
2016

Question: 1 – 30

ii- xv

Question: 1

Give one example each of 'oil in water' and 'water in oil' emulsion.

[1]

Answer:

Oil in water : milk / vanishing cream (any one)

Water in oil : butter / cold cream (any one)

Question: 2

Which of the following isomers is more volatile : o-nitrophenol or p-nitrophenol?

[1]

Answer:

o – nitrophenol

Question: 3

What type of ionic substances show such defect?

[1]

Answer:

Alkali metal halides/ Ionic substances having almost similar size of cations and anions (NaCl/KCl)

Question: 4

Write a feature which will distinguish a metallic solid from an ionic solid.

[1]

Answer:

Metallic solids	Ionic solids
Metallic solids are conductors of electricity in solid state as well as in molten state.	Ionic solids are insulators in solid state but conductors in molten state and in aqueous solutions.

Question: 5

Give an example of linkage isomerism.

[1]

Answer:

$[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$ are linkage isomers. In $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$, the bonding is through oxygen (-ONO) whereas in $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$, the bonding is through nitrogen (-NO₂).

Question: 6

Why do the transition elements have higher enthalpies of atomization? In 3d series (Sc to Zn), which element has the lowest enthalpy of atomization and why?

[1]

Answer:

Solutions with same osmotic pressure

Question: 7

State the formula relating pressure of a gas with its mole fraction in a liquid solution in contact with it.

[1]

Answer:

Partial pressure of a gas in solution = $K_H \times$ mole fraction of gas in solution.

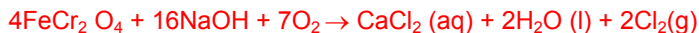
Or $p = K_H \chi$, where K_H = Henry's law constant

Question: 8

Describe the steps involved in the preparation of either potassium dichromate from sodium chromate.

Answer:

Preparation of potassium dichromate: The chromite ore is fused with molten alkali in the preparation of air to form chromate.



The solution containing sodium chromate is filtered with potassium chloride to give orange crystals of $\text{K}_2\text{Cr}_2\text{O}_7$.

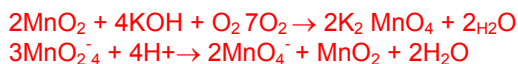


OR

Describe the steps involved in the preparation of potassium permanganate from manganese dioxide.

Answer:

Preparation of potassium permanganate: Potassium permanganate is prepared by the fusion of MnO_2 (pyrolusite) with potassium hydroxide and an oxidizing agent like KNO_3 to form potassium manganate which disproportionates in a neutral or acidic solution to form permanganate.



or



Question: 9

A reaction is of second order with respect to a reactant. How will the rate of reaction.

- Doubled,
- Reduced to half?

Answer:

Since Rate = $k[\text{A}]^2$

Let $[\text{A}] = a$
 $\therefore \text{Rate} = k a^2$

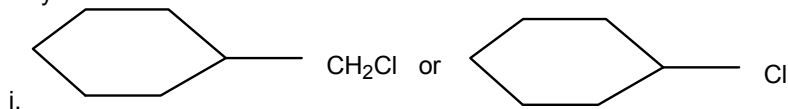
- If $[\text{A}] = 2a$
 $\therefore \text{Rate} = k(2a)^2 = 4 k a^2 = 4 \text{ times}$

- If $[\text{A}] = \frac{a}{2}$
 $\therefore \text{Rate} = k\left(\frac{a}{2}\right)^2 = \frac{1}{4} k a^2 = \frac{1}{4} \text{ th}$

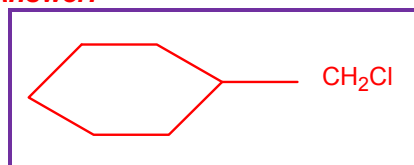
Question: 10

[2]

Which ones in the following Pairs of substances undergoes $\text{S}_\text{N}2$ substitution reaction faster and why?



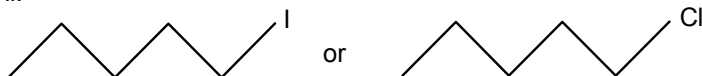
Answer:



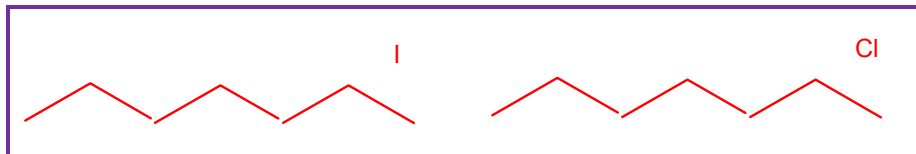
It is primary halide and therefore undergoes $\text{S}_\text{N}2$ reaction faster.



ii.



Answer:



As iodine is a better leaving group because of its large size, therefore undergoes SN_2 reaction faster.

Question: 11

Differentiate between disinfectants and antiseptics.

[2]

Answer:

Antiseptics :- They are applied to the living tissues such as wounds, cuts. For example detol, iodoform.

Disinfectants :- They are applied to inanimate objects such as floors . For Example – Sulphur dioxide in very low concentration.

Same substance can act as an antiseptic and disinfectant by varying the concentration.

Question: 12

The molar conductivity of a 1.5 M solution of an electrolyte is found to be $138.9 \text{ S cm}^2 \text{ mol}^{-1}$. Calculate the conductivity of this solution.

[2]

Answer:

$$\Lambda_m = 138.9 \text{ S cm}^2 \text{ mol}^{-1}$$

$$= \frac{138.9}{10000} \text{ S m}^2 \text{ mol}^{-1}$$

$$C = 1.5 \text{ M}$$

$$\Lambda_m = \frac{K}{C}$$

$$K = \Lambda_m \cdot C$$

$$K = \frac{138.9 \times 1.5}{10000}$$

$$K = 0.0208 \text{ S m}^{-1}$$

Question: 13

A reaction is of second order with respect to a reactant. How is its rate affected if the concentration of the reactant is (i) doubled (ii) reduced to half?

[2]

Answer:

If a reaction is of second order then



$$\text{Rate} = K[A]^2$$

1) If concentration of reactant is doubled then Rate becomes 4 times

2) If concentration of reactant is reduced to half Rate becomes $\frac{1}{4}$ times.

Question: 14

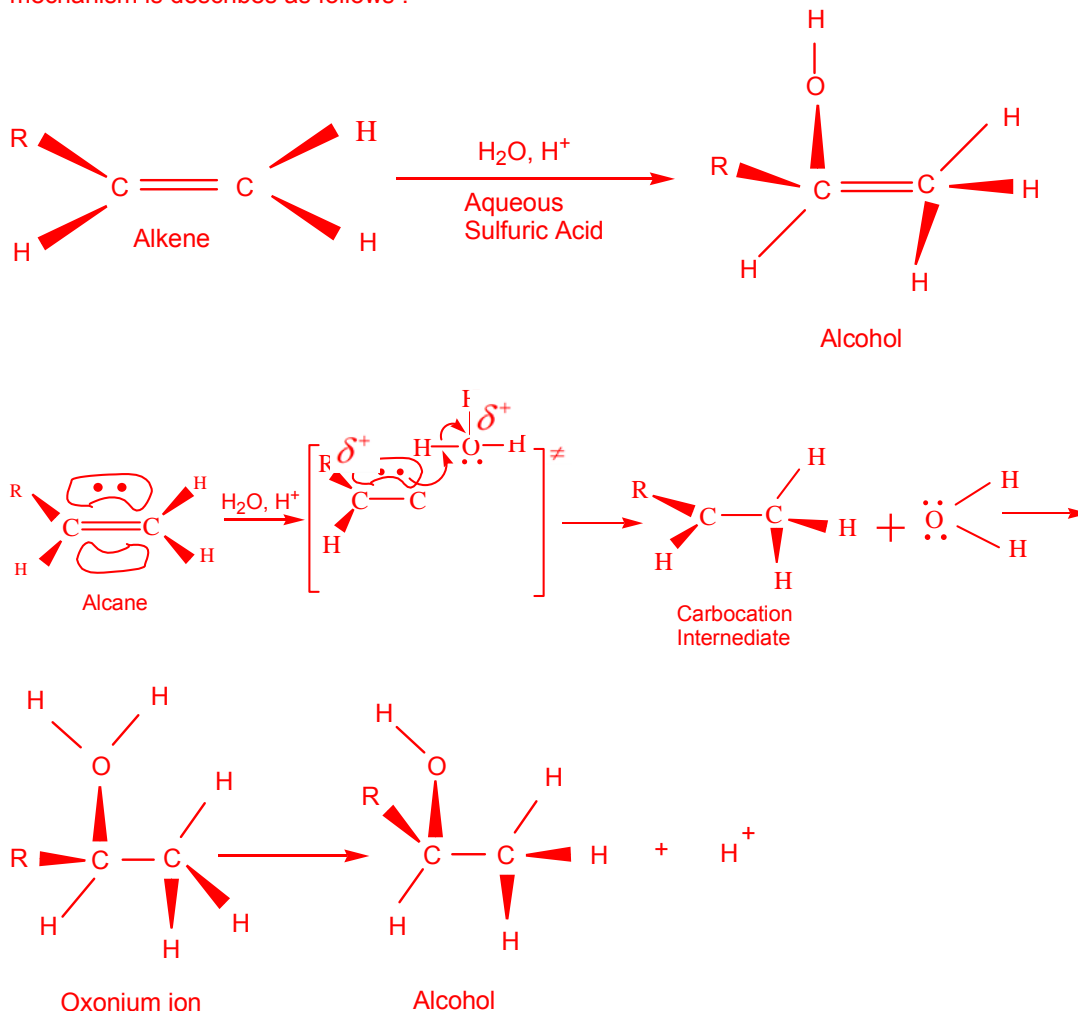
[2]



Explain the mechanism of acid catalysed hydration of an alkene to form corresponding alcohol.[2]

Answer:

Acid Catalyzed hydration of alkenes is one method of producing alcohols. Regioselectivity of hydration follows Markovnikov's rule according to which the hydrogen adds to that carbon which has the most hydrogen. Carbocation rearrangement can occur during the reaction. The mechanism is described as follows:



Question: 15

Write the structures of the following species:

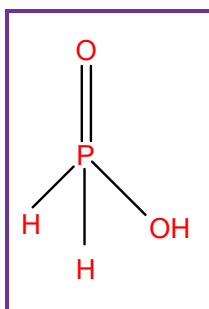
[2]

i. H_3PO_2

Answer:

Structure of H_3PO_2 (Phosphinic acid)

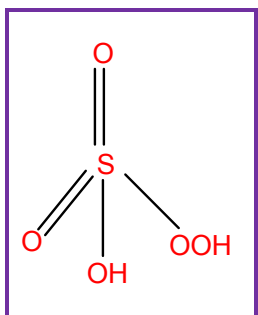




ii. H_2SO_5

Answer:

Structure of (Peroxomonosulphuric acid)



Question: 16

[2]

What is the chief ore of iron? Write chemical reactions taking place in the extraction of iron from its ore.

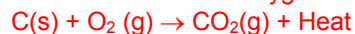
Answer:

Chief ore of iron is hematite Fe_2O_3 . Iron is obtained by the reduction of its ore, hematite Fe_2O_3 in a blast furnace. The iron ore is mixed with coke and limestone to form a mixture. This mixture is known as Charge.

The charge is then introduced into the blast furnace from the top. A blast of hot iron is blown in through the base of furnace.

The following reactions take place in the blast furnace:

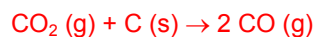
i. The coke combines with oxygen to form carbon dioxide.



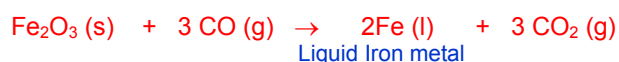
ii. Due to the intense heat in the furnace, limestone (CaCO_3) decomposes to form calcium oxide and carbon oxide



iii. The carbon dioxide reacts with more coke to form carbon monoxide



iv. Iron (III) oxide present in the ore is then reduced by carbon monoxide to form liquid iron. The molten iron is collecting at the bottom of the furnace.



- v. Calcium oxide formed in reaction (ii) reacts with silicon dioxide present in the ore to form molten calcium silicate known as slag. $\text{CaO (s)} + \text{SiO}_2 \text{ (s)} \rightarrow \text{CaSiO}_3 \text{ (l)}$

Question: 17

[2]

Define absorption. Write any two features which distinguish physisorption from chemisorption.

Answer:

Adsorption:

Molecules in the gaseous or liquid phase can adhere to solid surfaces, this phenomenon is called adsorption.

Physisorption:

In physisorption the adsorbate is held on the surface by weak Van der Waals forces. It is reversible in nature.

Chemisorption:

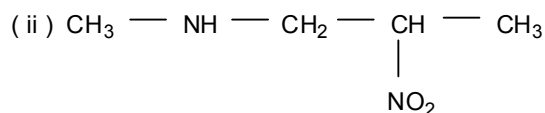
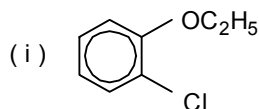
In chemisorption the forces holding the adsorbate on the surface are as strong as experienced in chemical bonding. It is irreversible in nature.

Question: 18

[2]

Write IUPAC names of the following:

[2]



Answer:

- 2-chloro-1-ethoxy benzene
- (N-Methyl) 2-nitro propanamine.

Question: 19

Discuss the synthesis of bakelite and give its use.

[3]

Answer:

Synthesis

Bakelite is prepared with the help of phenol and formaldehyde. Phenol and formaldehyde reacts in presence of alkaline to form o-hydroxyphenol and p-hydroxyphenol then these two hydroxyphenol gives Bakelite.

Uses:

Soft Bakelite is used as bonding give for wooden planks and in the preparation of varnishes.

OR

What are hormones? State the function of the following hormones:

[3]

- Testosterone
- Oxytocin

Answer:

Hormones are complex organic compounds which are produced in endocrine glands and are directly secreted into blood stream. These control the various metabolic processes.

- Testosterone controls normal function of male sex organs.



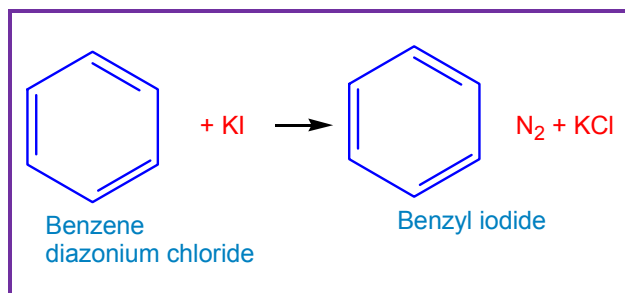
- ii. Oxytocin produces milk in the mammary glands of animals.

Question: 20

- i. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt. [1]

Answer:

The replacement of the diazonium group by iodine is done by treating a diazonium salt with potassium iodide.



- ii. Explain as to why haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions. [2]

Answer:

Haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions due to the following reasons:

- Resonance effect
- Difference in hybridization of carbon atom in C-X bond
- Instability of phenyl cation

Question: 21

Account for the following observations:

[3]

[3]

- i. pK_b for aniline is more than that for methylamine.

Answer:

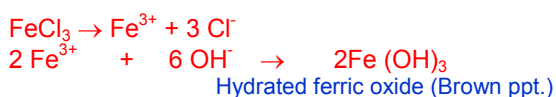
In aniline, the lone pair of electrons on the N-atom are delocalized over the benzene ring. As a result, electron density on the nitrogen decreases. In contrast, in CH_3NH_2 + I-effect of CH_3 increases the electron density on the N-atom.

Therefore, aniline is a weaker base than methylamine and hence its pK_b values are higher than that of methylamine.

- ii. Methylamine solution in water reacts with ferric chloride solution to give a precipitate of ferric hydroxide

Answer:

Methylamine being more basic than water, accepts a proton from water liberating OH^- ions. These OH^- ions combine with Fe^{3+} ions present in H_2O to form brown ppt. of hydrated ferric oxide.



- iii. Aniline does not undergo Friedel-Crafts reaction.



Answer:

Aniline being a Lewis base reacts with Lewis acid AlCl_3 to form a salt.

**Question: 22**

How are the following sols produced:

[3]

- a. Sulphur sol

Answer:

Sulphur solution is obtained by bubbling H_2S through an oxidizing agent like bromine water.

- b. Collodion

Answer:

Cellulose nitrate colloid can be prepared by dispersing it in a mixture of ethyl alcohol and ether. This is commercially known as collodion.

- c. Why is the third ionization energy of manganese (At. No. = 25) unexpectedly high?

Answer:

The bivalent ion Mn^{2+} has configuration $[\text{Ar}] 3d^5$ which is a stable configuration. So the third ionization energy of manganese is unexpectedly high.

Question: 23

[3]

- i. Out of white phosphorus and red phosphorus, which one is more reactive and why?

Answer:

These two most common forms of the element Phosphorus react differently because they are bonded differently. White phosphorus is structured as individual molecules of 4 atoms together to form a tetrahedron. The P_4 rings are held to each other by physical bonding but no chemical bonding. These P_4 rings are an unstable arrangement which makes the white phosphorus extremely reactive.

Red phosphorus also has groups of 4 atoms, but they are not rings. One side is open, which allows each P_4 group to chemically bond to a neighbouring group, so that a huge amorphous network is formed instead of individual molecules. This is a relatively stable arrangement which makes the red phosphorus less reactive.

- ii. Give one example each of 'oil in water' and 'water in oil' emulsion.

Answer:

Oil in water : milk / vanishing cream (any one)

Water in oil : butter / cold cream (any one)

- iii. What type of ionic substances show such defect?

Answer:

Alkali metal halides/ Ionic substances having almost similar size of cations and anions (NaCl/KCl)

Question: 24

After the ban on plastic bags, students of one school decided to make the people aware of the harmful effects of plastic bags on environment and Yamuna River. To make the awareness more impactful, they organized rally by joining hands with other schools and distributed paper bags to vegetable vendors, shopkeepers and departmental stores. All students pledged not to use



polythene bags in future to save Yamuna River. After reading the above passage, answer the following questions: [3]

i. What values are shown by the students?

Answer:

Concern towards environment caring, socially awareness, team work, etc.

ii. What are biodegradable polymers? Give one example.

Answer:

Polymers which can be degraded by the action of microorganisms, e.g., PHBV, Nylon-2- nylon- 6/ or any natural polymer.

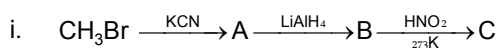
iii. Is polythene a condensation or an addition polymer ?

Answer:

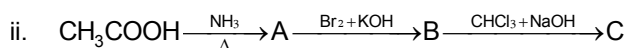
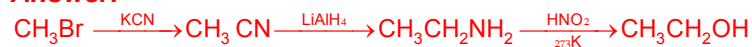
Addition polymer

Question: 25

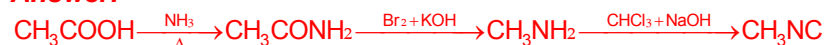
Give the structures of A, B and C in the following reactions : [3]



Answer:



Answer:



iii. Limiting molar conductivity

Answer:

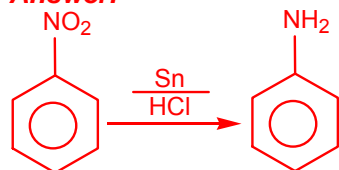
Limiting molar conductivity when concentration approaches zero the conductivity is known as limiting molar conductivity.

OR

How will you convert the following :

i. Nitrobenzene into aniline

Answer:



ii. Ethanoic acid into methanamine



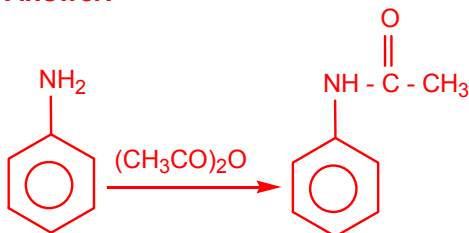
Answer:



iii. Aniline into N-phenylethanamide

(Write the chemical equations involved.)

Answer:



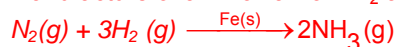
Question: 26

Taking two examples of heterogeneous catalytic reactions, explain how a heterogeneous catalyst helps in the reaction. [3]

Answer:

Solid catalysts are used in a number of gaseous reactions. Such catalytic reactions called heterogeneous reactions. Examples of heterogeneous catalysis are:

i. Manufacture of ammonia from N_2 and H_2 by Haber's process in the presence of catalyst



ii. V_2O_5 catalyst is used in the manufacture of H_2SO_4 by contact process



Solid catalyst helps in the following ways:

- Simultaneous adsorption of reactants increases the concentration at the surface of the catalyst which increases the reaction rate.
- Adsorption of reactant molecules makes the attack of other molecules pm of easier.
- Some adsorbed molecules dissociate into atoms which are very reactive.
- Heat of adsorption released provides activation energy for the reaction.

OR

Explain each of the following observations: [3]

i. Tetrahedral Ni complexes are paramagnetic but square planar Ni complexes are diamagnetic.

Answer:

In the complex $[\text{NiCl}_4]^{2-}$, nickel undergoes sp^3 hybridization and the complex has tetrahedral geometry, in the presence of weak ligand field Cl^- , the unpaired electrons of nickel do not paired up. So the complex is paramagnetic.

In complex like, $[\text{NiCl}_4]^{2-}$, the unpaired electrons of 3d orbitals are forced to pair in the presence of strong ligand field of CN^- , Ni^{2+} ion undergoes dsp^2 hybridization resulting in square planar geometry. As there are no unpaired electrons, the complex is diamagnetic.

ii. Only transition metals are known to form π - complexes.



Answer:

π – complex is the compounds of transition metals with alkenes, alkynes, benzene and other ring system. In such compounds, the metal-carbon bonds arise from covalent interaction between the π –electron of unsaturated hydrocarbon and the vacant of filled d-orbitals which are present in transition metals.

Question: 27

- i. Non – ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why are they caused? Explain with one example for each type. [2]

Answer:

Non an ideal solutions showing positive deviation	Non an ideal solutions showing negative deviation
The intermolecular attractive forces between solute-solvent molecules are weaker than those between solute-solute and solvent –solvent molecules i.e. $A-B < A-A$ and $B-B$ interactions.	The intermolecular attractive forces between solute-solvent molecules are stronger than those between solute-solute and solvent – solvent molecules i.e. $A-B > A-A$ and $B-B$ interactions.
<i>Example:</i> Mixture of ethanol and acetone forms a solution with positive deviation from Raoult's law. In pure ethanol, molecules are hydrogen bonded. On adding acetone, its molecules get in between the ethanol molecules and break some of the hydrogen bonds between them. Due to weakening of interactions, the solution shows positive deviation from Raoult's law.	<i>Example:</i> Mixture of chloroform and acetone forms a solution with negative deviation from Raoult's law. This is because chloroform molecule is able to form hydrogen bond with acetone molecule. This decreases the escaping tendency of molecules for each component and consequently the vapor pressure decreases resulting in negative deviation from Raoult's law.

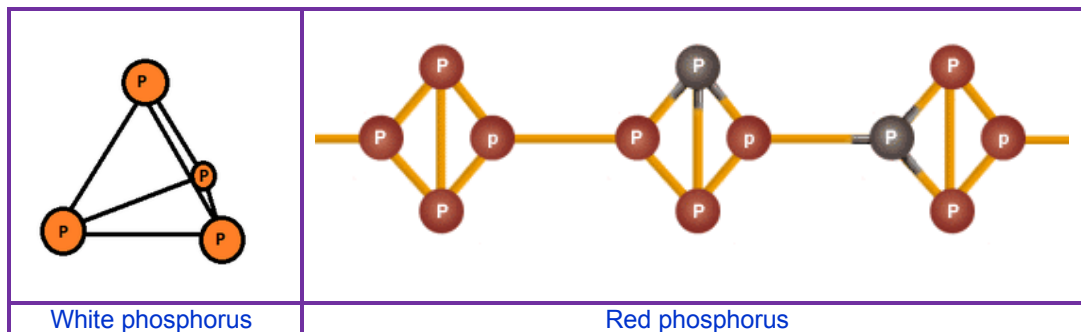
- ii. Give an example of linkage isomerism. [1]

Answer:

$[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$ are linkage isomers. In $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$, the bonding is through oxygen (-ONO) whereas in $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$, the bonding is through nitrogen (-NO₂).

OR

Draw the structures of white phosphorus and red phosphorus. Which one of these two types of phosphorus is more reactive and why?

Answer:

Generally there is an increase in density of elements from titanium ($Z = 22$) to copper ($Z = 29$) in the first series of transition elements.

Answer:

The decrease in metallic radius coupled with increase in atomic mass results in a general increase in the density of the elements from titanium ($Z = 22$) to copper ($Z = 29$) in the first series of transition elements.

White phosphorus is less stable and therefore, more reactive than the red phosphorus under normal conditions because of angular strain in the P_4 molecule where the angles are 60° only.

Question: 28

- a. Define the following terms:
i. Limiting molar conductivity

[2]

Answer:

Limiting molar conductivity when concentration approaches zero the conductivity is known as limiting molar conductivity.

- ii. Fuel cell

Answer:

Fuel cells are the cells which convert the energy of combustion of fuels to electrical energy.

- b. 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 $1.29 \times 10^{-2} \text{ S cm}^{-1}$.

Answer:

$$\text{Cell constant (G}^* \text{ is Conductivity} \times \text{Resistance): } 1.29 \frac{\text{S}}{\text{m}} \times 100 \Omega = 129 \text{ m}^{-1} = 129 \text{ cm}^{-1}$$

$$\text{Conductivity of } 0.02 \text{ mol L}^{-1} \text{ KCl solution} = \frac{\text{cell constant}}{\text{resistance}}$$

$$\kappa = \left(\frac{G^*}{R} \right) = \left(\frac{129 \text{ m}^{-1}}{520 \Omega} \right) = 0.248 \text{ S m}^{-1} = 0.248 \times 10^{-2} \text{ S cm}^{-1}$$

$$\text{Concentration} = 0.02 \text{ mol L}^{-1} = 1000 \times 0.02 \text{ mol m}^{-3} = 20 \text{ mol m}^{-3}$$

$$\text{Molar conductivity } (\Delta_m) : \left(\frac{\kappa}{c} \right) = \frac{248 \times 10^{-3} \text{ S m}^{-1}}{20 \text{ mol m}^{-3}} = 124 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1} = 124 \text{ S cm}^2 \text{ mol}^{-1}$$

OR

- a. Explain the State Faraday's first law of electrolysis. How much charge in terms of Faraday is required for the reduction of 1 mol of Cu^{2+} to Cu .

Answer:

The amount of substance deposited at any electrode during electrolysis is directly proportional to the quantity of electricity passed through the electrolyte. (aq. Solution or melt) Charge = $Q = 2F$.

- b. Calculate emf of the following cell at 298 K $\text{Mg(s)} \parallel \text{Mg}^{2+} (0.1 \text{ M}) \parallel \text{Cu}^{2+} (0.01) \parallel \text{Cu(s)}$

$$[\text{Given } E_{\text{cell}}^\circ = +2.71 \text{ V, } F = 96500 \text{ C mol}^{-1}]$$

Answer:



$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.059}{n} \log \frac{[\text{Mg}^{2+}]}{[\text{Cu}^{2+}]}$$

$$E_{\text{cell}} = 2.71 - \frac{0.059}{2} \log \frac{0.10}{0.01}$$

$$E_{\text{cell}} = 2.71 - \frac{0.059}{2} \log 10 = 2.71 - 0.0295 = 2.68 \text{ V}$$

Question: 29

Illustrate the following reactions giving a chemical equation for each;

[2]

i. Kolbe's reaction

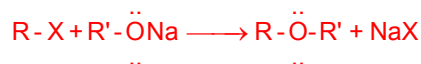
Answer:

In this reaction, phenol is reacted with sodium hydroxide to form sodium phenoxide. Sodium phenoxide formed reacts with carbon dioxide to form ortho hydroxyl benzoic acid or salicylic acid as the main product.

ii. Williamson synthesis,

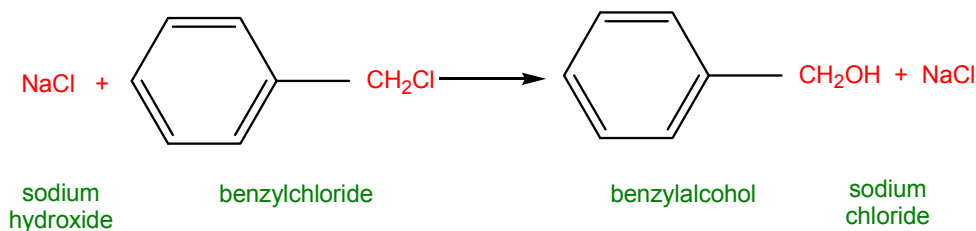
Answer:

It is an important laboratory method for the preparation of symmetrical and unsymmetrical ethers. In this method, an alkyl halide with sodium alkoxide to form ether.



iii. Benzyl chloride to benzyl alcohol,

Answer:



Question: 30

Write chemical equations for the reactions involved in the manufacture of potassium permanganate from pyrolu site ore.

[2]

Answer:

Preparation of potassium permanganate: Potassium permanganate is prepared by the fusion of MnO_2 (pyrolusite) with potassium hydroxide and an oxidizing agent like KNO_3 to form potassium manganate which disproportionate in a neutral or acidic solution to form permanganate.



How does vulcanization change the character of natural rubber?

[1]

Answer:

Heating rubber with sulphur causes cross linking of polymer chains through disulphide bonds. This makes rubber hard and stiff. It prevents the intermolecular movement of rubber springs resulting in change of physical character of rubber.



OR

- a. An element has a body centered cubic structure with a cell edge of 288 pm. The density of the element is 7.2 g cm^{-3} . Calculate the number of atoms present in 208g of the element. [2]

Answer:

$$\text{Volume of unit cell} = (288 \times 10^{-10} \text{ cm})^3 = 2.389 \times 10^{-23} \text{ cm}^3$$

$$\text{Volume of 208 g of the element} = \frac{\text{Mass}}{\text{Density}} = \frac{208 \text{ g}}{7.2 \text{ g cm}^{-3}} = 28.89 \text{ cm}^3$$

$$\text{Number of unit cells} = \frac{\text{Total volume}}{\text{Volume of a unit cell}} = \frac{28.89 \text{ cm}^3}{2.389 \times 10^{-23} \text{ cm}^3} = 12.09 \times 10^{23}$$

For a b.c.c. structure, number of atoms per unit cell = 2

∴ Number of atoms present in 208g

$$\begin{aligned} &= \text{No. of atoms per unit cell} \times \text{No. of unit cells} \\ &= 2 \times 12.09 \times 10^{23} = 24.18 \times 10^{23} = 2.418 \times 10^{24} \end{aligned}$$

- b. Why is the vapour pressure of a solution of glucose in water lower than that of water? [1]

Answer:

A part of the water surface is occupied by non-volatile glucose molecules. This decreases the effective surface area for the vaporization of water molecules. Consequently, the vapor pressure of a solution of glucose in water is lower than that of water.

