohexane freezes at $-1.95^\circ C$. Determine the molecular mass of menthol. The freezing point and molal depression constant of cyclohexane are $6.5^\circ C$ and 20.2 K m^{-1} , respectively.

b) State Henry's Law and mention its two important applications.

c) Which of the following has higher boiling point and why: 0.1 M NaCl or 0.1 M Glucose.

Ans. a) $\Delta T_f = K_f m = K_f W_B / M_B \times 1000 / W_A$

$$8.45 = 20.2 \times 6.2 / M_B \times 1000 / 93.8$$

$$M_B = 158 \text{ g mol}^{-1}$$

b) The solubility of a gas in a liquid is directly proportional to the pressure of the gas.

Applications:

1) Solubility of CO_2 is increased at high pressure.

2) Mixture of He and O_2 are used by sea divers as He is less soluble than nitrogen.

c) 0.1 M NaCl and because NaCl gets dissociated into 2 ions.

Q.3 a) Define azeotropes and explain briefly minimum boiling point azeotropes by taking suitable examples.

b) The vapour pressure of pure liquid A and B are 450 mm and 700 mm of Hg respectively at 50 K. Calculate the composition of liquid mixture if total vapor pressure is 600 mm of Hg. Also find the composition of the mixture in vapor phase.

Ans. Azeotropes is a liquid mixture which boils at constant temperature without undergoing change in composition.

Example:- A mixture of 95% ethanol and 3% water by mass forms minimum boiling azeotropes i.e. it boils at a temperature lower than expected from ideal behavior , as it shows positive deviation from ideal behavior.

b) $p_A^0 = 450\text{mmHg}$, $p_B^0 = 700\text{mmHg}$

$$p = p_A^0 X_A + p_B^0 X_B$$

$$600 = 450(X_A) + 700(1 - X_A)$$

On solving , we get $X_A = 0.4$, $X_B = 0.6$

In vapor phase

$$P_A = 0.4 \times 450\text{mmHg} = 180\text{mmHg}$$

$$P_B = 0.6 \times 700\text{mmHg} = 420\text{mmHg}$$

$$X_A = 180\text{mm} / 600\text{mm} = 0.3$$

$$X_B = 1 - X_A = 1 - 0.3 = 0.7$$

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PGT CHEMISTRY

AFS PATHANKOT

ELECTROCHEMISTRY

5 Marks Question

Q.1.(a) State and explain Kohlrausch law of independent migration of ions.

(b) The molar conductivity of 0.025 mol L⁻¹ methanoic acid is 46.1 S cm² mol⁻¹. Calculate its degree of dissociation and dissociation constant. Given $\lambda_{\text{H}^+}^{\circ} = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$ and $\Lambda_{\text{HCOO}^-}^{\circ} = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$.

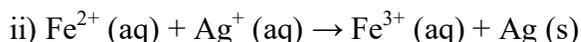
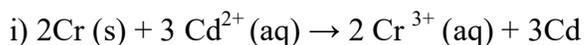
Q.2.(a) Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

(b) Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and if Λ° for acetic acid is $390.5 \text{ S cm}^2 \text{ mol}^{-1}$, what is the dissociation constant.

Q.3. (a) Give a brief account of corrosion and its mechanism.

(b) How is cathodic protection of iron different from its galvanisation.

Q.4. the standard cell potentials of galvanic cell in which the following reactions take place:



Calculate the rG° and equilibrium constant of the reaction.

Q.5. (a) Explain working of H₂-O₂ fuel cell

(b) For the equilibrium, $2\text{H}_2 \text{(g)} + \text{O}_2 \text{(g)}$



Calculate log K for it ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$).

ELECTROCHEMISTRY

5 mark Question

- (Q.1) (i) Define corrosion. (ii) What is rust? (iii) Write three factors which promote corrosion.

Ans (i) The process of slowly eating away of the metal due to attack of the atmospheric gases on the surface of the metal resulting into the formation of compounds such as oxides, sulphides etc is called corrosion.

(ii) Rust is hydrated ferric oxide, $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$.

(iii) Reactivity of the metal: More active metals are readily corroded.

Presence of air and moisture: Air and moisture accelerate corrosion.

Presence of electrolytes: Iron rusts faster in saline water than in pure water

(Q.2)(i) State Faraday' first and second law of electrolysis.

(ii) If resistance of a solution is 20 ohms, what will be the conductance of the same solution?

(iii) When 3 ampere of electricity is passed for 45 minutes to the metal, 2.0 g of metal is deposited. Find equivalent weight of metal.

Ans (i) Faraday' first law of electrolysis

Mass of any substance deposited or liberated at any electrode is directly proportional to the quantity of electricity passed through the electrolyte

Faraday's second law of electrolysis

When same quantity of electricity is passed through solutions of different electrolytes connected in series, the weights of the substances produced at the electrodes are directly proportional to their equivalent weights.

(ii) conductance is reciprocal of resistance, so conductance of the solution = $1/20 = 0.05 \text{ ohm}^{-1}$.

(iii)

$$Q = i \times t$$

$$= 3 \times 45 \times 60 = 8100 \text{ C}$$

\therefore 8100 C of electricity deposits metal = 2 g

$$\therefore 96500 \text{ C of electricity deposits metal} = \frac{2 \text{ g}}{8100 \text{ C}} \times 96500 \text{ C}$$
$$= 23.82 \text{ g}$$

\therefore Eq. wt of metal is = 23.82 g

(Q3.) (i) Why is the salt bridge used in electrochemical cell?

(ii) Name an electrode which is used as a reference electrode? Give its diagram and working.

(iii) How does electrochemical series help in the following:

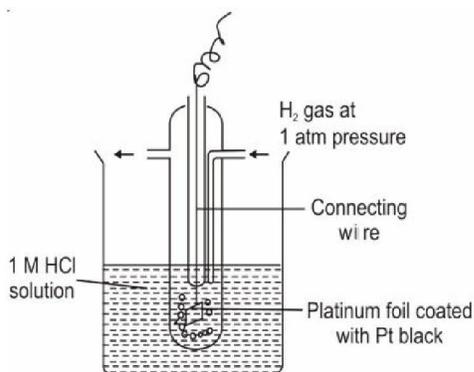
(a) Comparing the relative oxidizing or reducing properties of elements.

(b) Predicting the reactivity of a metal with acid.

Ans(i) In an electrochemical cell, salt bridge is used to maintain the electrical neutrality of the solutions in two half cells. It completes the electrical circuit by allowing the ions to flow from one solution to other without mixing the two solutions.

- (ii) The absolute value of the electrode potential of a single electrode cannot be measured because oxidation and reduction half cell cannot take place alone. To overcome this difficulty, we use a reference electrode whose electrode potential is arbitrarily assigned a value.

Example: Standard or Normal Hydrogen Electrode (SHE or NHE). Its electrode potential is taken as 0.00 V at zero Kelvin.



Standard Hydrogen Electrode

To determine the electrode potential of any electrode, a cell is set up with SHE as one of the electrodes. Since, the EMF of the SHE electrode is arbitrarily taken as 0.00 V, the EMF of the cell will directly give the electrode potential value of the other electrode.

- (iii) The arrangement of various elements in order of their increasing values of electrode potentials is known as electrochemical series.

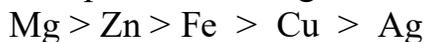
- (a) Positive sign of electrode potential value represents the reduction potential.

This indicates that greater the value of reduction potential, more easily the substance is reduced. It is said to be a stronger oxidising agent.

Thus, according to electrochemical series, F_2 has the highest reduction potential (strongest oxidising agent) and Li^+ ion has the lowest reduction potential, thus it is the weakest oxidizing agent in the series.

- (b) A metal with greater oxidation potential can displace metals with lower oxidation potential from their salt solution.

For example: Decreasing order of oxidation potentials of these metals are:



Hence, each metal can displace metals on its right from the salt solutions

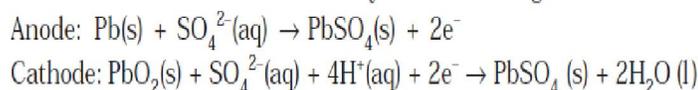
- (Q.4) (a) Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100Ω . If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520Ω , calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is 1.29 S/m .

- (b) Write the cathodic and anodic reactions for the charging of lead storage battery.

Ans (a)

The cell constant is given by the equation:
 Cell constant = G^* = conductivity \times resistance
 $= 1.29 \text{ S/m} \times 100 \text{ } \Omega = 129 \text{ m}^{-1} = 1.29 \text{ cm}^{-1}$
 Conductivity of 0.02 mol L^{-1} KCl solution = cell constant / resistance
 $= \frac{G^*}{R} = \frac{129 \text{ m}^{-1}}{520 \text{ } \Omega} = 0.248 \text{ S m}^{-1}$
 Concentration = 0.02 mol L^{-1}
 $= 1000 \times 0.02 \text{ mol m}^{-3}$
 $= 20 \text{ mol m}^{-3}$
 Molar conductivity = $\Lambda_m = \frac{\kappa}{c}$
 $= \frac{248 \times 10^{-3} \text{ S m}^{-1}}{20 \text{ mol m}^{-3}}$
 $= 124 \times 10^{-4} \text{ S m}^2\text{mol}^{-1}$

(b)



(Q5) a) Predict the products of electrolysis in each of the following:

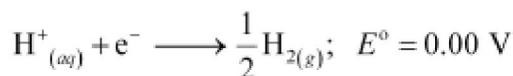
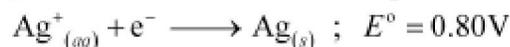
- (i) An aqueous solution of AgNO_3 with silver electrodes.
- (ii) An aqueous solution of AgNO_3 with platinum electrodes.
- (iii) A dilute solution of H_2SO_4 with platinum electrodes.
- (iv) An aqueous solution of CuCl_2 with platinum electrode

b) Define electrochemical cell?

Ans. a)

(i) At cathode:

The following reduction reactions compete to take place at the cathode.



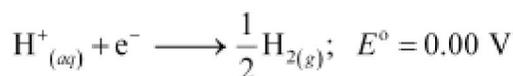
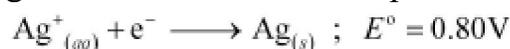
The reaction with a higher value of E° takes place at the cathode. Therefore, deposition of silver will take place at the cathode.

At anode:

The Ag anode is attacked by NO_3^- ions. Therefore, the silver electrode at the anode dissolves in the solution to form Ag^+ .

(ii) At cathode:

The following reduction reactions compete to take place at the cathode.



The reaction with a higher value of E° takes place at the cathode. Therefore, deposition of silver will take place at the cathode.

At anode:

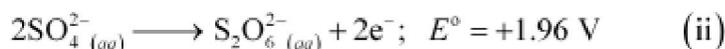
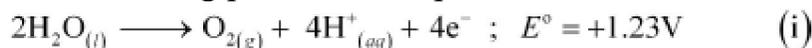
Since Pt electrodes are inert, the anode is not attacked by NO_3^- ions. Therefore, OH^- or NO_3^- ions can be oxidized at the anode. But OH^- ions having a lower discharge potential and get preference and decompose to liberate O_2 .



(iii) At the cathode, the following reduction reaction occurs to produce H_2 gas.



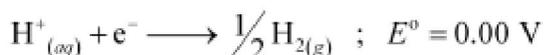
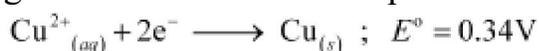
At the anode, the following processes are possible.



For dilute sulphuric acid, reaction (i) is preferred to produce O_2 gas. But for concentrated sulphuric acid, reaction (ii) occurs.

(iv) At cathode:

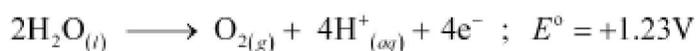
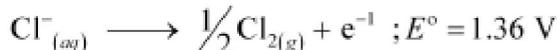
The following reduction reactions compete to take place at the cathode.



The reaction with a higher value of E° takes place at the cathode. Therefore, deposition of copper will take place at the cathode.

At anode:

The following oxidation reactions are possible at the anode.



At the anode, the reaction with a lower value of E° is preferred. But due to the over-potential of oxygen, Cl^- gets oxidized at the anode to produce Cl_2 gas.

ELECTROCHEMISTRY

5 MARKS QUESTION

Q.1.(a) State and explain Kohlrausch law of independent migration of ions.

(b) The molar conductivity of 0.025 mol L⁻¹ methanoic acid is 46.1 S cm² mol⁻¹. Calculate its degree of dissociation and dissociation constant. Given $\lambda_{\text{H}^+}^{\circ} = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$ and $\Lambda_{\text{HCOO}^-}^{\circ} = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$.

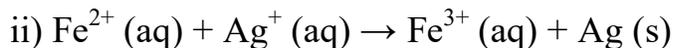
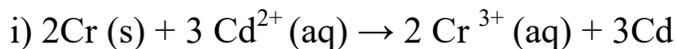
Q.2.(a) Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

(b) Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and if Λ° for acetic acid is $390.5 \text{ S cm}^2 \text{ mol}^{-1}$, what is the dissociation constant.

Q.3. (a) Give a brief account of corrosion and its mechanism.

(b) How is cathodic protection of iron different from its galvanisation.

Q.4. the standard cell potentials of galvanic cell in which the following reactions take place:



Calculate the rG° and equilibrium constant of the reaction.

Q.5. (a) Explain working of H₂-O₂ fuel cell

(b) For the equilibrium, $2\text{H}_2 \text{ (g)} + \text{O}_2 \text{ (g)}$



Calculate log K for it ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$).

5 MARKS QUESTIONS

1. (a) For a reaction $A + B \rightarrow \text{Products}$, the rate law is given by $r = k [A]^{1/2} [B]^2$ What is the order of reaction?

(b) The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times how will it affect the rate of formation of Y?

(c) Write two points of difference between order and molecularity of a reaction.

Ans. ((a) Order=2.5

(b) Rate is directly proportional to $[X]^2$

$$R = k(3X)^2 = 9k$$

Therefore rate will increase 9 times.

(C)

S N o.	ORDER OF A REACTION	MOLECULARITY OF A REACTION
1	It is the sum of the powers of concentration terms of reactants in the rate law expression.	It is the total no. of reacting species which actually bring about the reaction.
2	It may be fractional number or zero.	It is always a whole number.it is never zero.

2. a) Define (i) Activation energy (ii) Collision frequency

b) The rate constants of a reaction at 500k & 700k are $0.02s^{-1}$ & $0.07s^{-1}$ respectively. Calculate the value of E_a & A .

Ans.(a) Refer NCERT

(b) $\log K_2/K_1 = E_a/2.303 R[1/T_1 - 1/T_2]$ by putting the correct values and then calculate it.

$$E_a = 18.23 \text{ KJ/mol}$$

3. (i) A reaction is first order in A & second order in B.

a) Write differential rate equation.

b) How is the rate affected on increasing the concentration of B three times?

c) How is the rate affected when conc of both A&B is doubled? (ii) Name the factors which affect the rate of reaction.

Ans.(i)a. $\text{Rate} = k[\text{A}][\text{B}]^2$

b. Rate will increase 9 times

c. $\text{Rate} = k[2\text{A}][2\text{B}]^2 = 8 \text{ times}$

(ii) Temp. ,Pressure, Catalyst and concentration of reacting species.

Unsolved questions for practice.....

4. a) Deduce the expression of half-life for zero order reaction.
b) Show that time required for 99.9% completion of the first order reaction is 10 times of $t_{1/2}$ for first order chemical reaction.
5. a) For a reaction $\text{A} + \text{B} \rightarrow \text{Products}$, the rate law is given by $r = k [\text{A}]^{1/2} [\text{B}]^2$. What is the order of reaction?
(b) The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times how will it affect the rate of formation of Y?

CHEMICAL KINETICS

5 marks questions

Q1:- Rate of a reaction is given by the expression $\text{Rate} = k[A]^2 [B]$

a) What are the units for the rate and the rate constant for the reaction

b) A first order reaction is 20% complete in 10 minutes. Calculate the time for 75% completion of the reaction

Ans:- a) unit of Rate = $\text{mol L}^{-1}\text{s}^{-1}$
unit of rate const = $\text{mol}^{-2} \text{L}^2 \text{s}^{-1}$

b) $k = 2.303/t \log [A^0]/[A]$
correct substitution and calculation
time required = 62.13 min

Q2:- a) As a reaction proceeds why does its rate keep on changing?

b) What will be the effect of temperature on the rate of reaction?

c) The rate constant of a reaction is $1.5 \times 10^7 \text{s}^{-1}$ at 50°C and $4.5 \times 10^7 \text{s}^{-1}$ at 100°C

Calculate the value of activation energy for the reaction. [$R = 8.314 \text{JK}^{-1}\text{mol}^{-1}$]

Ans:- a) Rate keeps changing due to change in conc of reactants

b) As the temp increases, the rate of reaction also increases due to increase in kinetic energy of molecules

b) $\log k_2/k_1 = E_a/2.303R [1/T_1 - 1/T_2]$

Correct substitutions

Correct answer units

Q3:- Calculate the overall order of a reaction which has the rate expression,

$$\text{Rate} = K[A]^{3/2}[B]^{-1}.$$

(b) The first order rate constant for the decomposition of ethyl iodide by the reaction:



Its energy of activation is 209 kJ/mol. Calculate the rate constant of the reaction at 700K.

(c) What do you understand by elementary reaction?

Ans:- (a) Half order.

$$(b) \log K_2 = \log K_1 + \frac{E_a}{2.303 R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$= \log (1.60 \times 10^{-5}) + \frac{209000 \text{ J mol/L}}{2.303 \times 8.314 \text{ J mol/L/K}} \left[\frac{1}{600 \text{ K}} - \frac{1}{700 \text{ K}} \right]$$

$$= -2.197 \implies K = 6.36 \times 10^{-3} \text{ s}^{-1}.$$

(c) Single step reactions are elementary reactions

Q4(a) A first order reaction is found to have a rate constant $K = 1.60 \times 10^{-5} \text{ s}^{-1}$.

Find the half life of the reaction.

(b) Write units of zero order and first order reaction?

(c) Define energy of activation.

$$\text{Ans:- (a) } t_{1/2} = \frac{0.693}{5.5 \times 10^{-14} \text{ s}^{-1}} = 1.26 \times 10^{14}$$

(b) Mole litre⁻¹ sec⁻¹, Sec⁻¹

(c) Correct definition.

Q5 a) :- The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

Ans:- From Arrhenius equation, we obtain

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303 R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$$

It is given that, $k_2 = 4k_1$

$$T_1 = 293 \text{ K}$$

$$T_2 = 313 \text{ K}$$

$$\text{Therefore, } \log \frac{4k_1}{k_2} = \frac{E_a}{2.303 \times 8.314} \left(\frac{313 - 293}{293 \times 313} \right)$$

$$\Rightarrow 0.6021 = \frac{20 \times E_a}{2.303 \times 8.314 \times 293 \times 313}$$

$$\Rightarrow E_a = \frac{0.6021 \times 2.303 \times 8.314 \times 293 \times 313}{20}$$

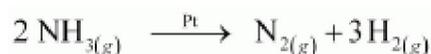
$$= 52863.33 \text{ J mol}^{-1}$$

$$= 52.86 \text{ kJ mol}^{-1}$$

Hence, the required energy of activation is $52.86 \text{ kJ mol}^{-1}$.

b) Q:- The decomposition of NH_3 on platinum surface is zero order reaction. What are the rates of production of N_2 and H_2 if $k = 2.5 \times 10^{-4} \text{ mol}^{-1} \text{ L s}^{-1}$?

Ans:- The decomposition of NH_3 on platinum surface is represented by the following equation.



Therefore,

$$\text{Rate} = -\frac{1}{2} \frac{d[\text{NH}_3]}{dt} = \frac{d[\text{N}_2]}{dt} = \frac{1}{3} \frac{d[\text{H}_2]}{dt}$$

However, it is given that the reaction is of zero order.

Therefore,

$$\begin{aligned} -\frac{1}{2} \frac{d[\text{NH}_3]}{dt} &= \frac{d[\text{N}_2]}{dt} = \frac{1}{3} \frac{d[\text{H}_2]}{dt} = k \\ &= 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1} \end{aligned}$$

Therefore, the rate of production of N_2 is

$$\frac{d[\text{N}_2]}{dt} = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

And, the rate of production of H_2 is

$$\frac{d[\text{H}_2]}{dt} = 3 \times 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$= 7.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

SURFACE CHEMISTRY

5 MARK QUESTIONS

Q1. Give reason for the following observations:

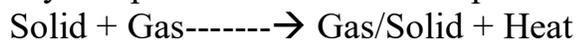
- (i) Addition of alum purifies the water.
- (ii) Brownian movement provides stability to the colloidal solution.
- (iii) Leather gets hardened after tanning.
- (iv) Physisorption decrease with increase of temperature.
- (v) Gelatin which is a peptide is added in icecreams.

Ans.(i) The Al^{3+} ions furnished by alum help in the coagulation of negatively charged colloidal particles present in water as impurities.

(ii) The Brownian movement is due to the unbalanced bombardment of the colloidal particles of the molecules of dispersion medium. It has a stirring effect which does not permit the particles to settle and responsible for stability of sols.

(iii) Animal hide is colloidal in nature and contains positively charged particles. When a hide is soaked in a tannin which contains negatively charged colloidal particles, mutual coagulation takes place and leather become hard.

(i) Physisorption is an exothermic process:



According to Le chatlier's principle, if we increase the temperature equilibrium will shift in the backward direction, i.e., gas is released from the adsorbed surface.

(ii) Ice creams are emulsions which get stabilized by emulsifying agents like gelatin.

Q2(a) Differentiate between adsorption and absorption .

(b) Out of $MgCl_2$ and $AlCl_3$ which one is more effective in causing Coagulation of negatively charged sol and why ?

(c) Out of sulphur sol and proteins which one forms multimolecular colloids ?

Ans.(a) **Absorption** – (i) It is a surface phenomena . Adsorbate molecules are held at the surface of adsorbent.

(ii) The concentration of the adsorbate at the adsorbent surface is much more than in the bulk
Example - Water vapours On silica gel.

Absorption – (i) Absorption occur in the bulk Of the absorbing substance.

(ii) Absorbed material is uniformly distributed throughout the bulk Thus, concentration is same throughout .

Example Water vapours are absorbed by anhydrous calcium chloride

- (b) Aluminium chloride is more effective in causing coagulation of negatively charged sol as Al^{3+} ion has greater positive charge than Mg^{2+} ion.
- (c) Sulphur sol.

Q3.(a) What is the difference between multimolecular and macromolecular colloids? Give one example of each. How are associated colloids different from these two types of colloids?

(b) Comment on the statement that "colloid is not a substance but state of a substance."

Ans. **Multimolecular colloids** - In this type of colloids, colloidal particles are aggregates of atoms or molecules each having size less than 1 nm. Multimolecular colloids are generally lyophobic in nature.

For example- surface sol, gold sol.

Macromolecular colloids - In this type of colloids, colloidal particles are themselves large molecules of colloidal dimensions. Macromolecular colloids are generally lyophilic in nature.

For example starch, protein, polythene etc.

Associated colloids - There are certain substances which at low concentration behave as normal electrolyte but higher concentration exhibit colloidal behaviour due to formation of aggregates. Such colloids are known as associated colloids. For example Soap and detergents.

(b) The given statement is true. This is because the same substance may exist as a colloid under certain conditions and as a crystalloid under some other conditions.

For example, NaCl in water behaves as a crystalloid while in benzene, it behaves as a colloid. It is the size of the particle which matters, i.e.; the state in which the substance exists. If the size of the particle lies in the range of 1 nm to 1000 nm, it is in the colloidal state,

Q4.(a) Explain the following terms-

(i) Electrophoresis

(ii) Peptization

(iii) Electroosmosis

(b) How is adsorption of a gas related to its critical temperature? Give reason.

Ans (i) Electrophoresis - The movement of colloidal particles towards oppositely charged electrode in an electric field is known as electrophoresis.

(ii) Peptization -The process of Converting a precipitate into a colloidal solution By adding an electrolyte is called Peptization

(iii) Electro osmosis -When electrophoresis i.e., movement of particle is prevented by some suitable means, it is observed that dispersion medium begins to move in the electric field This phenomena is known as electro osmosis.

(B) **Ans.** Higher the critical temperature of the gas. Greater is the ease of liquefaction. i.e. greater Vander walls forces of attraction and hence large adsorption will occur.

Q5. Define absorption with an example .Why is adsorption exothermic in nature? write the types of adsorption based on the nature of forces between adsorbate and adsorbent .

Ans. The accumulation of the molecular species at the surface rather than in the bulk of a solid or liquid is known as an adsorption.

For example- water vapour and absorbed by silica gel.

when a gas is adsorbed on the surface of solid its entropy decreases since adsorption is a spontaneous process, therefore ΔG must be negative. As $-T\Delta S$ is +ve, ΔG can be negative only if ΔH has sufficiently high negative value. Hence adsorption is exothermic in nature. There are two types of adsorption based on the nature of forces between adsorbate and adsorbent –

(i) Physical adsorption -When accumulation of gas on the surface of solid occurs due to weak vander waal forces.

(ii) Chemical adsorption- When the gas molecules or atoms are held to the surface of solid by chemical bonds.

SURFACE CHEMISTRY

5 Marks:

1 (a) Give reasons for the following:

(iii) Physical adsorption multilayered & chemical adsorption is monolayered

(v) Gelatin is added to ice-cream

(iii) Leather hardened on tanning

(b) Define the following:

(i) Dialysis (ii) Homogenous catalysis

Ans: (a) (i) Physical adsorption involves VanderWaal's force of attraction so any number of layers may be formed where as chemical adsorption involve chemical bond formation

(ii) It acts as emulsifier/stabilizing agent

(iii) Animal hide is colloidal in nature & positively charged. When a hide is soaked in tannin which is negatively charged colloidal particles mutual coagulation takes place.

(b)(i) Dialysis: it is a process of removing a dissolved substance from a colloidal solution by membrane

(ii) . Homogenous catalyst – when reactants and catalyst are in same phase.

2. Discuss the effect of pressure & temperature on the adsorption of gases on solids?

Ans – Effect of pressure on adsorption: - At constant temp the extent of adsorption of gas (x/m) in the solid increases with pressure. A graph between x/m and the pressure P of a gas at constant temp is called adsorption isotherm.

Freundlich adsorption isotherm -

At lower range of pressure, (x/m) is directly proportional to the applied pressure.

$$x/m \propto p^1$$

At high pressure range, the extent of adsorption of a gas (x/m) is independent of the applied pressure i.e.

$$x/m \propto p^0$$

At intermediate pressure range, the value of (x/m) is proportional to the fractional power of pressure i.e.

$$x/m \propto p^{1/n}$$

Where 1/n is fraction. Its value may be between 0 and 1

$$X/m = kp^{1/n}$$

$$\text{Log}(x/m) = \text{log } k + 1/n \text{ log } p$$

Effect of temp on Adsorption – Adsorption is generally temperature depended. Mostly adsorption processes are exothermic and hence, adsorption decreases with increasing temp. However for an endothermic adsorption process adsorption increases with increase in Temperature.

3. (i) Describes some features of catalysis by Zeolites?

(ii) Comment on the statement that “colloid is not a substance but state of a substance”?

Ans –(i) Features of catalysis by Zeolites:-

(a) Zeolites are hydrated alumino silicates which have a three dimensional network structure containing water molecules in their pores.

(b) To use them as catalysts, they heated so that water of hydration present in the pores is lost and the pores become vacant.

© The size of pores varies from 260 to 740 pm. Thus, only those molecules can be adsorbed in these pores and catalyzed whose size is small enough to enter these pores. Hence, they act as molecular sieves or shape selective catalysts.

An important catalyst used in petroleum industries is ZSM-5. It converts alcohols into petrol by first dehydrating them to form a mixture of hydrocarbons.

Alcohols $\xrightarrow[\text{Dehydration}]{\text{ZSM-5}}$ Hydrocarbons

(ii) The given statement is true. This is because the statement may exist as a colloid under certain conditions and as a crystalloid under certain other conditions. e.g.: NaCl in water behaves as a crystalloid while in benzene, behaves as a colloid (called associated colloid). It is the size of the particles which matters i.e. the state in which the substance exists. If the size of the particles lies in the range 1nm to 1000nm it is in the colloid state.

4.(a) What type of colloidal sol is formed in the following:

(i) Sulphur vapours are passed through cold water.

(ii) White of an egg is mixed with water

(iii) Soap solution

(b) Define the term:

(i) Electrophoresis

(ii) Coagulation

Ans(a)(i) Multimolecular colloids

(ii) Macromolecular colloids

(iii) Associated colloids

(b) Electrophoresis - Movement of Colloidal particles towards opposite electrode in presence of external electric field.

Coagulation – The process of setting of colloidal particles is called coagulation of the sol.

5. (a) What are lyophobic & lyophilic sol? Give one example of each. Why lyophobic sol is easily coagulated?

(b) What do you mean by activity & selectivity of catalyst?

Ans. (a) lyophobic sols: Particles of dispersed phase have no affinity for dispersion medium. These are not easily prepared & need stabilizing agents for their preservation. Eg gold, sulphur, Fe(OH)₃ etc. Lyophilic sol: Particles of dispersed phase have greater affinity for the dispersion medium. They are self stabilized because of strong attractive forces operating between suspended particles & the dispersion medium. Eg gum, gelatin, starch etc

The stability of lyophobic sol is only due to the presence of charge on colloidal particles. If charge is removed by addition of electrolyte, the particles come nearer to each other & coagulated.

(b) Activity of solids: The ability of a catalyst to increase the rate of reaction.

Selectivity of catalyst: It is the ability of a catalyst to direct a reaction to yield a particular reaction.

SURFACE CHEMISTRY – 5 MARKS

1	<p>a) Write any two characteristics of Chemisorption.</p> <p>b) Why does physisorption decrease with the increase of temperature?</p> <p>c) Why are powdered substances more effective adsorbents than their crystalline forms?</p> <p>d) Why is it necessary to remove CO when ammonia is obtained by Haber's process?</p>	2 1 1 1
ANS	<p>a) i. Chemisorption is highly specific in nature. It occurs only if there is a possibility of chemical bonding between the adsorbent and the adsorbate. ii. Like physisorption, chemisorption also increases with an increase in the surface area of the adsorbent.</p> <p>b) Physisorption is exothermic in nature. Therefore, in accordance with Le-Chateliere's principle, it decreases with an increase in temperature. This means that physisorption occurs more readily at a lower temperature.</p> <p>c) Powdered substances are more effective adsorbents than their crystalline forms because when a substance is powdered, its surface area increases and physisorption is directly proportional to the surface area of the adsorbent.</p> <p>d) It is important to remove CO in the synthesis of ammonia as CO adversely affects the activity of the iron catalyst, used in Haber's process.</p>	
2	<p>a) Why is the ester hydrolysis slow in the beginning and becomes faster after sometime?</p> <p>b) What is the role of desorption in the process of catalysis?</p> <p>c) What modification can you suggest in the Hardy-Schulze law?</p>	2 1 2
ANS	<p>a) Ester hydrolysis can be represented as: The acid produced in the reaction acts as a catalyst and makes the reaction faster. Substances that act as catalysts in the same reaction in which they are obtained as products are known as autocatalysts.</p> <p>b) The role of desorption in the process of catalysis is to make the surface of the solid catalyst free for the fresh adsorption of the reactants on the surface.</p> <p>c) Hardy-Schulze law states that 'the greater the valence of the flocculating ion added, the greater is its power to cause precipitation.' This law takes into consideration only the charge carried by an ion, not its size. The smaller the size of an ion, the more will be its polarising power. Thus, Hardy-Schulze law can be modified in terms of the polarising power of the flocculating ion. Thus, the modified Hardy-Schulze law can be stated as 'the greater the polarising power of the flocculating ion added, the greater is its power to cause precipitation.'</p>	
3	<p>a) Why is it essential to wash the precipitate with water before estimating it quantitatively?</p> <p>b) Distinguish between the meaning of the terms adsorption and absorption. Give one example of each.</p>	2 3
ANS	<p>a) When a substance gets precipitated, some ions that combine to form the precipitate get adsorbed on the surface of the precipitate. Therefore, it</p>	

	<p>becomes important to wash the precipitate before estimating it quantitatively in order to remove these adsorbed ions or other such impurities.</p> <p>b) Adsorption is a surface phenomenon of accumulation of molecules of a substance at the surface rather than in the bulk of a solid or liquid. The substance that gets adsorbed is called the 'adsorbate' and the substance on whose surface the adsorption takes place is called the 'adsorbent'. Here, the concentration of the adsorbate on the surface of the adsorbent increases. In adsorption, the substance gets concentrated at the surface only. It does not penetrate through the surface to the bulk of the solid or liquid. For example, when we dip a chalk stick into an ink solution, only its surface becomes coloured. If we break the chalk stick, it will be found to be white from inside. On the other hand, the process of absorption is a bulk phenomenon. In absorption, the substance gets uniformly distributed throughout the bulk of the solid or liquid.</p>	
4	<p>a) Give reason why a finely divided substance is more effective as an adsorbent.</p> <p>b) What are the factors which influence the adsorption of a gas on a solid?</p>	2 3
ANS	<p>a) Adsorption is a surface phenomenon. Therefore, adsorption is directly proportional to the surface area. A finely divided substance has a large surface area. Both physisorption and chemisorption increase with an increase in the surface area. Hence, a finely divided substance behaves as a good adsorbent.</p> <p>b) There are various factors that affect the rate of adsorption of a gas on a solid surface.</p> <p>(i) Nature of the gas: Easily liquefiable gases such as NH_3, HCl etc. are adsorbed to a great extent in comparison to gases such as H_2, O_2 etc. This is because Van der Waal's forces are stronger in easily liquefiable gases.</p> <p>(ii) Surface area of the solid The greater the surface area of the adsorbent, the greater is the adsorption of a gas on the solid surface.</p> <p>(iii) Effect of pressure: Adsorption is a reversible process and is accompanied by a decrease in pressure. Therefore, adsorption increases with an increase in pressure.</p> <p>(iv) Effect of temperature Adsorption is an exothermic process. Thus, in accordance with Le-Chatelier's principle, the magnitude of adsorption decreases with an increase in temperature.</p>	
5	<p>a) What is the difference between multimolecular and macromolecular colloids? Give one example of each. How are associated colloids different from these two types of colloids?</p> <p>b) Explain what is observed</p> <p>(i) When a beam of light is passed through a colloidal sol.</p> <p>(ii) An electrolyte, NaCl is added to hydrated ferric oxide sol.</p> <p>(iii) Electric current is passed through a colloidal sol?</p>	2 3
ANS	<p>a) (i) In multi-molecular colloids, the colloidal particles are an aggregate of</p>	

atoms or small molecules with a diameter of less than 1 nm. The molecules in the aggregate are held together by van der Waal's forces of attraction.

Examples of such colloids include gold sol and sulphur sol.

(ii) In macro-molecular colloids, the colloidal particles are large molecules having colloidal dimensions. These particles have a high molecular mass. When these particles are dissolved in a liquid, sol is obtained. For example: starch, nylon, cellulose, etc.

(iii) Certain substances tend to behave like normal electrolytes at lower concentrations. However, at higher concentrations, these substances behave as colloidal solutions due to the formation of aggregated particles. Such colloids are called aggregated colloids.

b) (i) When a beam of light is passed through a colloidal solution, then scattering of light is observed. This is known as the Tyndall effect. This scattering of light illuminates the path of the beam in the colloidal solution.

(ii) When NaCl is added to ferric oxide sol, it dissociates to give Na^+ and Cl^- ions. Particles of ferric oxide sol are positively charged. Thus, they get coagulated in the presence of negatively charged Cl^- ions.

(iii) The colloidal particles are charged and carry either a positive or negative charge. The dispersion medium carries an equal and opposite charge. This makes the whole

METALLURGY LONG ANSWER (5 MARKS)

Q-1. Discuss some of the factors which need consideration before deciding the extraction of a metal from its ore.

A-1. The factors are:

- 1) Types of the impurities.
 - a) the ores containing lighter gangue particles – hydraulic washing.
 - b) Ores containing magnetic impurities- magnetic separation
 - c) Sulphide ores- froth floatation process
 - d) Ores which form soluble compounds with with certain reagents and contain insoluble impurities- chemical/ leaching method.
- 2) Nature of the metal to be extracted – the concentrated ore is then converted into a form which is suitable for the reduction to the metal either by calcinations or by roasting.

The calcined or roasted ore is then reduced to the metal by any of the following suitable method:

- a) highly electropositive metals- electrolytic reduction
- b) moderately reactive metals- carbon reduction method.
- c) Less reactive metals- self reduction method.

Q-2. a) You are provided with the impure samples of zinc, copper and germanium. Which methods would you recommend for the purification of each of these metals? 3

b) Why CaF_2 is used in the extraction of Al? 2

A-2. a) Zinc- it is a low boiling metal. So distillation method can be used. Vapours of zinc when cooled to 1070 K gives pure zinc

Copper- electrolytic method. The anode is made up of impure copper, whereas a thin strip of the pure copper acts as the cathode. Acidified copper sulphate is used as the electrolyte.

Germanium- zone- refining method.

b) CaF_2 is used in the manufacture of Al as it brings down melting point of alumina as well as it acts as a flux.

Q-3 a) The choice of the reducing agent in a particular case depends on the thermodynamic factor. How do you agree with this statement? State your views with examples. 3

b) What is the function of basic lining in steel manufacture?

2

A-3.a) The choice of the reducing agent in the extraction of a metal from its ore or any suitable salt of that metal depends upon the energetics of the process. For the reaction/process to be in favourable direction the ΔG should be negative the more is the negative value the more is the tendency for the reaction to occur.

During the reduction of haematite to iron, carbon is used. At temperature below 983 K, haematite is reduced by CO, whereas at higher temperatures carbon is better reducing agent.

b) Basic lining of lime (CaO) or MgO is used to remove acidic impurities like SiO_2 as non-fusible slag.

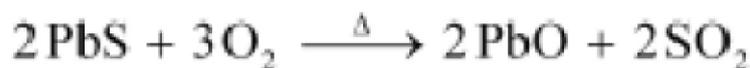


Q-4. Giving examples, differentiate between 'roasting' and 'calcination'.

A-4 Roasting is the process of converting sulphide ores to oxides by heating the ores in a regular supply of air at a temperature below the melting point of the metal. For example, sulphide ores of Zn, Pb, and Cu are converted to their respective oxides by this process.



Zinc blende



Galena



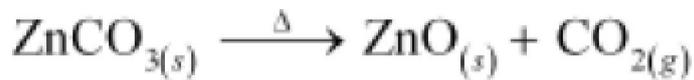
Copper

glance

On the other hand, calcination is the process of converting hydroxide and carbonate ores to oxides by heating the ores either in the absence or in a limited supply of air at a temperature below the melting point of the metal. This process causes the escaping of volatile matter leaving behind the metal oxide. For example, hydroxide of Fe, carbonates of Zn, Ca, Mg are converted to their respective oxides by this process.



Limonite



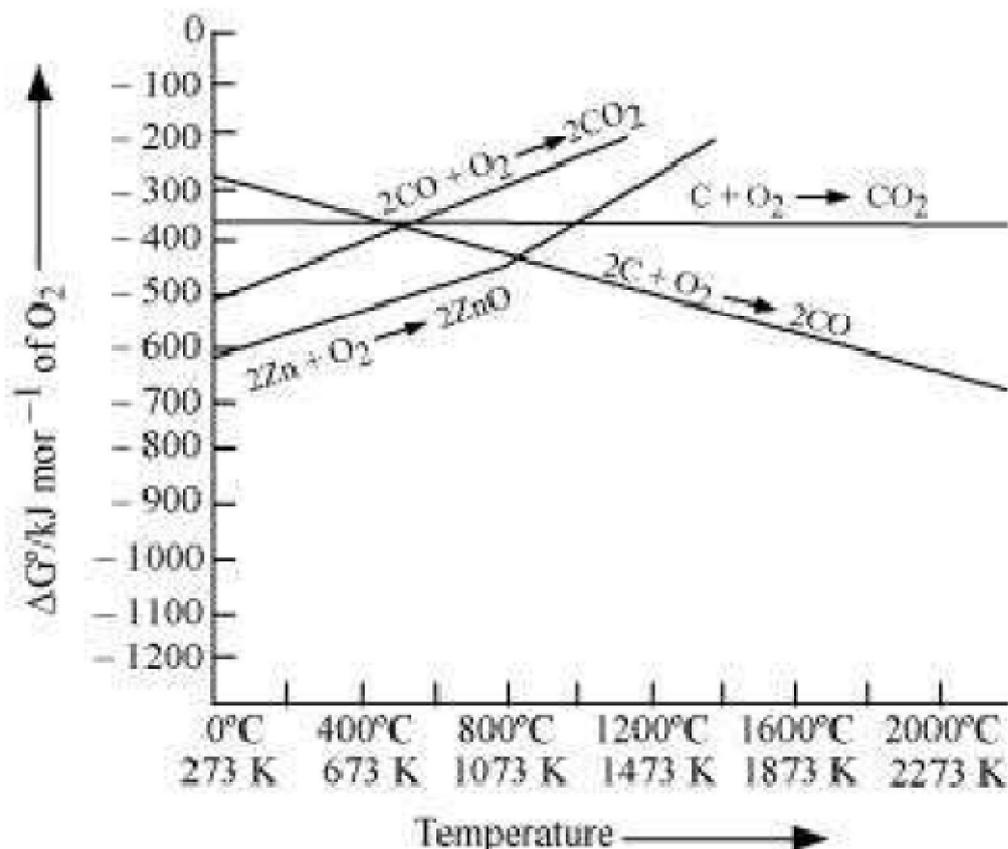
Calamine



Dolomite

Q-5 a) Out of C and CO, which is a better reducing agent for ZnO? 2

b) What is the role of graphite rod in the electrometallurgy of aluminium? 3



Reduction of ZnO to Zn is usually carried out at 1673 K. From the above figure, it can be

observed that above 1073 K, the Gibbs free energy of formation of CO from C and above

1273 K, the Gibbs free energy of formation of CO_2 from C is lesser than the Gibbs free

energy of formation of ZnO. Therefore, C can easily reduce ZnO to Zn.

On the other hand, the Gibbs free energy of formation of CO_2 from CO is always higher

than the Gibbs free energy of formation of ZnO. Therefore, CO cannot reduce ZnO.

Hence, C is a better reducing agent than CO for reducing ZnO.

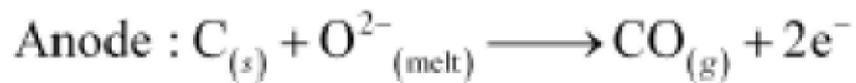
b) In the electrometallurgy of aluminium, a fused mixture of purified alumina (Al_2O_3),

cryolite (Na_3AlF_6) and fluorspar (CaF_2) is electrolysed. In this electrolysis, graphite is

used as the anode and graphite-lined iron is used as the cathode. During the electrolysis,

Al is liberated at the cathode, while CO and CO_2 are liberated at the anode, according to

the following equation.



If a metal is used instead of graphite as the anode, then O₂ will be liberated. This will not only oxidise the metal of the electrode, but also convert some of the Al liberated at the cathode back into Al₂O₃. Hence, graphite is used for preventing the formation of O₂ at the anode. Moreover, graphite is cheaper than other metals.

METALLURGY

5 Marks Questions

1. (i) Name the method of refining which is based on the principle of adsorption.
(ii) What is the role of depressant in froth floatation process?
(iii) What is the role of limestone in the extraction of iron from its oxides?
(iv) What is the role of SiO_2 in the extraction of copper?
(v) How is cast iron different from pig iron?

Ans. (i) Chromatographic methods
(ii) It prevents one of the sulphide ores from being wetted by oil.
(iii) It is decomposed to CaO which removes SiO_2 by forming slag.
(iv) SiO_2 acts as flux to remove FeO by forming slag.
(v) Cast iron is different from pig iron and is made by melting pig iron with scrap iron and coke using hot air blast. It has slightly lower carbon content (about 3%) and is extremely hard and brittle.

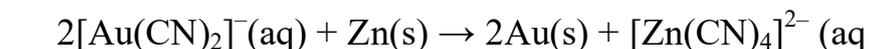
2. (i) How is copper obtained from low grade copper?
(ii) Although carbon and hydrogen are good reducing agents but they are not used to reduce metallic oxides at high temperatures. Why?
(iii) Write two basic requirements for refining of a metal by Mond process and by Van Arkel method.

Ans. (i) In case of low grade copper ores, leaching is carried out using acid or bacteria in the presence of air. In this process, copper goes into the solution as Cu^{2+} ions. The resulting solution is treated with scrap iron or H_2 to get metallic copper.
(ii) It is because at high temperature carbon and hydrogen react with metals to form carbides and hydrides respectively.
(iii) (a) the metal should form a volatile compound with an available reagent,

(b) the volatile compound should be easily decomposable, so that the recovery is easy.

3. (i) Write the chemical reactions involved in the extraction of gold by cyanide process. Also give the role of zinc in the extraction.
(ii) Name the common elements present in the anode mud in electrolytic refining of copper.
(iii) Why is an external emf of more than 2.2V required for the extraction of Cl_2 from brine?

Ans. (i) $4\text{Au(s)} + 8\text{CN}^-(\text{aq}) + 2\text{H}_2\text{O(aq)} + \text{O}_2(\text{g}) \rightarrow 4[\text{Au}(\text{CN})_2]^-(\text{aq}) + 4\text{OH}^-(\text{aq})$



(ii) Selenium, tellurium, silver, gold, platinum, and antimony.

(iii) For the reaction $2\text{Cl}^- (\text{aq}) + 2\text{H}_2\text{O} \rightarrow (\text{l}) 2\text{OH}^- (\text{aq}) + \text{H}_2 (\text{g}) + \text{Cl}_2 (\text{g})$
 (g) Value of ΔG° is + 422 kJ. Using the equation $\Delta G^\circ = -nFE^\circ$ the value of E° comes out to be -2.2V. Therefore extraction of Cl_2 from brine will require an external emf of greater than 2.2V.

4. (i) The mixture of compounds A and B is passed through a column of Al_2O_3 by using alcohol as eluant. Compound A is eluted in preference to compound B. Which of the compounds A or B, is more readily adsorbed on the column?
 (ii) Why are sulphide ores converted to oxide before reduction?
 (iii) What should be the considerations during the extraction of metals by electrochemical method?

Ans. (i) Since compound 'A' comes out before compound 'B', the compound 'B' is more readily adsorbed on column.
 (ii) Sulphides are not reduced easily but oxides are easily reduced.
 (iii) Generally two things are considered so that proper precautions can be taken.
 (a) reactivity of metal produced.
 (b) suitability of electrodes.

5. (i) What is flux? What is the role of flux in the metallurgy of iron and copper?
 (ii) Why is froth floatation method selected for the concentration of sulphide ores?
 (iii) Write the overall reaction taking place in the process used for the electrolysis of alumina by Hall-Heroult process.

Ans. (i) Flux is a substance which is used to remove impurities from ore. In the metallurgy of copper SiO_2 is flux which combines with the impurity of FeO and forms FeSiO_3 . In case of metallurgy of Iron CaO is flux which removes impurities of SiO_2 by forming CaSiO_3 .
 (ii) The mineral particles become wet by oils while the gangue particles by water. A rotating paddle agitates the mixture and draws air in it. As a result, froth is formed which carries the mineral particles. The froth is light and is skimmed off. It is then dried for recovery of the ore particles.
 (iii) Cathode: $\text{Al}^{3+} (\text{melt}) + 3\text{e}^- \rightarrow \text{Al}(\text{l})$
 Anode: $\text{C}(\text{s}) + \text{O}^{2-} (\text{melt}) \rightarrow \text{CO}(\text{g}) + 2\text{e}^-$
 $\text{C}(\text{s}) + 2\text{O}^{2-} (\text{melt}) \rightarrow \text{CO}_2 (\text{g}) + 4\text{e}^-$

HALOGEN FAMILY

FIVE MARKS QUESTIONS

Q 1 (a) . Explain why fluorine forms only one oxoacid, HOF.

Ans: 'F' can form only -1 oxidation state, due to small size and absence of empty d – orbitals , hence it forms only one oxoacid HOF

(b) . Explain why in spite of nearly the same electro negativity, oxygen forms Hydrogen bonds while chlorine does not.

Ans: Due to small size of Oxygen as compared to chlorine

(c) With what neutral molecule is ClO^- isoelectronic? Is that molecule a Lewis base?

Ans: ClF is isoelectronic with ClO^- and it has lone pairs hence act as Lewis base.

(d). Oxidising ability of halogens is $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$ give reason.

Ans: The decreasing oxidising ability of the halogens in aqueous solution

Down the group is evident from their standard electrode potentials

which are dependent on the parameters indicated below:

(e) Ionic character of Metal chlorides decreases as oxidation state increases, Explain.

Ans: As oxidation state increases Ionization energy increases hence ionic Character decreases. and the halides in higher oxidation state will be more covalent than the one in lower oxidation state .

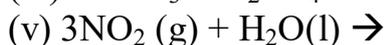
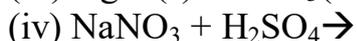
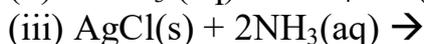
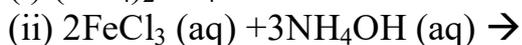
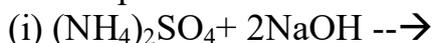
Q2 Complete the following Reactions of Chlorine:



Nitrogen Family

Five Marks Question

1. Complete and balance – 1x5=5



2. Give reasons for the following? [1X5=5]

(a) Nitrogen does not show catenation.

(b) PCl_5 exists but NCl_5 does not.

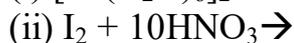
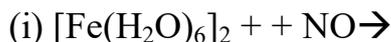
(c) The stability of Hydrides follows the order-
 $\text{NH}_3, \text{PH}_3, \text{AsH}_3, \text{SbH}_3$

(d) PH_3 is a weaker base than NH_3 .

(e) Molecular nitrogen is chemically inert.

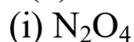
3. (a) In 15 group, stability of -3, +5 oxidation state decreases and stability of +3 increases? (2,1,1,1,1)

(b) Complete the reactions;



4. (a) Hydrides of 15/16 group act as ligand (complexing agent)?

(b) Draw the structure of following :-



(c) Complete the reactions



NOBLE GASES

Five marks questions

Q1 Explain the following about noble gases:-

- general electronic configuration
- atomic radius
- ionization enthalpy
- electron gain enthalpy
- boiling points.

Ans (a) ns^2np^6 except He ns^2

(b) Largest in the period, van der Waals radius, increases down the group

(c) highest in the period due to completely filled valence shell, decreases down the group.

(d) large positive values due to completely filled valence shell.

(e) very low due to weak dispersion forces.

Q2 Assign suitable reasons:-

a) Noble gases have very high ionization enthalpy.

b) Why do noble gases have comparatively large atomic size?

c) Among noble gases only Xe forms established compounds.

d) Complete the reaction, $XeF_2 + H_2O \longrightarrow$

e) Xe mainly forms compounds with And

Ans (a) stable electronic configuration.

(b) van der Waals radius.

(c) Xe has low ionization enthalpy.

(d) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

(e) F and O due to high electronegativity.

Q3 (a) Describe the noble gas species which is isostructural with ICl_4^- , IBr_2^- , BrO_3^- .

(b) Name the noble gas compound, which is explosive solid.

(c) Kr forms only

Ans. (A) XeF_4 , XeF_2 , XeO_3

(b) XeO_3 xenon trioxide

(c) KrF_2

Q4 Name different molecules of noble gas , XENON ,also mention their hybridization, valence shell electron pairs ,lone pairs and shape.

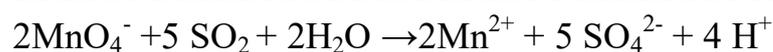
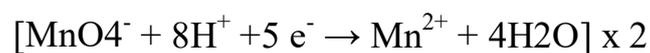
Ans.

S.no.	MOLECULE	HYBRIDISATION	VSEP	Lone pairs	SHAPE
1	XeF ₂	Sp ³ d	5	3	Linear
2	XeF ₄	Sp ³ d ²	6	2	Square planar
3	XeF ₆	Sp ³ d ²	7	1	Distorted octahedral
4	XeOF ₂	Sp ³ d	5	2	T-shape
5	XeO ₂ F ₂	Sp ³ d	5	1	See-saw
6	XeOF ₄	Sp ³ d ²	6	1	Square pyramidal
7	XeO ₃	Sp ³	4	1	pyramidal
8	XeO ₄	Sp ³	4	0	tetrahedral

OXYGEN FAMILY 5 marks questions

1) An element A exists as a yellow solid in standard state. It forms a volatile hydride B which is a foul smelling gas and is extensively used in quantitative analysis of salts. When treated with oxygen, B forms an oxide C which is a colourless, pungent smelling gas. This gas when passed through acidified KMnO_4 solution, decolourises it. C gets oxidized to another oxide D in the presence of a heterogeneous catalyst. Identify A, B, C, D and also give the chemical equation of reaction of C with acidified KMnO_4 solution and conversion of C to D.

Ans 1) A = Sulphur B = H_2S Gas, C = SO_2 gas, D = SO_3 Gas



INNER TRANSITION ELEMENTS

(FIVE MARKS QUESTIONS)

1. Compare the chemistry of actinoids with that of lanthanoids with special reference to :-

- I) Electronic configuration
- II) Atomic and ionic sizes
- III) Oxidation state
- IV) Chemical reactivity
- V) Magnetic behaviour

Ans. I) e.c :- in lanthanoids 4f orbitals are progressively filled whereas in actinoids 5f are progressively filled

Ii)oxidation state :- lanthanoids show +3 state some shows +2 and +4 .

but actinoids show +3,+4,+5,+6,+7 oxidation state. +3 and +4 are common.

Iii)atomic and ionic sizes :- decreases from left to right in both.but decreases more in case of actinoids.

Iv) chemical reactivity :- actinoids are more reactive than lanthanoids.

V) Magnetic behaviour: Ln are paramagnetic but Magnetic behaviour of An cant be studied as they are radioactive.

2. (i)Actinoid contraction is greater from element to element than LanthanoidContraction. Why?

Due to poor shielding by 5f electrons in the Actinoids than that of the 4f electron in the Lanthanoids

(ii).What is lanthanide contraction? How does it affect the chemistry of elements, which follow lanthanoids?

Decrease in atomic / ionic radii across lanthanoid series with increase in atomic number.

Due to lanthanoid contraction the atomic/ionic radii 5d Series elements decrease. Consequently the properties of 4d and 5d series elements become similar.

(iii). $\text{La}(\text{OH})_3$ is stronger base than $\text{Lu}(\text{OH})_3$ Why?

Due to larger size of La^{3+} as compared to Lu^{3+} , it has a greater ionic character hence gives more no. of $-\text{OH}$ ions.

Transition Element (d BLOCK Elements)

(Five Marks Question)

Q.1 How would you account for the following:

- 1) Cr^{2+} is reducing in nature while with the same d- orbital configuration (d^4) Mn^{3+} is an oxidizing agent.
- 2) In a transition metal series, the metal which exhibits the greatest number of oxidation states occurs in the middle of series.
- 3) Many of the transition elements and their compounds can act as good catalysts.
- 4) The metallic radii of the third (5d) series of transition elements are virtually the same as those of corresponding members of the second series.
- 5) The enthalpies of atomization of transition elements are quite high.

Answer –

- (1) Cr^{2+} to Cr^{3+} gaining stable configuration for t_{2g}^3 .
- (2) Due to higher no. of unpaired electron.
- (3) Due to showing variable oxidation state and incomplete d orbitals.
- (4) Due to lanthanoid contraction.
- (5) Due to presence of unpaired electron and strong metallic bonding.

Q.2 Assign the reason for the following-

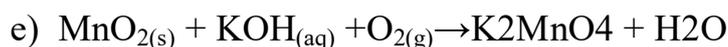
- 1) The enthalpies of atomization of transition elements are quite high.
- 2) The transition metals generally form coloured compounds.
- 3) Transition metals are well known to form complex compounds.
- 4) Transition metals and their compounds generally exhibit a paramagnetic behavior.
- 5) Zn, Cd, Hg are not regarded as a transition elements.

Answer-

- (1) Due to strong metallic bonding.
- (2) Due to unpaired electron and d-d transition.
- (3) Due to small size, high ionic charge and incomplete d orbitals.
- (4) Due to presence of unpaired electron.
- (5) Due to completely filled d (d^{10}) configuration.

Q. 3 Complete the following chemical equations:

- a) $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{+2} + \text{H}_2\text{O}$
- b) $\text{MnO}_4^- (\text{aq}) + \text{C}_2\text{O}_4^{2-} (\text{aq}) + \text{H}^+ (\text{aq}) \rightarrow \text{Mn}^{+2} + \text{CO}_2$
- c) $\text{Cr}_2\text{O}_7^{2-} (\text{aq}) + \text{Fe}^{2+} (\text{aq}) + \text{H}^+ (\text{aq}) \rightarrow \text{Cr}^{+3} + \text{Fe}^{+3} +$
- d) $\text{Cr}_2\text{O}_7^{2-} (\text{aq}) + \text{H}_2\text{S} (\text{aq}) + \text{H}^+ (\text{aq}) \rightarrow \text{Cr}^{+3} + \text{S} + \text{H}_2\text{O}$



Q.4 State the reason for the following-

- 1) Cu^+ ions are not stable in aqueous solution.
- 2) In the series Sc to Zn, the enthalpy of atomization of Zn is the lowest.
- 3) Mn exhibits the highest oxidation state of +7 among the 3d-series of transition elements.
- 4) Co^{2+} is easily oxidized to Co^{3+} in the presence of a strong ligand.
- 5) Many of the transition elements are known to form interstitial compounds.

Ans- (1) due to very high hydration enthalpy.

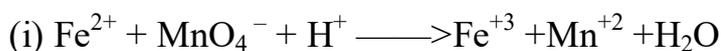
(2) due to weak metallic bonding in absence of unpaired electron.

(3) due to maximum no. of unpaired electron.

(4) due to stable configuration of $(t_{2g})^6$.

(5) due to presence of voids in crystalline structure.

Q 5-(a) Complete the following chemical reaction equations:



(b) Explain the following observations:

(i) In general the atomic radii of transition elements decrease with atomic number in a given series. (ii) The $E^\circ_{\text{M}^{2+}/\text{M}}$ for copper is positive (+ 0.34 V). It is the only metal in the first series of transition elements showing this type of behaviour.

(iii) The E° value for $\text{Mn}^{3+} | \text{Mn}^{2+}$ couple is much more positive than for $\text{Cr}^{3+} | \text{Cr}^{2+}$ or $\text{Fe}^{3+} | \text{Fe}^{2+}$ couple.

Ans. – (1) due to increasing no. of proton and effective nuclear charge but no. of shell remain the same.

(2) Due to high hydration enthalpy and comparatively low atomisation enthalpy.

(3) due to obtained the stable configuration of d4 to d5. but this is not in case of cr and fe.

Transition elements

5 marks question

Q.1 Explain the general characteristics of the first series of transition elements .

A1. General characteristics of the first series of transition elements .

- *Variable oxidation states.
- * Most of the transition elements show paramagnetic behavior.
- *They form complexes.
- * They form alloys.
- * Most of the transition elements and their compounds act as Catalyst.
- *They form interstitial compounds.
- * they form coloured compounds.

Q.2 In what way is the electronic configuration of the transition elements different from that of the non-transition elements

Why are Mn^{2+} compounds more stable than Fe^{2+} towards oxidation to their +3 state

A2. the electronic configuration of the transition elements is $(n-1)d^{1-10}, ns^{1-2}$, while that of the non transition elements is $ns^2 np^{1-6}$

Mn^{2+} has stable configuration and does not easily change into Mn^{3+} , while Fe^{2+} on oxidation form Fe^{3+} , which is stable.

Q.3 What are the characteristics of the transition **elements** and why are they called transition elements ? which of the d-block element may not be regarded as transition elements ?

A3. The characteristics of the transition **elements: they have /form vacant d orbitals, variable oxidation states, coloured compounds, complex compounds, alloys, interstitial compounds, paramagnetic behavior.**

They called transition elements because they are present in between s and p block elements.

Zn, Cd and Hg are not regarded as transition elements as they have all the paired electrons in d orbitals.

Q.4 Explain giving reason :

- a) transition metals and many of their compounds show paramagnetic behavior .
- b) the enthalpies of atomisation of they transition metals are high.
- c) the transition metals generally form coloured compounds.
- d) transition metals in their many compounds acts as good catalyst

A4. (a) Due to presence of half filled d orbitals.

(b) Due to strong interatomic interaction between them.

(c) Due to d-d transition.

(d) Due to vacant d orbital, small size

Q.5 Write down the number of 3d electrons in each of the following ions. Ti^{2+} , V^{2+} , Cr^{3+} , Mn^{2+} , Fe^{2+} , Fe^{3+} , Co^{2+} , Ni^{2+} and Cu^{2+} . Indicate how would you expect the five 3d orbitals to be occupied for these hydrated ions (octahedral).

A5. Ions	Configuration	Occupancy of 3d orbital
Ti^{2+}	$3d^2$	t_{2g}^2
V^{2+}	$3d^3$	t_{2g}^3
Cr^{3+}	$3d^3$	t_{2g}^3
Mn^{2+}	$3d^5$	t_{2g}^5
Fe^{2+}	$3d^6$	t_{2g}^6
Fe^{3+}	$3d^5$	t_{2g}^5
Co^{2+}	$3d^7$	$t_{2g}^6 e_g^1$
Ni^{2+}	$3d^8$	$t_{2g}^6 e_g^2$
Cu^{2+}	$3d^9$	$t_{2g}^6 e_g^3$

Coordination Chemistry

5 Marks

- 1.(a) Explain the bonding in coordination compounds in terms of Werner's postulates.
(b) How many geometrical isomers are possible in the following coordination entities?
(i) $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$ (ii) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$

Answer

(a) Werner's postulates explain the bonding in coordination compounds as follows:

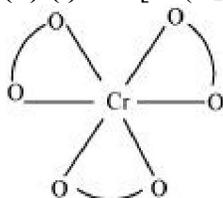
(i) A metal exhibits two types of valencies namely, primary and secondary valencies. Primary valencies are satisfied by negative ions while secondary valencies are satisfied by both negative and neutral ions.

(In modern terminology, the primary valency corresponds to the oxidation number of the metal ion, whereas the secondary valency refers to the coordination number of the metal ion.)

(ii) A metal ion has a definite number of secondary valencies around the central atom. Also, these valencies project in a specific direction in the space assigned to the definite geometry of the coordination compound.

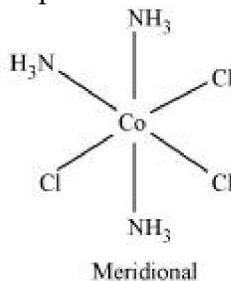
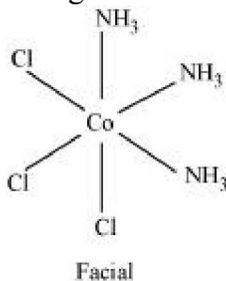
(iii) Primary valencies are usually ionizable, while secondary valencies are non-ionizable.

- (b) (i) For $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$, no geometric isomer is possible as it is a bidentate ligand.



- (ii) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$

Two geometrical isomers are possible.



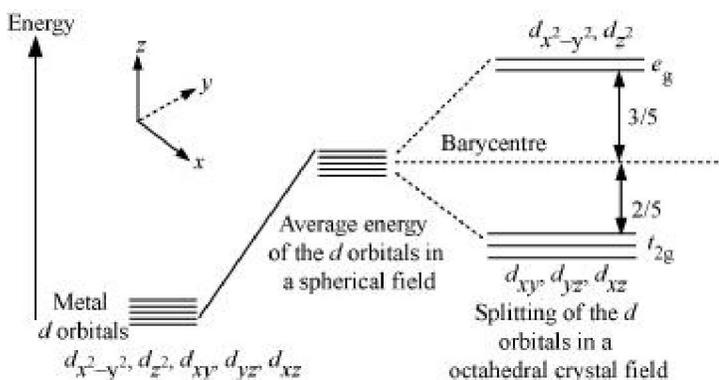
2. (a) .What is spectrochemical series? Explain the difference between a weak field ligand and a strong field ligand.

. (b) Draw figure to show the splitting of d orbitals in an octahedral crystal field.

Answer (a) A spectrochemical series is the arrangement of common ligands in the increasing order of their crystal-field splitting energy (CFSE) values. The ligands present on the R.H.S of the series are strong field ligands while that on the L.H.S are weak field ligands. Also, strong field ligands cause higher splitting in the d orbitals than weak field ligands.

$I^- < Br^- < S^{2-} < SCN^- < Cl^- < N_3^- < F^- < OH^- < C_2O_4^{2-} \sim H_2O < NCS^- \sim H^- < CN^- < NH_3 < en \sim SO_3^{2-} < NO_2^- < phen < CO$

(b)The splitting of the d orbitals in an octahedral field takes place in such a way that $d_{x^2-y^2}$, d_{z^2} experience a rise in energy and form the e_g level, while d_{xy} , d_{yz} and d_{zx} experience a fall in energy and form the t_{2g} level.



3. (a) $[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why?

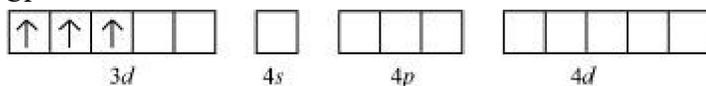
(b) Discuss briefly giving an example in each case the role of coordination compounds in:

- (i) biological system
- (ii) medicinal chemistry
- (iii) analytical chemistry

Answer

(a) Cr is in the +3 oxidation state i.e., d^3 configuration. Also, NH_3 is a weak field ligand that does not cause the pairing of the electrons in the $3d$ orbital.

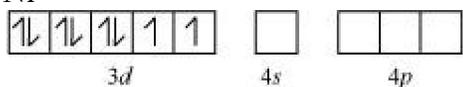
Cr^{3+}



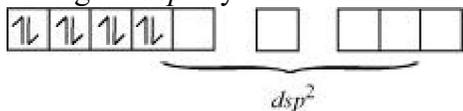
Therefore, it undergoes d^2sp^3 hybridization and the electrons in the $3d$ orbitals remain unpaired. Hence, it is paramagnetic in nature.

In $[\text{Ni}(\text{CN})_4]^{2-}$, Ni exists in the +2 oxidation state i.e., d^8 configuration.

Ni^{2+} :



CN^- is a strong field ligand. It causes the pairing of the $3d$ orbital electrons. Then, Ni^{2+} undergoes dsp^2 hybridization.



As there are no unpaired electrons, it is diamagnetic.

(b) (i) Role of coordination compounds in biological systems:

We know that photosynthesis is made possible by the presence of the chlorophyll pigment. This pigment is a coordination compound of magnesium. In the human biological system, several coordination compounds play important roles. For example, the oxygen-carrier of blood, i.e., haemoglobin, is a coordination compound of iron.

(ii) Role of coordination compounds in medicinal chemistry:

Certain coordination compounds of platinum (for example, *cis*-platin) are used for inhibiting the growth of tumours.

(iii) Role of coordination compounds in analytical chemistry:

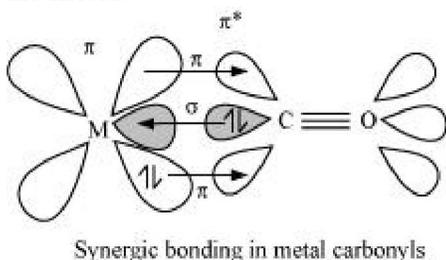
During salt analysis, a number of basic radicals are detected with the help of the colour changes they exhibit with different reagents. These colour changes are a result of the coordination compounds or complexes that the basic radicals form with different ligands.

(iii) Role of coordination compounds in extraction or metallurgy of metals:

The process of extraction of some of the metals from their ores involves the formation of complexes. For example, in aqueous solution, gold combines with cyanide ions to form $[\text{Au}(\text{CN})_2]$. From this solution, gold is later extracted by the addition of zinc metal.

4. Discuss the nature of bonding in metal carbonyls.. What is meant by the *chelate effect*? Give an example.

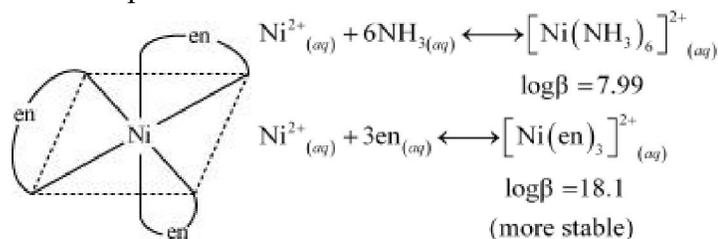
Answer: The metal-carbon bonds in metal carbonyls have both σ and π characters. A σ bond is formed when the carbonyl carbon donates a lone pair of electrons to the vacant orbital of the metal. A π bond is formed by the donation of a pair of electrons from the filled metal d orbital into the vacant anti-bonding π^* orbital (also known as back bonding of the carbonyl group). The σ bond strengthens the π bond and vice-versa. Thus, a synergic effect is created due to this metal-ligand bonding. This synergic effect strengthens the bond between CO and the metal.



Chelate effect: When a ligand attaches to the metal ion in a manner that forms a ring, then the metal- ligand association is found to be more stable. In other words, we can say that

complexes containing chelate rings are more stable than complexes without rings. This is known as the chelate effect.

For example:

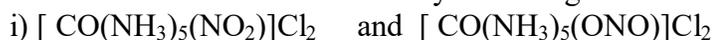


5, (a) Write IUPAC name of the following



(b) A solution of [Ni(H₂O)₆]²⁺ is green but a solution of [Ni(CN)₄]²⁻ is colourless. Explain.

© Which isomerisms are shown by following



Answer(a) (b) Hexaaminocobalt (III)chloride

(b) In [Ni(H₂O)₆]²⁺, $\text{H}_2\ddot{\text{O}}:$ is a weak field ligand. Therefore, there are unpaired electrons in Ni²⁺. In this complex, the *d* electrons from the lower energy level can be excited to the higher energy level i.e., the possibility of *d-d* transition is present. Hence, Ni(H₂O)₆²⁺ is coloured.

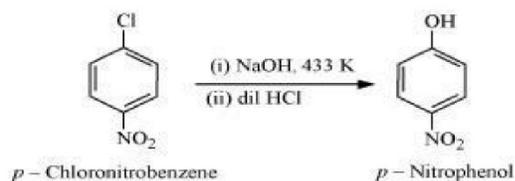
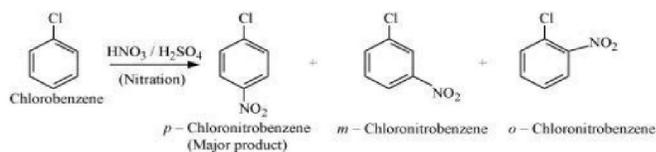
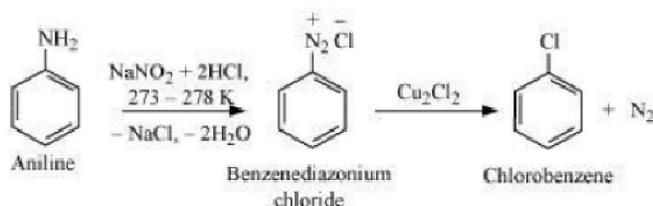
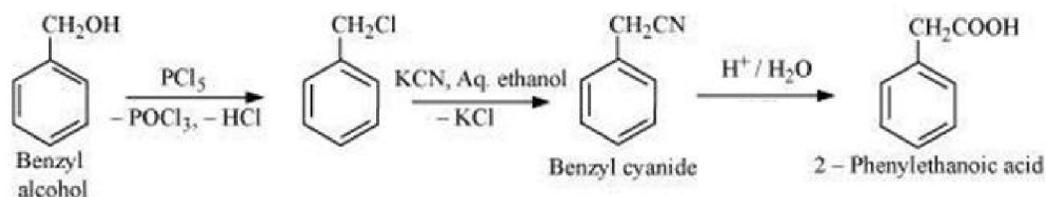
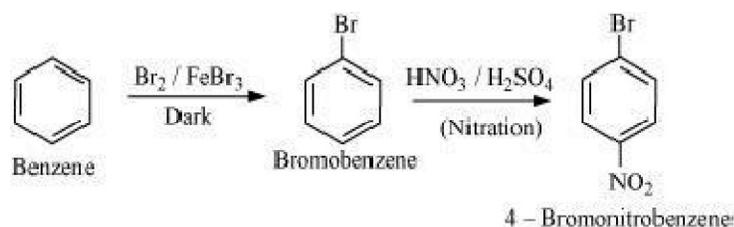
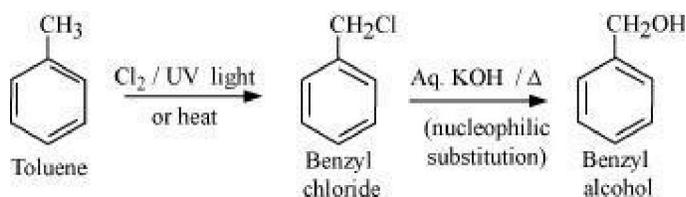
In [Ni(CN)₄]²⁻, the electrons are all paired as CN⁻ is a strong field ligand. Therefore, *d-d* transition is not possible in [Ni(CN)₄]²⁻. Hence, it is colourless.

© i) Linkage isomerism ii) Ionization isomerism

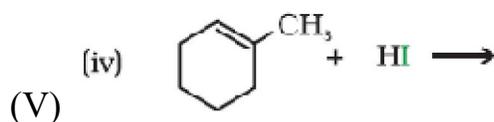
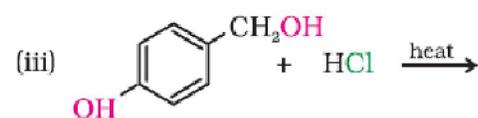
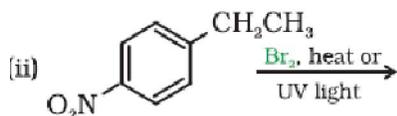
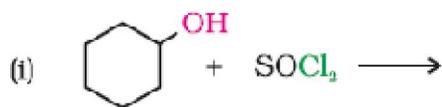
HALO ARENES 5-Marks Questions

Q1) How do you convert the following?

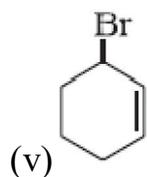
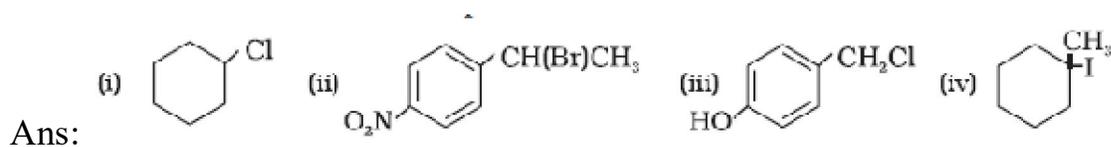
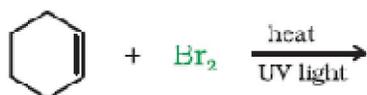
- (i) Toluene to benzylalcohol (ii) Benzene to 4-bromonitrobenzene
 (iii) Benzylalcohol to 2-phenylethanoic acid (iv) Aniline to chloro benzene (v)
 Chloro benzene to p-nitrophenol



Q2. Draw the structures of major monohalo products in each of the following reactions:



(V)



3. (i) Why are halo alkanes more reactive than haloarenes?.

Ans. In haloarenes, there is double bond character between carbon and halogen due to resonance effect which makes it less reactive. In benzene, carbon atom is

sp² hybridised which is more electronegative than sp³ C present in halo alkanes. Hence C-Cl bond in aryl halides is shorter and stronger.

(ii) Why do halo alkanes undergo nucleophilic substitution whereas haloarenes undergo electrophilic substitution?

Ans. Due to more electro negative nature of halogen atom in halo alkanes carbon atom becomes slightly positive and is easily attacked by nucleophilic reagents. While in halo arenes due to resonance, carbon atom becomes slightly negative and attacked by electrophilic reagents.

(iii) Aryl halides cannot be prepared by the action of sodium halide on phenol in the presence H₂SO₄. Why?

Ans. Due to resonance the carbon-oxygen bond in phenol has partial double bond character and it is stronger than carbon oxygen single bond.

(iv) p-dichloro benzene has higher m.p. than those of ortho and m-isomers.?

Ans. p-dichloro benzene is symmetrical, fits into crystal lattice more readily and has higher melting point

(v) Why does preparation of aryl iodides requires presence of an oxidising agent?

Ans. Iodination reaction is reversible in nature To carry out the reaction in the forward direction, HI formed during iodination is removed by oxidation. HIO₄ is used as an oxidising agent.

4. (a) How are the following conversions carried out?

(i) Aniline to chlorobenzene

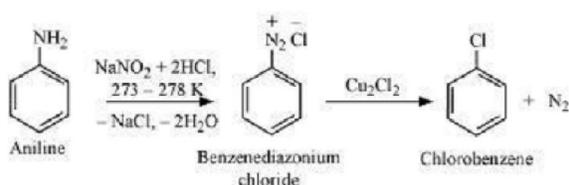
(ii) Chloro benzene to p-nitrophenol

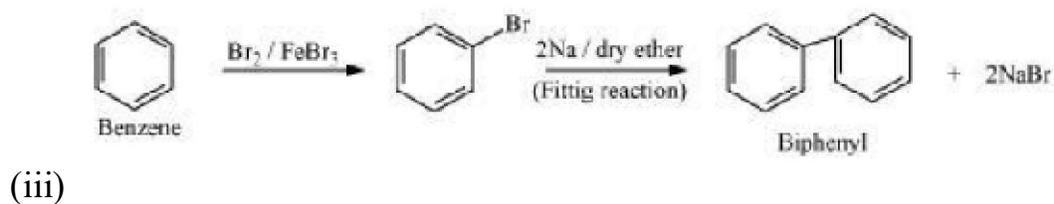
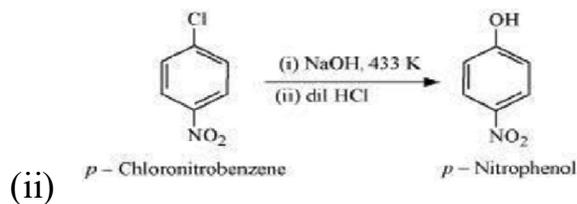
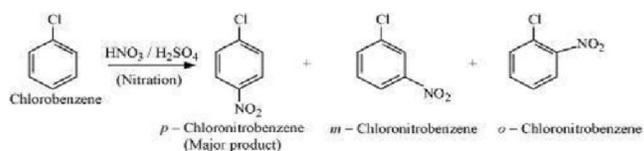
(iii) Benzene to diphenyl

(iv) Benzyl chloride to benzyl alcohol

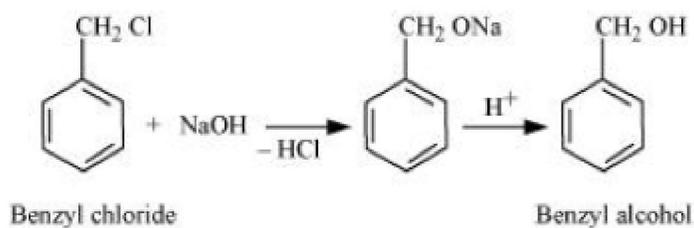
(v) Aniline to iodobenzene

Ans: (i)

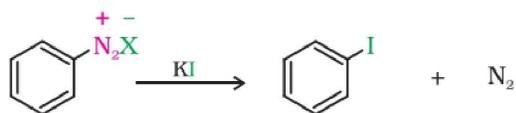
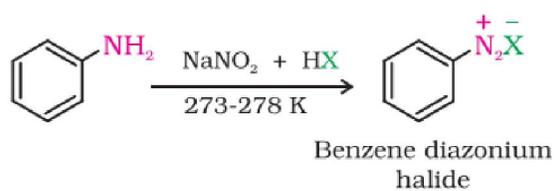




(iv)



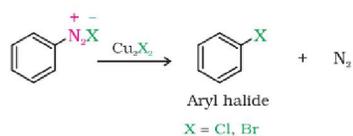
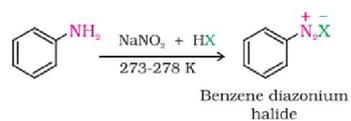
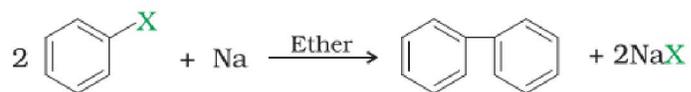
(v)



5. Write:

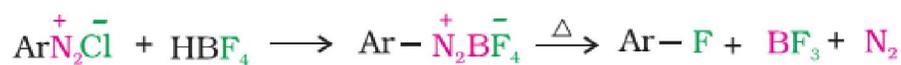
(i) Fittig Reaction (ii) Sandmeyer Reaction (iii) Balz-Schiemann reaction
 (iv) Friedel-Crafts Alkylation (v) Friedel-Crafts Acylation

Ans: (i)

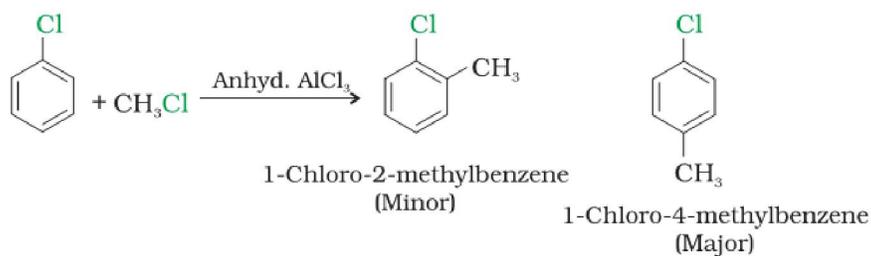


(ii)

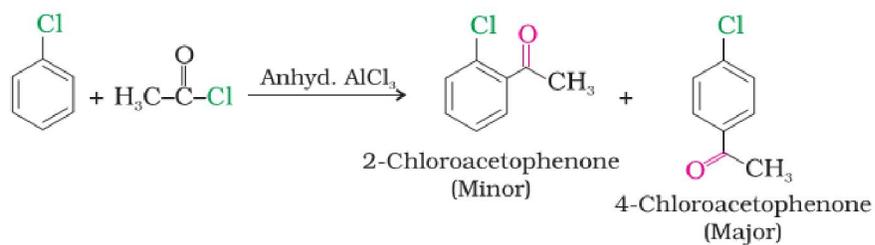
(iii)



(iv)



(v)

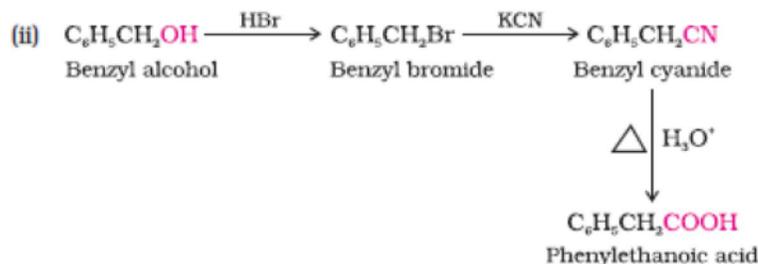
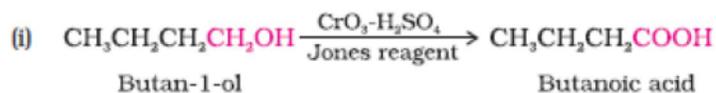


Q.3- Write chemical reactions to affect the following transformations:

- (a)(i) Butan-1-ol to butanoic acid (ii) Benzyl alcohol to phenyl ethanoic acid

(b) Why is the Dipole moment of methanol higher than that of phenol?

Ans.(a)



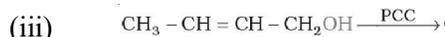
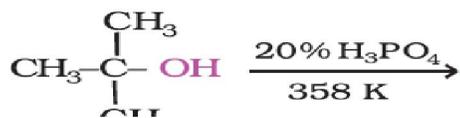
(b) Due to electron withdrawing effect of phenyl group, the C—O bond in phenol is less polar, whereas in case of methanol the methyl group has electron releasing effect and hence C—O bond in it is more polar.

Q.4-Complete the following reactions.

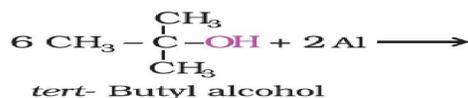
Pyridine



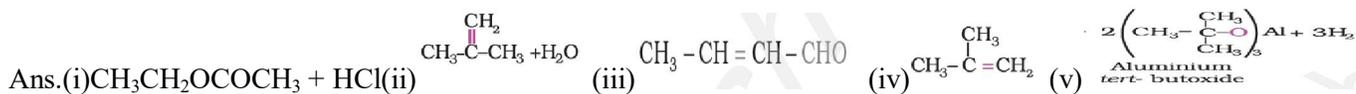
(ii)



(iv)



(v)



Q.5-An Organic compound 'A' with molecular formula CH_2O on treatment with Grignard Reagent 'B' followed by acidic hydrolysis, gives a compound 'C'. Compound 'C' on treatment with I_2 and NaOH , gives a yellow compound 'D'. The compound 'C' on treatment with CrO_3 , gives a compound 'E' having the same functional group with the compound 'A' and gives the same compound 'D' on treatment with I_2 and NaOH . Identify the compound A, B, C, D and E.

Ans. A = HCHO (Methanal) B = CH_3MgBr (Methyl Magnesium Bromide) C = $\text{CH}_3\text{CH}_2\text{OH}$ (Ethanol)

D = CHI_3 (Iodoform) E = CH_3CHO (Ethanal)

QUESTION BANK

CLASS-XII

SUBJECT-CHEMISTRY

UNIT- (11)

ETHERS

5 Marks

1. Write all five electrophilic substitution reactions of anisole.

2. Give reasons:

i. Ethers are partially soluble in water.

Ans: Due to formation H-bond with water.

ii. Ethers may explode on storage.

Ans: Due to formation of ether peroxides.

iii. Ethers acts as lewis base.

Ans: due to presence of lone pair of electrons.

iv. Higher ethers are insoluble in water.

Ans: Due to large number of alkyl groups.

v. Diethyl ether is used as starting fluid in diesel engines.

Ans: Due to high cetane number.

QUESTION BANK (XII)

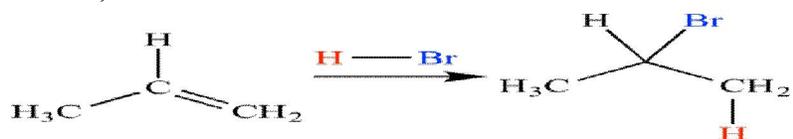
HALOALKANES AND HALOARENES

5 MARK QUESTION-

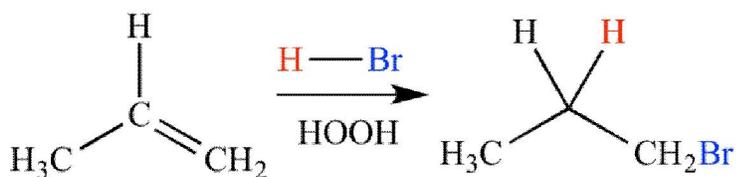
Q.1. Give one example each of

- a) Markwonikov's addition.
- b) Kharasch effect.
- c) Finkelstein reaction
- d) Dehydro halogenation (b elimination reaction)
- e) Wurtz reaction

Ans. a)

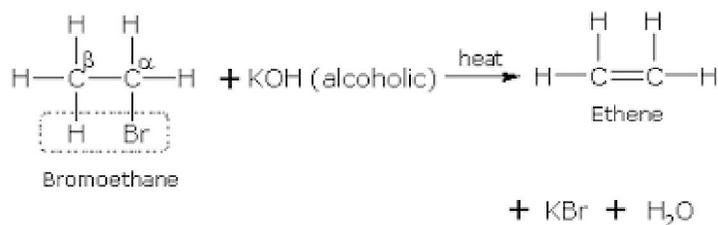


b)

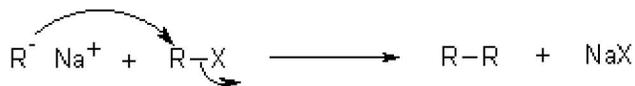


c) $\text{C}_2\text{H}_5\text{Cl} + \text{NaI}$ (with acetone) $\rightarrow \text{C}_2\text{H}_5\text{I} + \text{NaCl}$

d)



e)



Q.2. Account for the following:

- 1) Halo alkanes have higher boiling point than the corresponding parent alkane.
- 2) Boiling point of halo alkanes $\text{RI} > \text{RBr} > \text{RCl} > \text{RF}$

- 3) Halo alkanes are polar in nature but sparingly soluble in water.
- 4) Kharasch effect is possible only with HBr and not with HCl and HI.
- 5) Alcohol reacts with thionyl chloride to give pure halo alkane.

Ans. 1) Due to high mol. Mass

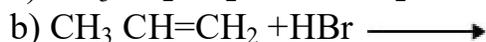
2) Due to high mol. Mass

3) . Cannot form H-bonds with water molecules & cannot break H-bonds between water molecules

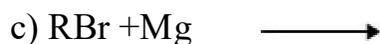
4) Both steps of mechanism are exothermic in case of HBr while in case of HCl or HI either step is exothermic

5) Other by product are gases leaving behind the pure RX

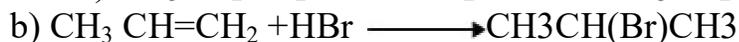
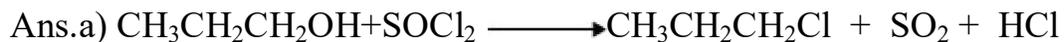
Q.3. Write the structure of the major organic product in each of the following reactions:



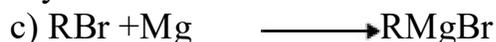
dry ether



ethanol



dry ether



ethanol



Q.4. Explain the following with suitable examples:

- a) chiral and chirality
- b) enantiomers
- c) racemic mixture
- d) retention of configuration
- e) inversion of configuration.

TOPIC: PHENOL

FIVE MARKS QUES:

1. Give the reason for the following statement:

(i) Reactions of alcohol/phenol with acid chloride carry in the presence of pyridine.

(ii.) The boiling points of phenols are higher than the corresponding arenes and haloarene.

(iii) Phenols are sparingly soluble in water.

(iv) o-nitrophenol is more acidic than o-methoxyphenol.

(v) Phenol does not give protonation reaction readily.

Ans(i) Pyridine is used in acylation of alcohol/phenol to remove the acid produced (HCl or CH₃COOH) during the reaction.

(ii) Phenols form H-bonds among their molecules and water because the –O–H is a polar bond. The H-bonding in phenols is stronger and have comparatively much higher boiling point than arenes and haloarenes.

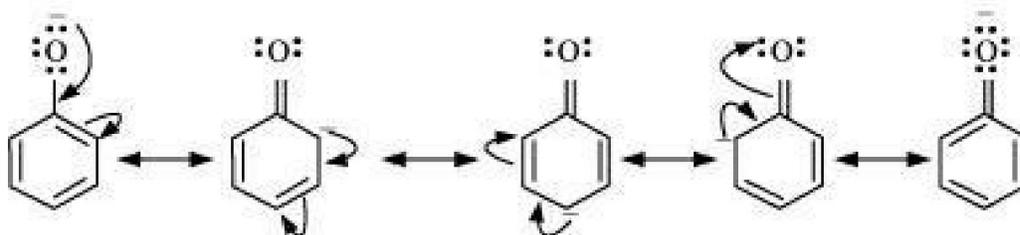
(iii) phenols are sparingly soluble in water because of the limited H-bonding due to large benzene ring.

(iv) –NO₂ group is an electron withdrawing group and tend to decrease the electron density on –OH thereby increasing its tendency to lose H⁺ ions, consequently increasing the acidic nature. but in o-methoxyphenol, –OCH₃ group has +I effect and hence less is acidic.

(v) C–OH in phenol is stabilized due to resonance and electron pair at oxygen atom in phenol is not readily available to proton, thus protonation not occurs readily.

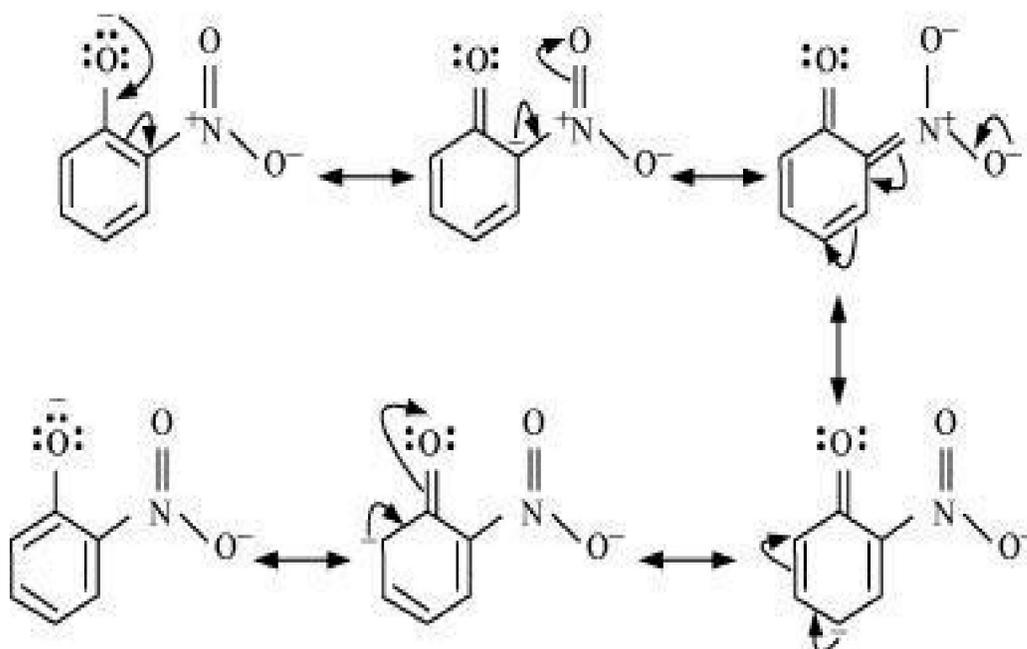
2. *Ortho* and *para* nitrophenols are more acidic than phenol. Draw the resonance structures of the corresponding phenoxide ions.

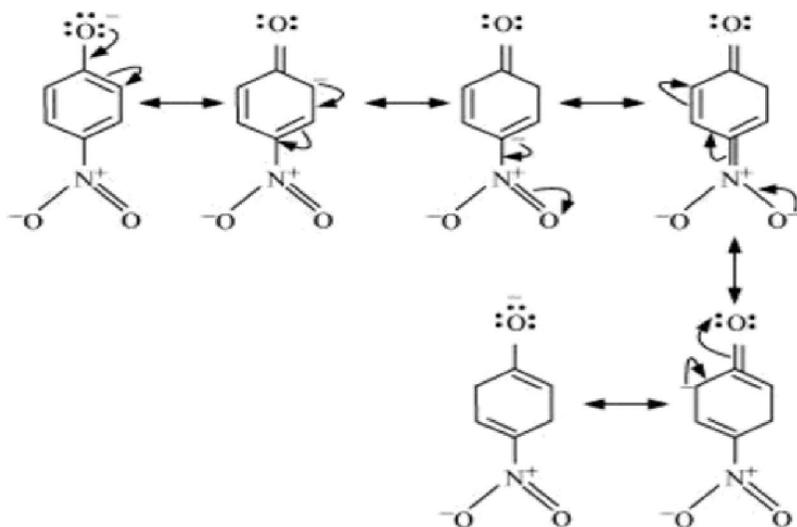
Ans:



Resonance structures of phenoxide ion

Resonance structures of o-nitrophenoxide ion





It can be observed that the presence of nitro groups increases the stability of phenoxide ion.

3. Benzene is sulphonated with oleum formed compound (A) which on heating with NaOH and acidify give compound (B) which on nitration with conc. HNO_3 give product (C). On nitration of (B) with dil HNO_3 at low temperature give mixture of nitro derivatives (D) and (E). Identify each compound A, B, C, D and E.

Ans: A---: Benzene Sulphonate.

B---: Phenol

C---: 2,4,6 trinitrophenol.

D---: o- nitrophenol. (minor product)

E---: p- nitrophenol (major Product)

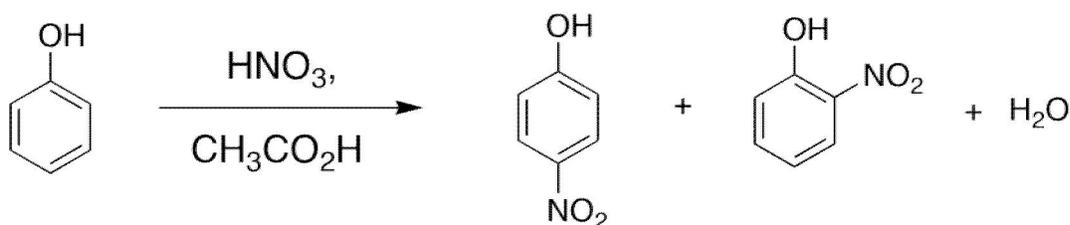
4. (i) Which is stronger acid – Phenol or cresol? Why?

(ii) How can we produce o & p nitro benzene from phenol ?

(iii) How benzene obtained from phenol?

Ans: Phenol is stronger acid because in cresol, due to the presence of one $-CH_3$ group having +I effect increases electron density on O of $-OH$ group and thus decreasing its acidic strength

: (ii) Phenol reacts with dil. HNO_3 at 298 K forming o-nitrophenol and p nitrophenol respectively.



(iii) Benzene obtained from phenol by treating with zinc



5.(i) Write the name reaction in the following:

(a) Formation of salicylaldehyde.

(b) Formation of salicylic acid.

(ii) Write the IUPAC name of the product obtained in the following chemical reactions:

(a) Nitration of phenol with conc HNO_3 .

(b) benzene on reaction with conc. H_2SO_4 and $NaOH$.

(c) Phenol with sodium

Ans (i) (a) Reimer-Tiemann reaction .

(b) Kolbe's reaction

(ii) (a) 2,4,6 trinitro phenol

(b) Phenol / hydroxyl benzene.

(c) sodium phenoxide

V.L.SEMALTY

PGT(CHEM) K.V.No.1 HBK DEHRADUN

ALDEHYDE

LONG ANSWER TYPE QUESTION

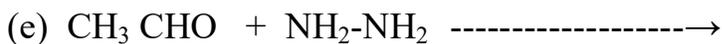
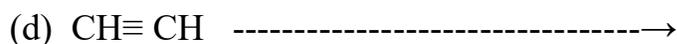
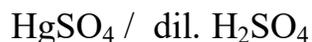
(5)

Marks)

1. Complete the following reaction –



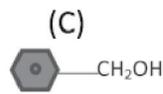
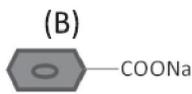
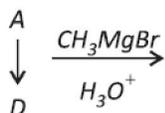
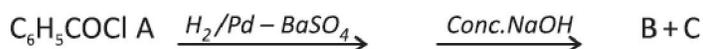
(i) PCl_5 / (ii) Pd / BaSO_4



Ans. (a) $\text{C}_6\text{H}_5\text{CHO}$ (b) CH_3CHO (c) $\text{CH}_3\text{CH}_2\text{CHO}$ (d) CH_3CHO (e) $\text{CH}_3\text{CH=N-NH}_2$

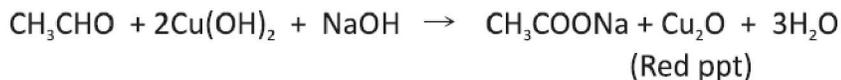
2.

(a) Write the structures of A, B, C and D in the following reactions:



(b) Distinguish between: (i) Acetone and Acetaldehyde (ii) Benzaldehyde and Benzophenone

(i) Acetaldehyde on warming with Fehling solution, gives red precipitate of cuprous oxide, while acetone does not.



(ii) Benzaldehyde gives Tollens' test, while benzophenone not.



3. Explain the following:

(a) (i) Wolff - Kishner reduction

(ii) Clemensen's reduction

(iii) Stephan Reduction

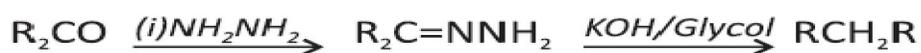
(b) How will you carried out following conversions:

(i) Acetic acid to acetaldehyde

(ii) Ethanal to But-2-enal

Ans .(a) (i)

Wolff-kishner reduction



(ii)

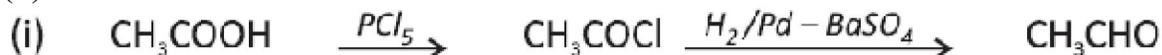
Clemensen's reduction



(iii) Stephan Reduction



(b)



(ii) Dil. NaOH Heat



4. Answer the following questions

(a) Why does methanal not give aldol condensation while ethanal gives?

(b) Arrange the following in order of increasing boiling points:

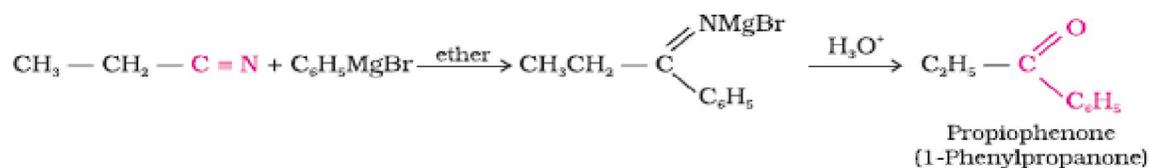


(c) How will you convert Phenyl magnesium bromide to Propiophenone? (Write the equation)

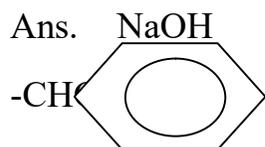
Ans. (a) This is because only those compounds which have alpha hydrogen atoms can undergo aldol condensation. Ethanol possesses alpha -hydrogen and Methanal has no alpha hydrogen atoms, hence does not undergo aldol condensation.

(b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{C}_2\text{H}_5\text{OC}_2\text{H}_5 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CHO} < \text{CH}_3(\text{CH}_2)_2 \text{OH}$

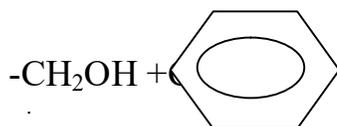
(c)



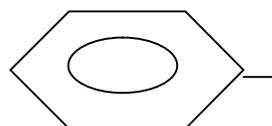
(5) An organic compound 'A' which has characteristic odour on treatment with NaOH forms two compounds 'B' and 'C'. Compound 'B' has the molecular formula $\text{C}^7\text{H}_8\text{O}$ which on oxidation gives back compound 'A'. Compound 'C' is the sodium salt of an acid which when heated with soda lime yields an aromatic hydrocarbon 'D'. Deduce A,B,C,D.



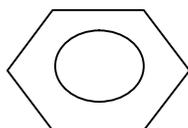
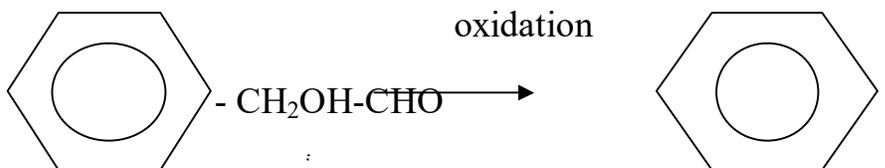
[A]



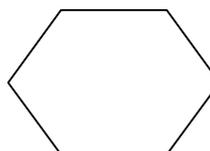
[B]

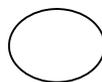


[C]



NaOH, CaO





+

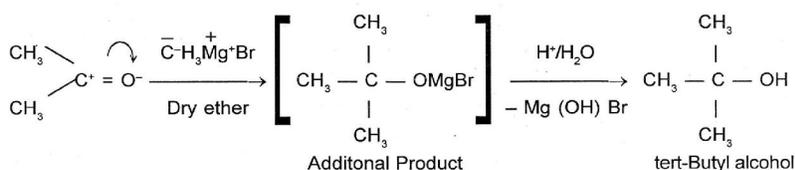
D

KETONES

5 marks question :-

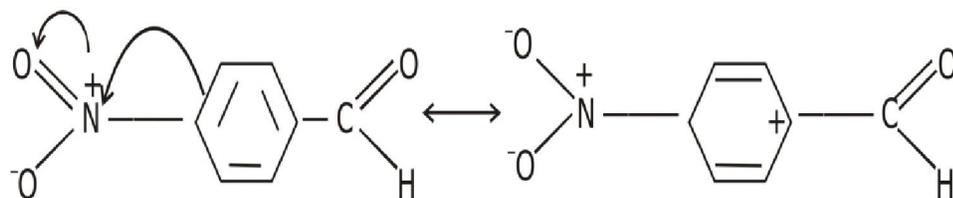
Q1.a) Convert acetone into tertiary butyl alcohol

b) Out of p-nitro benzaldehyde and benzaldehyde which is more reactive towards nucleophilic addition reactions and why



In p-nitrobenzaldehyde, the NO_2 group is a powerful electron-withdrawing group.

It withdraws electrons both by inductive and resonance effect thereby decreasing the electron density on the carbon atom of carboxyl group. This facilitates the attack of the nucleophile and hence makes it more reactive than benzaldehyde.



Q2. Distinguish the following pair of compounds

- Benzoic acid and ethyl benzoate
- Pentan-2-one and Pentan-3-one
- Benzaldehyde and Acetophenone

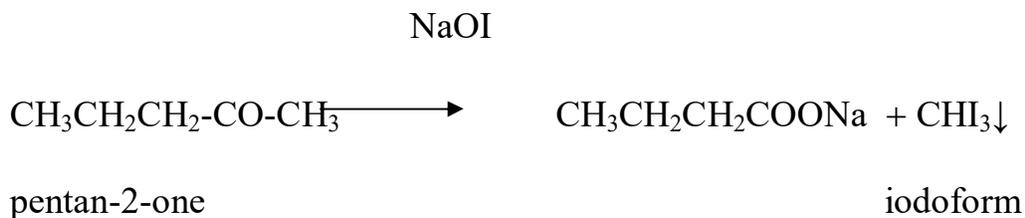
Ans. a) Benzoic acid on treatment with sodium hydrogen carbonate produces effervescence due to evolution of CO_2 , as it is more acidic than phenol.



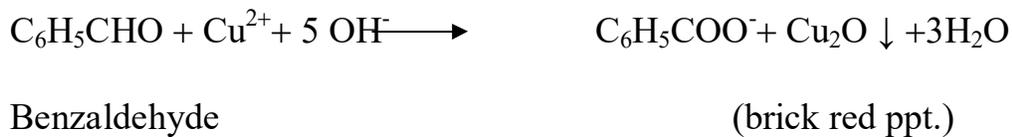
(Benzoic acid)

(effervescence)

b) Pentan-2-one gives a yellow ppt. of iodoform on treatment with a mixture of NaOH and I₂ but not Pentan-3-one, as it lacks the terminal methyl ketone group.



c) Benzaldehyde gives a brick red precipitate on treatment with Fehling's A and B solution on oxidation but acetophenone does not.



AMINES(PREPARATION & PHYSICAL PROPERTIES)

5 MARK QUESTION (5)

1. A compound (X) having formula C_3H_7NO reacts with Br_2 in the presence of $NaOH$ to give another compound (Y). Compound (Y) reacts with HNO_2 to form ethanol and N_2 gas. Identify (X) and (Y). Write the reaction involved.

Ans: Since Y gives ethanol and N_2 gas with HNO_2 , therefore it is $CH_3CH_2NH_2$. Ethan amine (Y) is formed on reacting (X) with Br_2 and $NaOH$; Therefore X is $CH_3CH_2CONH_2$.

Therefore $X = CH_3CH_2CONH_2$, $Y = CH_3CH_2NH_2$

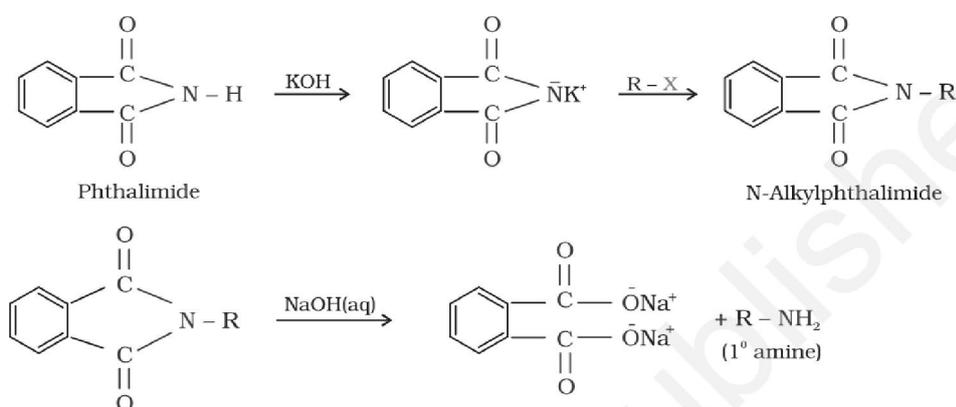
The reactions are –



2. Define the Gabriel phthalimide synthesis in detail.

Ans: Gabriel synthesis is used for the preparation of primary amines. Phthalimide on treatment with ethanolic potassium hydroxide forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis produces the corresponding primary amine.

Ans:



3. Write structures and IUPAC names of different isomeric amines corresponding to the molecular formula, $C_4H_{11}N$.

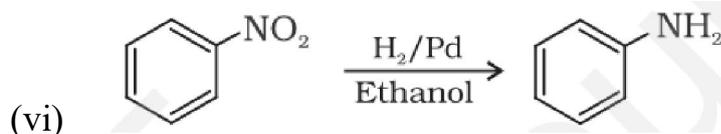
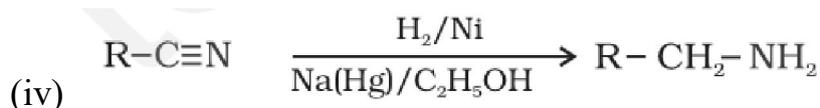
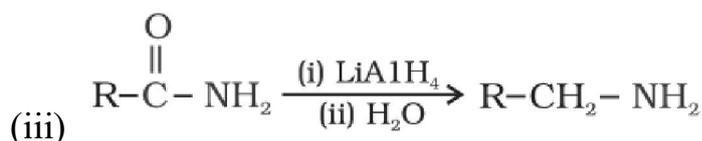
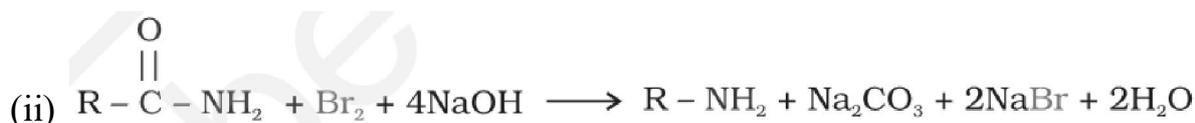
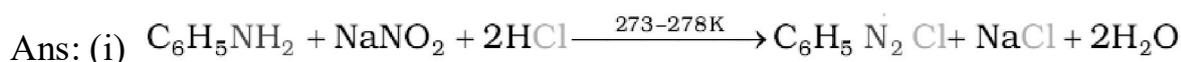
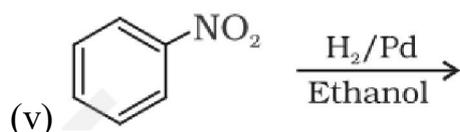
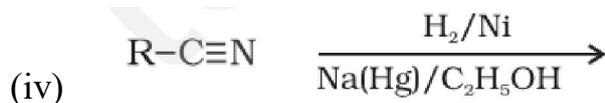
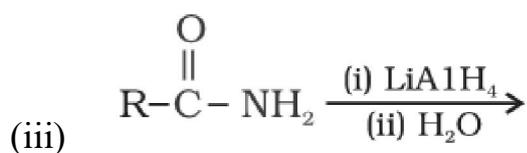
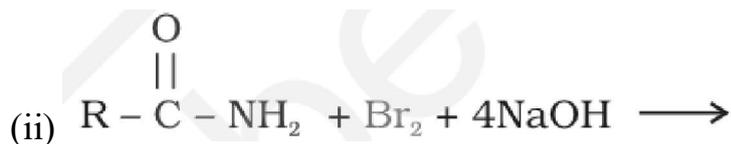
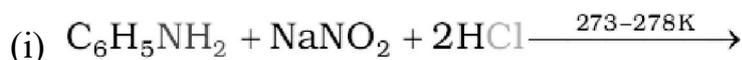
Ans: (i) $CH_3CH_2CH_2CH_2NH_2$ - Butan-1-amine

(ii) $CH_3CH_2CH_2NHCH_3$ - N-Methylpropan-1-amine

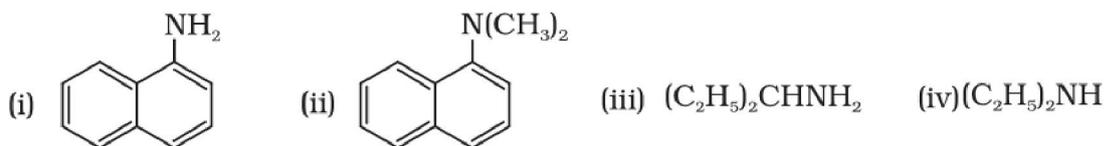
(iii) $CH_3CH_2NHCH_2CH_3$ - N-Ethylethanamine

- (iii) $\text{CH}_3\text{CH}_2\text{N}(\text{CH}_3)_2$ - N,N-Dimethylethanamine
 (iv) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{NH}_2$ - 2-Methylpropan-1-amine
 (v) $\text{CH}_3\text{CH}_2\text{CH}(\text{NH}_2)\text{CH}_3$ - Butan-2-amine
 (vi) $\text{CH}_3\text{CH}(\text{NH}_2)\text{CH}_3$ - N-Methylpropan-2-amine
 (v) $\text{CH}_3\text{C}(\text{CH}_3)(\text{NH}_2)\text{CH}_3$ - 2-Methylpropan-2-amine

4. Complete the following reactions:



5. (a) Classify the following amines as primary, secondary or tertiary:



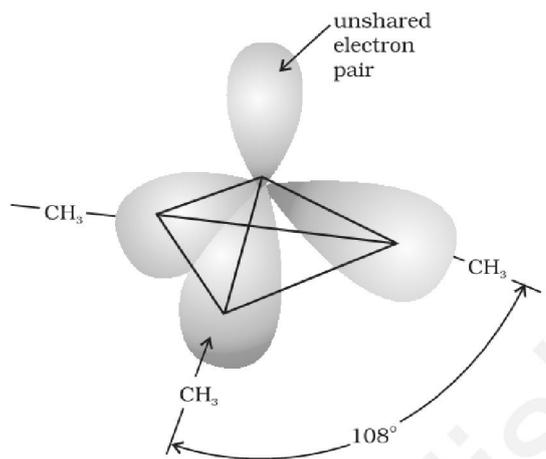
(b) Define the structure of $-NH_2$ Group

Ans: (a) Primary (iii)

Secondary (i) and (iv)

Tertiary (ii)

(b) Like ammonia, nitrogen atom of amines is trivalent and carries an unshared pair of electrons. Nitrogen orbitals in amines are therefore, sp^3 hybridised and the geometry of amines is pyramidal. Each of the three sp^3 hybridised orbitals of nitrogen overlap with orbitals of hydrogen or carbon depending upon the composition of the amines. The fourth orbital of nitrogen in all amines contains an unshared pair of electrons. Due to the presence of unshared pair of electrons, the angle $C-N-E$, (where E is C or H) is less than 109.5° ; for instance, it is 108° in case of trimethylamine.



AMINES

5 marks questions

Q1. Give reasons for the following:

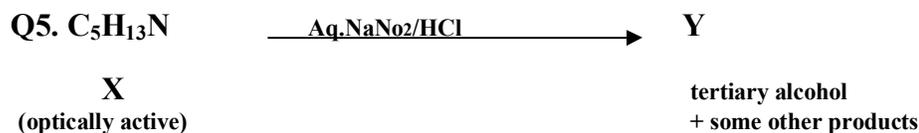
- Diazonium salts of aromatic amines are more stable than those of aliphatic amines.
- Gabriel Phthalimide Reaction is preferred for synthesizing primary amines.
- Gabriel Phthalimide Reaction is not preferred for synthesizing primary aromatic amines.
- $(\text{CH}_3)_3\text{N}$ reacts with BF_3 while $(\text{C}_6\text{H}_5)_3\text{N}$ does not react with BF_3 .
- p-aminobenzoic acid does not exist as dipolar ion while aminoacetic acid exist as dipolar ion.

Q2. Why does bromination of aniline, even under very mild conditions, gives 2, 4, 6-tribromoaniline instantaneously?

Q3. Which one is more acidic? Explain.



Q4. How will you convert toluene into sym-trinitrobenzene?



(i) Identify (X) and (Y)

(ii) Is (Y) optically active?

(iii) Give structures of intermediate(s), if any, in the formation of (Y) from (X)?

ANSWERS

Ans1. i) Diazonium salts of aromatic amines undergo resonance. Due to resonance Diazonium salts of aromatic amines are more stable than those of aliphatic amines.

ii) Gabriel Phthalimide Reaction results in formation of primary amines only. Sec & Tert. Amines are not formed in the reaction. Thus pure primary amines can be obtained.

iii) Gabriel Phthalimide Reaction involves nucleophilic substitution of alkyl halides by the anion formed by phthalimide. As aryl halides do not undergo nucleophilic substitution reactions, primary aromatic amines cannot be prepared.

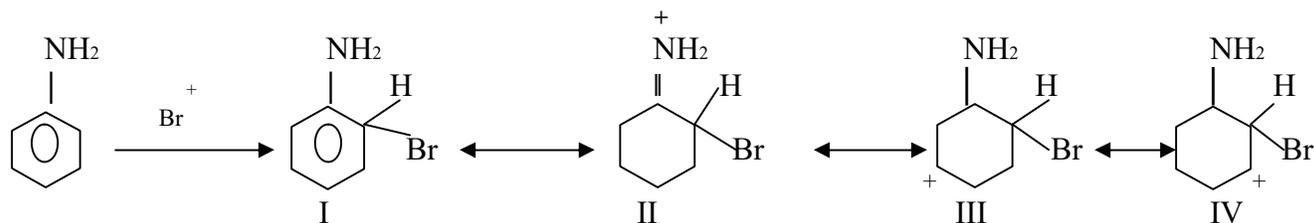
iv) In $(\text{C}_6\text{H}_5)_3\text{N}$ the lone pair of electrons on nitrogen is delocalized over three benzene rings and hence it is not available for co-ordinate bond formation with electron deficient BF_3 . Such delocalization is not possible in case of trimethyl amine, hence it readily reacts with BF_3 .

v) P-aminobenzoic acid shows resonance due to which it reduces the availability of lone pair of electrons on N but also decreases the acidic nature of $-\text{COOH}$ group. Thus $-\text{NH}_2$ group in p-aminobenzoic acid cannot extract a proton from $-\text{COOH}$ group and it does not exist as dipolar ion. On

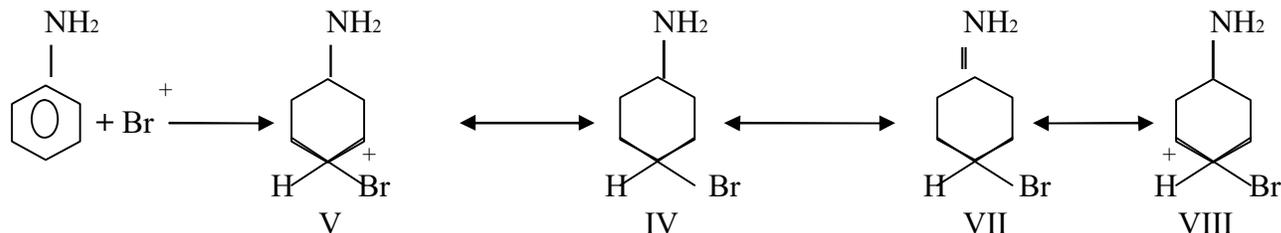
the other hand no such resonance as seen in aminoacetic acid so it can easily extract a proton from –COOH group and it exist as dipolar ion.

Ans 2. Due to strong electron-donating effect of the –NH₂ group, the electron density increases at the o-,p-positions. Further, when aniline is treated with Br₂, the Br⁺ attacks the benzene ring at o- and p- positions to form carbocation intermediates which are stabilized not only by the usual resonance of the benzene ring but also by the –NH₂ group given below:

o-Bromination:

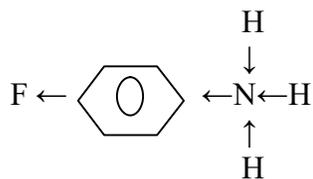


p- Bromination:

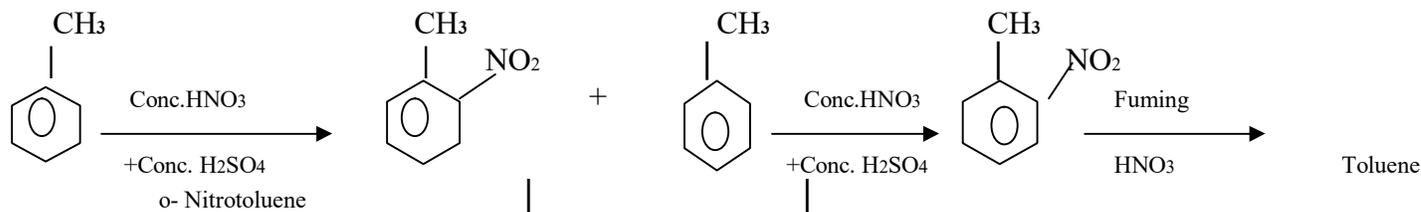


In case of o- bromination, the carbocation intermediate is stabilized not only by usual resonating structure (I,III and IV) but stabilized by resonance structure (II) in which the lone pair of electrons on the N-atom interacts with the positively charged carbon of the ring . Similarly, in case of p- bromination, the carbocation is stabilization not only by the usual resonating structure (V,VI and VIII) but is also stabilized by the resonance structure(vii) in which the lone pair of the electrons on the N- atom interacts with the positively charged carbon of the ring .These additional resonating structures (II and VII)increase the stability of the carbocation to such an extent that bromination occurs instantaneously at the p- and two o- positions giving 2,4,6-tribromoaniline.

Ans 3. Due to powerful-I-effect of the F- atom, it withdraws electrons from the NH₃ group. As a result, electron density in the N—H bond of p-fluoroanilium ion decreases and hence release of a proton from p- fluoroanilium ion is much more easier than from anilinium ion. Therefore, p- fluoroanilium ion is more acidic than anilinium ion.



Ans 4.



NUCLEIC ACIDS (5 Marks Questions)

Q1 The particles in nucleus of the cell, responsible for heredity are called chromosomes which are made up of proteins and another type of biomolecules called nucleic acids .DNA and RNA are long chain polymers of the nucleotides which are made up of nitrogen containing heterocyclic base ,a pentose sugar and phosphoric acid residue

i)What do you get when DNA & RNA are hydrolysed ?

ii)Which acid is present in nucleic acids?

iii) Write the components of nucleotide?

iv)What is the role of nucleic acid ?

v) How does a nucleotide of DNA and RNA differ with respect to sugar moiety?

Ans:i)Nucleotides

ii)Phosphoric acid

iii)Nitrogenous base, sugar &phosphoric acid

iv) Transfer of heredity character &protein synthesis

v) In DNA oxygen is removed from pentose sugar.

Que.2:- (a) Differentiate D.N.A and R.N.A with respect to composition ,structure and function?

(b) What are nucleotides? Name the bond joining two nucleotides?

Ans:-(a)

Sr No	Character	DNA	RNA
1	The sugar moiety	DNA molecules contains β -D-2 deoxyribose.	RNA molecules contains β -D-ribose.
2	Nitrogen Bases	DNA contains uracil (U). It does not contain thymine (T). ie ATGC	RNA contains thymine (T). It does not contain uracil (U). ie

			AUGC
3	Structure	Double stranded helical	Single stranded
4	Biological function	Transfer of heridity information	Protein synthesis
5	Size	Very large	small

(b) A nucleotide is formed by all the three basic components of nucleic acids (i.e., pentose sugar, phosphoric acid, and base) .

Nucleotide = Sugar + Base + Phosphoric acid

The bond joining two nucleotides is Phospho diester linkage.

Que.3:- What are nucleotides and nucleosides ?Which nucleotide is present in R.N.A not in D.N.A and Which nucleotide is present in D.N.A not in D.N.A.xplain structure of R.N.A?

Nucleic acids are long chain of polymers of nucleotides. They are also called polynucleotides. Nucleic acids are mainly of two types, the DNA and RNA

Ans: A nucleoside is formed by the attachment of a base to position of sugar.

Nucleoside = Sugar + Base

A nucleotide is formed by all the three basic components of nucleic acids (i.e., pentose sugar, phosphoric acid, and base) .

Nucleotide = Sugar + Base + Phosphoric acid

The nucleotide is present in R.N.A not in D.N.A is Uracil and nucleotide is present in D.N.A not in R.N.A is thymine.

The RNA is a single stranded polynucleotide .

Que.4:-Name different types of RNA with functions performed by them. What happens in transcription and translation?

i)m RNA- carries themessages from DNA

ii)t RNA-decodes the message from m- RNA

iii)r RNA -helps in protein synthesis at ribosomes

During transcription DNA synthesises m-RNA carrying triplets of nitogen bases

During translation t- RNA decodes the message of m -RNA and synthesises protein with the help of r-RNA

Que 5a)How are phosphate and nitrogen base linked to sugar molecule?

- b)Name the linkage between two nucleotides .
- c)Which nitrogen bases are bicyclic?
- d)Give example of a nucleotide.

Ans:-a)Phosphate joins 3rd carbon of pentose sugar to the5th carbon of another where as nitrogen base attached to 1st carbon of sugar.

- b) Phosphodiester linkage
- c) Purine
- d)ATP ,ADP GMP or any other

Que.6:- Explain the process 'replication of DNA'. Why is it called semiconservative? Write two functions of DNA.

Que7:- Draw structure of D.N.A highlighting its composition, bonding between two strands and various components ?

TOPIC- PROTEIN AND VITAMINS

FIVE MARKS QUESTIONS

Q1 Write all fat soluble vitamins and one water soluble with one function of it and source for those vitamins?

Ans-

Vitamin	Source	Deficiency disease
Vitamin -A	Fish,Liver	Night blinddness
Vitamin-D	Sunlight	Rickets
Vitamin-E	Vegetable germ oil	Musculer weakness
Vitamin-K	Green leafy vegetables	Increased blood clotting time
Vitamin-C	Citrus fruit	Scurvey

Q2 Define the following terms-

- 1) Protein 2) Amino acid 3) Vitamins 4) Avitaminosis 5) Tripeptide

Ans-1) Protein is a polypeptide chain of more than 100 amino acid having molar mass higher than 10000u are called protein.

- 2) The simplest repeating unit of polypeptide chain is called amino acid.
- 3) The vital amines are called vitamins and they are to be required daily in our diet.
- 4) Deficiency diseases which are caused by the deficiency of many vitamins are called Avitaminosis
- 5) When 3 amino acid join together they form tripeptide.

Q3 Write all the Vitamins present in Vitamin B complex write their chemical name ,source and deficiency diseases caused by their deficiency?

CARBOHYDRATE

5 MARKS QUESTIONS AND ANSWERS

- (A) What are the method for the prepration of glucose ?
(B) Write two difference between reducing & non –reducing suger.
(C)What do you mean by carbohydrates?

Answer-(a)1.Glucose is prepared by the acidic hydrolysis of surose according to the reaction given below:-



Sucrose

Glucose

2.It is also prepared by the hydrolysis of starch as given below-



Starch

Glucose

2. Write five importance of carbohydrates.

3. (a) What is the structural feature characterising reducing sugars ?

(b) Why are carbohydrates generally optically active?

(c) What are the hydrolysis products of 1. Sucrose 2. Lactose

1. (a) Which one of the following is a polysaccharide : Maltose, Starch, Glucose, Fructose.

(b) Write the product formed when glucose is treated with HI.

(c) How do you explain the absence of aldehyde group in pentaacetate of glucose.

Answer-(a) Starch (b) n- hexane (c) Because pentaacetate does not give Fehlling test with Cu^+ ion

2. (a) Write the reaction involved when D-glucose is treated with the following reagents: (i) HCN (ii) HNO_3

(b) Write three main functions of carbohydrate in plants.

POLYMER

QUESTION BANK ---(5 MK QUESTIONS)

Q.1. Write the monomers of i) Polythene ii) polystyrene iii) polypropylene iv) Teflon v) polypropylene

Ans. Monomers are :

- i) Polythene :--Ethene
- ii) polystyrene :--styrene
- iii) polypropylene:--propylene
- iv) Teflon :-tetraflouroethene
- v) Polyester:--ethylene glycol and terephthalic acid

Q 2. Classify the following as addition or condensation polymers.

(Nylon 6,6 , polyester , Teflon , BuNa-N , Natural Rubber)

Ans : Nylon 6,6 : condensation polymer

polyester : condensation polymer

Teflon : Addition polymer

BuNa-N : Addition polymer

Natural Rubber : Addition Polymer

Q 3. Classify the following as homopolymer or copolymer.

(Glyptal , PHBV , Terylene , BuNa-N , Polythene)

Ans. Glyptal :-Copolymer

PHBV : Copolymer

Terylene: Copolymer

BuNa-N : Copolymer

Polythene: Homopolymer

Q 4. Match the following

	A	B
1.	Nylon 6,6	a.Nonstickware
2.	Teflon	b.Ropes and Tyres
3.	Nylon2 Nylon6c.	Pressure cooker handle
4.	Bakelite	d. Adhesives
5.	Synthetic Rubber	e. Medical field

Ans. 1-----b

2-----a

3-----e

4-----c

5-----d

Q.5.

Topic- Addition Polymers]

5 mark questions-

Q1-What are polymers? How are they classified on the basis of (i) structure (ii) synthesis and (iii) molecular forces involved? Give one example of each kind

Ans-Polymers are the macromolecules formed by the monomers.

exp-PVC, PAN etc

(i) Classification of polymers on the basis of structure -

- (a) Linear Polymers-Polythene,
- (b) Branched Polymers-Buna S rubber
- (c) Cross Linked Polymers-Bakelite

(ii) Classification of polymers on the basis of synthesis -

- (a) Addition Polymers-PVC
- (b) Condensation Polymers-Nylon-6

(iii) Classification of polymers on the basis molecular forces-

- (a) Elastomers - Rubber
- (b) Fibers-Nylon
- (c) Thermoplastics-PVC
- (d) Thermosettings-Bakelite

Q2-What is polymerization? Define and explain the terms : addition polymerization and condensation polymerization. Give one example of each type.

Ans-Polymerisation is a process to form polymers by monomers.

Addition polymerisation-Process in which monomers are in repeated form and no small molecules are removed called addition polymerisation.

exp-PVC

Condensation polymerisation-Process in which after condensation small molecules are removed called condensation polymerisation.

exp-Nylon-6

Q3-Explain what do you mean by copolymerization with suitable examples. What are polyolefins? Give example.

Ans-Process in which two kind of monomers on polymerisation form polymers are called copolymerisation.

exp-Buna S rubber formed by two monomers 1,3-Butadiene and styrene

Polyolefins-These are polymers derived from unsaturated hydrocarbons.

exp-Polypropene

Q4-Give a brief description of natural and synthetic rubbers. What is vulcanization? How does it improve properties of natural and synthetic rubbers?

Ans-Natural rubber-sticky, low elastic and hard.

exp-Natural rubber

Synthetic rubber-nonsticky, more elastic and soft

exp-Neoprene

Vulcanisation-It is a process of heating rubber with sulphur. This is done so as to make it more elastic, more abrasion resistant by sulphur cross linking.

Q5-How are polymers classified on the basis of sources? Give its examples.

Ans -On the basis of sources polymers are classified in to three classes-

(a) Natural Polymer-From animal and plant kingdom.

exp-Protein, starch etc

(b) Semisynthetic Polymer -From natural substance by man made.

exp-Rayon,Cellulose nitrate

(c)Synthetic Polymer-Man made polymers

exp-PVC,PAN etc

CHAPTER 16 Chemistry in everyday life

5 MARKS QUESTIONS

Q1. Answer the following questions

- a. Why do we need to classify drugs in different ways ?
 - b. Explain the term target molecules or drug targets as used in medicinal chemistry.
 - c. Name the macromolecules that are chosen as drug targets
 - d. Why should not medicines be taken without consulting doctors ?
 - e. Define the term chemotherapy.
- a. Drugs:
- cause different pharmacological effect.
 - interact with different molecular targets.
 - act differently on biochemical processes.
 - have different structures .
- b. Biomolecules with which drug molecules interact are called as target molecules or drug targets

6

- c. Proteins, lipids, enzymes, nucleic acids, carbohydrates.
- d. Doctors will recommend suitable and proper dose of drug after diagnosing the disease. If suitable drug is not taken and also drug taken in doses higher than recommended may cause harmful effect and act as a poison
- e. Use of chemicals for therapeutic effect i.e. for curing diseases

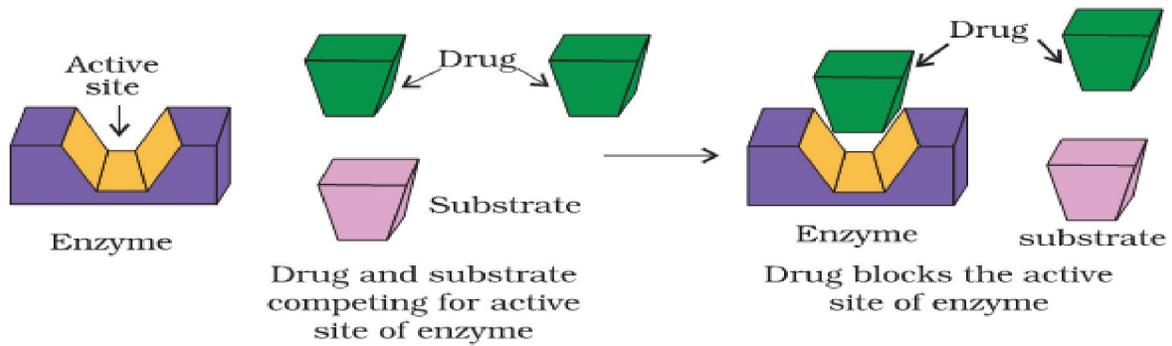
Which forces (ii) hydrogen bonding (iii) dipole-dipole interaction (van der Waals interaction)

Q2. Write note on drug target interaction.

Ans Drug target interaction can be explained by considering drug enzyme interaction.

Enzymes act as biocatalysts. Active site of enzyme holds the substrate molecule in a suitable position and attacked by the reagent effectively and chemical reaction takes place. Drugs inhibit the attachment of substrate on active site of enzymes in two different ways.

(i).Competitive inhibitor drugs compete with the natural substrate for their attachment on the active sites of enzymes.



(ii) Some drugs instead of binding to the active site, bind to the allosteric site of enzyme and hence change the shape of the active site in such a way that substrate can not recognize it. If the bond formed between an enzyme and an inhibitor is a strong covalent bond and can not be broken easily, then the enzyme is blocked permanently. The body then degrades the enzyme-inhibitor complex and synthesizes a new enzyme.



3.a. How do antiseptics differ from disinfectants? Give one example of each.

3M

b. Why are cimetidine and ranitidine better antacids than sodium hydrogen carbonate

or magnesium hydroxide or Aluminum hydroxide?

2M

ans a. 1. Antiseptics- Chemicals which kill or prevent microorganisms when applied to living tissues

i.e wounds, i.e floors, drainage systems, cuts, ulcers etc. Ex. 0.2% Phenol, Dettol

2. Disinfectants- Chemicals which kill or prevent microorganisms when applied to inanimate

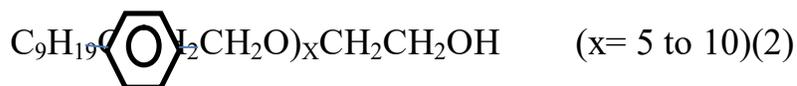
objects, i.e floors, drainage systems instruments etc. 1% Phenol, 2 to 0.4 ppm Chlorine

ans b. Sodium hydrogen carbonate or magnesium hydroxide or Aluminum hydroxide when administered

in excess make stomach alkaline and trigger the production of even more acid. These chemicals only control the symptoms and not the cause. Histamine stimulates the secretion of pepsin and HCl acid in stomach. Cimetidine and ranitidine prevent interaction of histamine with the receptors present in the stomach wall.

OTHER QUESTIONS FOR PRACTICE

1. {a} Between sodium hydrogen carbonate and magnesium hydroxide, which is a better antacid and why? 2M
- {b} Following type of non-ionic detergents are present in liquid detergents, emulsifying agents and wetting agents. Label the hydrophobic and hydrophilic parts in the molecule. Identify the functional group present in the molecule.



- {c} Aspirin is pain relieving antipyretic drug but can be used to prevent heart attack. Explain. (1)

2. {a} Answer the following questions:
 - (3)
 - (i) Why is use of aspartame limited to cold food and drink?
 - (ii) Soaps do not work in hard water. Why?
 - (iii) Why is bithional added to soap?
 {b} Give reasons for the following:
 - (2)
 - (i) Sulpha drugs work like antibiotics but they are not antibiotics.
 - (ii) Soaps are biodegradable whereas detergents are not so.

3. {a} What are antihistamines? How do they act on humans? Give two examples. 2M
- {b} Discuss two ways in which drugs the attachment of natural substrate on active site in an enzyme. 2M
- {c} What are agonists? 1M

4. {a} Define the following and give one example of each: (2)
 - (i) Antifertility drug
 - (ii) Antacids
 {b} Pick out the odd one from among the following on the basis of their medicinal

1. properties, mentioning the reason:

(2)

2. Luminal, Seconal, Phenacetin, Equanil.

{c} Where are receptors located?

(1)

5. [a] Name any two macromolecules chosen as drug targets.

(2)

[b] Which site of an enzyme is called allosteric site?

(1)

[c] What is the medicinal use of narcotic drug.

(1)

[d] Name one estrogen which forms the part of oral contraceptive.

(1)