2016

Question 1
What is meant by an 'intrinsic semiconductor'? [1]

Answer:
Pure substances exhibiting conductivity similar to that of silicon and germanium are called intrinsic semiconductors.

Question 2
State Henry's law about partial pressure of a gas in a mixture. [1]

Answer:
Henry's law: It states that the partial pressure of a gas in vapour phase (*P*) is proportional to its mole fraction (*x*) in the solution.

Question 3
What do you understand by 'denticity of a ligand'? [1]

Answer:
Denticity: The number of coordinating groups present in ligand is called the denticity of ligand. For example, bidentate ligand ethane-1, 2-diamine has two donor nitrogen atoms which can link to central metal atom.

$H_2\ddot{N} — CH_2 — CH_2 — \ddot{N}H_2$

Ethane -1, 2 - diamine

Question 4
Which will react faster in $S_N{}^2$ displacement, 1-bromopentane or 2-bromopentance and why? [1]

Answer:
1–Bromopentane, as it is a primary alkyl halide.

Question 5
Give the IUPAC name of the following compound: [1]

$$\begin{array}{l} CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} = \underset{\displaystyle Br}{\underset{|}{C}} - CH_2OH \end{array}$$

Answer:
2–Bromo –3– methyl-but –2–en–1–ol.

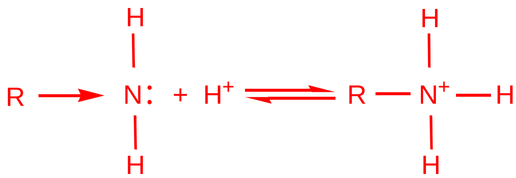
Question 6
Write the structure of the following compound: 3-oxopentanal. [1]

Answer:

$$CH_3 — CH_2 — \overset{\displaystyle O}{\overset{\|}{C}} — CH_2 — \overset{\displaystyle O}{\overset{\|}{C}} — H$$

Question 7
Why is an alkylamine more basic than ammonia? [1]

Answer:



Due to +I effect alkyl group pushes electron towards nitrogen and thus makes the lone pair of electrons more available for sharing with the proton of the acid. Hence alkyl amine is more basic than ammonia.

Question 8

What is meant by a 'broad spectrum antibiotic'? [1]

Answer:

The antibiotic which is effective against a wide range of microorganisms is known as broad spectrum antibiotic. For example, chlorophenicol.

Question 9

Differentiate between molarity and molality of a solution. Explain how molarity value of a solution can be converted into its molality. [2]

Answer:

Molarity (M) is the number of moles of solute dissolved in one litre of solution whereas molality (m) is the number of moles of the solute per thousand grams of solvent.

If MB is the molar mass of solute, d is the density of solution then molarity (M) value of a solution can be converted into its molality (m) by using the following for formula.

$$m = \frac{1000 \times M}{1000 \times d - M \times M_B}$$

Question 10

A 0.561 m solution of an unknown electrolyte depresses the freezing point of water by 2.93^0 C. what is Van't Hoff factor for this electrolyte? The freezing point depression constant (K_f) for water is 1.86^0 C kg mol^{-1}. [2]

Answer:

$\Delta Tf = Kf \times m$

$K_f = 1.86°C\ kg\ mol^{-1}$, $m = 0.561\ mol\ kg^{-1}$

Substituting these values in the above equation,
We get,

$$\Delta T_f = 1.86^oCkgmol^{-1} \times 0.561molkg^{-1} = 1.04^oC$$

$$(\Delta T_f)Calculated = 1.04^oC, (\Delta T_f)Observed = 2.93^oC$$

$$i = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}} = \frac{(\Delta T_f)\text{ observed}}{(\Delta T_f)\text{ calculated}}$$

$$i = \frac{2.93^oC}{1.04^oC} = 2.82$$

Question 11

Determine the value of equilibrium constant (K_c) and ΔG^0 for the following reaction: [2]

$Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s), E^0 = 1.05\,V$

$(F = 96500\ C)$

Answer:

$Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s);\ E° = 1.05\ V$

Here, $n = 2$

$$\log K_c = \frac{n}{0.059} E^o_{cell}$$

$$\log K_c = \frac{2}{0.059} \times 1.05 = 39.5932$$

$$K_c = \text{antilog}\,39.5932 = 3.919 \times 10^{39}$$

$K_c = 3.92 \times 10^{39}$

$$\Delta G^o = -nFE^o_{cell}$$

$$\Delta G^o = -2 \times 96500 \times 1.05 = -202650\ J$$

$$\Delta G^o = -202.65\ KJ$$

Question 12

Define the following terms given an example of each: [2]

i. Emulsion

Answer:

Emulsion: An emulsion is a colloidal system in which both the dispersed phase and the dispersion medium are liquids (e.g., milk, Cod liver, oil, etc.)

ii. Hydrosol

Answer:

Hydrosol: A sol in which solid is the dispersed phase and water in dispersion medium is called hydrosol.

Question 13

Explain how the phenomenon of adsorption finds application in the following processes: [2]

i. Production of vacuum

Answer:

Production of Vacuum: Adsorption can be successfully applied to create conditions of high vacuum. For this a bulb of charcoal cooled in liquid air, is connected to vessel which has already been exhausted as far as possible by vacuum pump. The remaining traces of air inspite of low pressure are adsorbed by the charcoal almost completely.

ii. Heterogeneous catalysis

Answer:

Heterogeneous Catalysis: There are many gaseous reactions of industrial importance involving solid catalyst. Manufacture of ammonia using iron as a catalyst, manufacture of H_2SO_4 by contact process using V_2O_5 catalyst and use of finely divided nickel in the hydrogenation of vegetable oils are the excellent examples. The gaseous reactants are adsorbed on the surface of the solid catalyst. As a result, the concentration of the reactants increases on the surface of the catalyst and hence the rate of reaction increases.

Question 14

How would your account for the following? [2]

i. The following order of increase in strength of acids:
$PH_3 < H_2S < HCl$

Answer:
Larger the difference in electronegativity greater will be polarity and hence greater will be acidic character.

ii. The oxidising power of oxoacids of chlorine follows the order:
$HClO_4 < HClO_3 < HClO_2 < HClO$

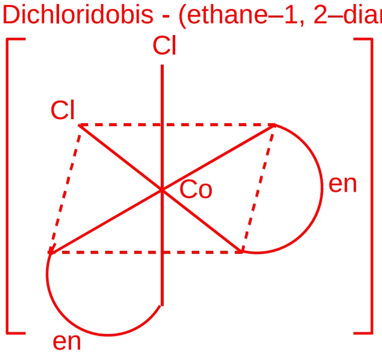
Answer:
As $HClO_4$ is most stable and tendency to give oxygen is least while HClO is least-stable and gives oxygen most easily.

Question 15

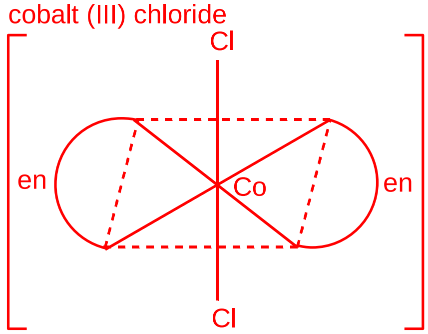
Name the following coordination compounds and draw their structures: [2]

i. $[CoCl_2(en)_2]Cl$

Answer:
Dichloridobis - (ethane–1, 2–diamine) cobalt (III) chloride



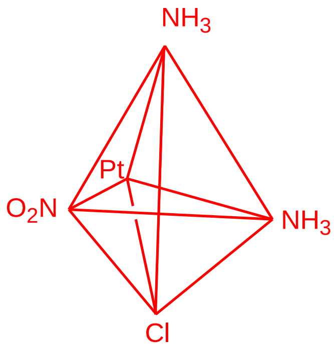
Octahedral cis - $[CoCl_2(en)_2]^+$



Octahedral trans - $[CoCl_2(en)_2]^+$

ii. $[Pt(Hn_3)_2Cl(NO_2)]$

Answer:
Diamminechloridonitrito- N platinum (II)



Tetrahedral

Question 16

Explain what is meant by the following: [2]

i. Peptide linkage

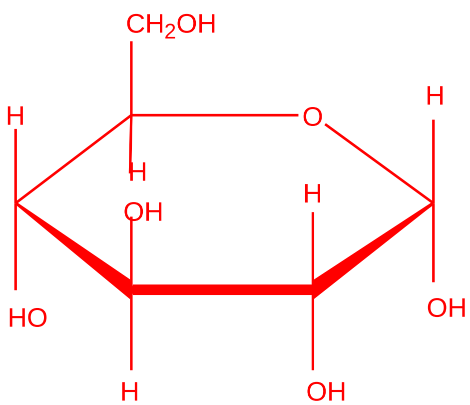
Answer:

Peptide linkage: The amide (—C(=O)—NH—) linkage between two a-amino acids formed with the loss of a water molecule is called a peptide linkage.

ii. Pyranose structure of glucose

Answer:

The six membered cyclic structure of glucose is called pyranose structure (α –or β-), in analogy with heterocylic compound pyran.



α – D – (+) – Glucopyranose

Question 17

Name the products of hydrolysis of [2]

i. Sucrose

Answer:

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{or invertase}]{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

ii. Lactose

Answer:

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{or invertase}]{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

Lactose　　　　Glucose　　Galactose

OR

Mention three such properties of glucose which cannot be explain.

Answer:

The following facts and reactions cannot be explained by open chain structure of glucose.

i. Despite having the aldehyde group, glucose does give 2, 4-DNP test, Shiff's test and it does not form the hydrogen sulphite addition product with $NaHSO_3$.

ii. The penta-acetate of glucose does not react with hydroxylamine indicating the absence of free aldehydic group.

Question 18

State the reason in each of the following cases: [2]

i. Soaps do not work well in hard water.

Answer:

Hard water contains calcium and magnesium salts. In hard water, soaps get precipitated as calcium and magnesium soaps which being insoluble stick to the clothes as gummy mass.

ii. Synthetic detergents are better than soaps.

Answer:

As synthetic detergents can be used in hard water as well as acidic solutions.

Question 19

Aluminium crystallises in a cubic close-packed structure. Radius of the atom in the metal is 125 pm. [2]

i. What is the length of the side of the unit cell?

Answer:

For fcc (or ccp), $a = 2\sqrt{2}r = 2 \times 1.414 \times 125$ pm

= 354 pm

ii. How many unit cells are there in 1 cm^3 of aluminium?

Answer:

$a = 354 \text{ pm} = 3.54 \times 10^{-8}$ cm

Volume of one-unit cell $= a^3 = (3.54\times 10^{-8} \text{ cm})^3 = 4.436 \times 10^{-23} \text{cm}^3 = 4.44 \text{ cm}^3$

$$\text{Number of unit cells} = \frac{\text{Total volume}}{\text{Volume of one unit cell}}$$

$$= \frac{1\text{cm3}}{4.44 \times 10^{-23} \text{cm}^3} = 2.25 \times 10^{22}$$

Question 20

A voltaic cell is set up at 25^0 C with the following half-cells, Al^{3+} (0.001 M) and Ni^{2+} (0.50 M). Write the cell reaction when the cell generates an electric current and determine the cell potential.

(Given: $E^0_{\frac{Ni^{2+}}{Ni}}$ = - 0.25 V, $E^0_{\frac{Al^{3+}}{Al}}$ =-1.66 V) [3]

Answer:

At anode: Al (s) $\rightarrow$ Al^{3+} (aq) + $3e^-$] × 2

At cathode: $Ni^{2+} + 2e^-$ $\rightarrow$ Ni(s)] × 3

Cell reaction: 2Al(s) + $3Ni^{2+}$ (aq) $\rightarrow$ $2Al^{3+}$(aq) + 3Ni (s)

Applying Nerst equation to the above cell reaction

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log\frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

Here, $E^o_{cell} = E^O_{Ni^{2+}/Ni} - E^O_{Al3+/Al} = -0.25V - (-1.66V) = 1.41V, n = 6$

$\therefore$ $[Al^{3+}] = 1\times10^{-3}$M, $[Ni^{2+}]$ = 0.5 M

$$\therefore \quad E_{cell} = 1.41V - \frac{0.0591}{6}\log\frac{(10^{-3})^2}{(0.5)^3} = 1.41V - \frac{0.0591}{6}\log(8\times10^{-6})$$

$$= 1.41\ V - \frac{0.0591}{6}(\log 2^3 + \log 10^{-6})$$

$$= 1.41\ V - \frac{0.0591}{6}[3 \times \log 2 + (-67) \log 10]$$

$$= 1.41\ V - \frac{0.0591}{6}[3 \times 0.3010 - 6]$$

$$= 1.41\ V + 0.050\ V$$

$$E_{cell} = 1.46\ V$$

Question 21

State the principle on which each of the following processes operates: [3]

i. Recovery of silver after the silver ore has been leached with NaCN.

Answer:

Recovery of silver after silver ore was leached with NaCN: During leaching Ag is oxidized to Ag+ which then combines with CN– ions to form soluble complex, [Ag(CN)2]–. Silver is then recovered from this complex by displacement method using more electropositive zinc metal.

$$2[Ag(CN)2]^-(aq) + Zn(s) \rightarrow 2Ag(s) + [Zn(CN)_4]^{2-}(aq)$$

ii. Electrolytic refining of a metal.

Answer:

Electrolytic refining of a metal: In this method, the impure metal is made to act as anode. A strip of same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of same metal. When electric current is passed the metal from the anode goes into solution as ions due to oxidation while pure metal gets deposited at the cathode due to reduction of metal ions. The voltage applied for electrolysis is such that impurities of more electropositive metals remain in the solution as ions while impurities of the less electropositive metals settle down under the anode as anode mud.

At anode: $M \rightarrow M^{n+} + n\bar{e}$

At cathode: $M^{n+} + n\bar{e} \rightarrow M$

iii. Vapour phase refining of a metal.

Answer:

Vapour phase refining of a metal: In this method, the metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal. For example, refining of nickel by Mond process.

$$Ni + 4CO \xrightarrow{330\text{-}350k} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450\text{-}470k} Ni + 4CO$$

Question 22

Complete the following chemical equations: [3]

i. $NaOH + Cl_2 \rightarrow$
(hot and conc.)

Answer:

$6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$
Hot and conc.

ii. $XeF_4 + O_2F_2 \xrightarrow{143K}$

Answer:

$XeF_4 + O_2F_2 \xrightarrow{143k} XeF_6 + O_2$

iii. $Br_2 + F_2 \rightarrow$
(excess)

Answer:

$Br_2 + 5F_2 \rightarrow 2\,BrF_5$

Question 23

a. Mention the optimum conditions for the industrial manufacture of ammonia by Haber's process.

Answer:

Optimum conditions for the industrial manufacture of ammonia by Haber's process.
Pressure: 200 bar
Temperature: 723–773 K
Catalyst: Finely divided iron and molybdenum as promoter.

b. Explain the following giving appropriate reasons:

i. Sulphur vapour exhibits paramangnetic behavior.

Answer:

In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding p* molecular orbitals like O_2 and, hence exhibits paramagnetic behaviour.

ii. Red phosphorus is less reactive than white phosphorus. [3]

Answer:

White phosphorus is more reactive than red phosphorus due to its discrete tetrahedral structure and angular strain. Red phosphorus is less reactive due its polymeric structure.

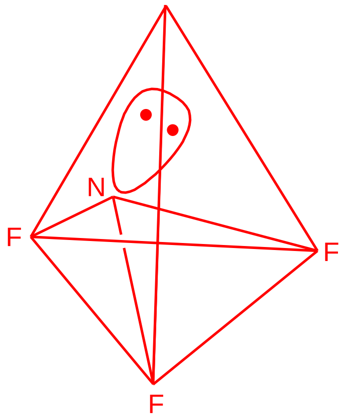
OR

Draw the structures of the following molecules:

i. NF_3

Answer:

Total no. of electron pairs around



The central N atom = $\frac{1}{2}(5+3) = 4$

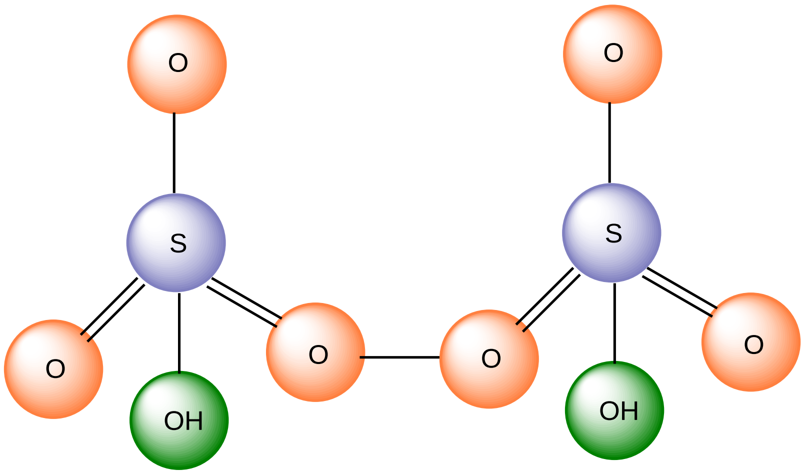
No. of bond pairs = 3

No. of lone pairs = 1

Therefore, according to VSEPR theory; NF3 should be pyramidal.

ii. $H_2S_2O_8$

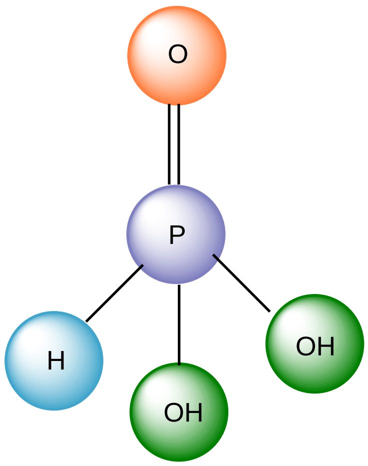
Answer:



Peroxodisulphuric acid ($H_2S_2O_8$)

iii. H_3PO_3

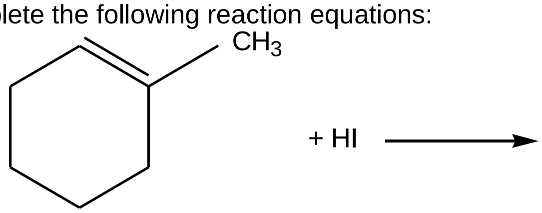
Answer:



Orthophosphorous acid (H_3PO_3)

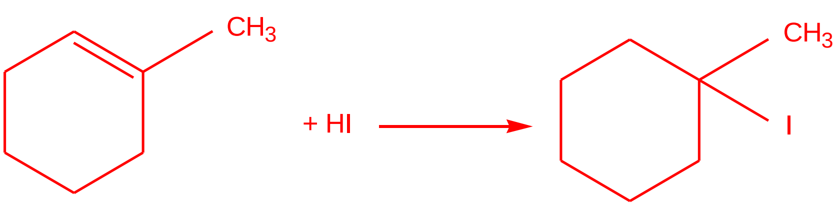
Question 24

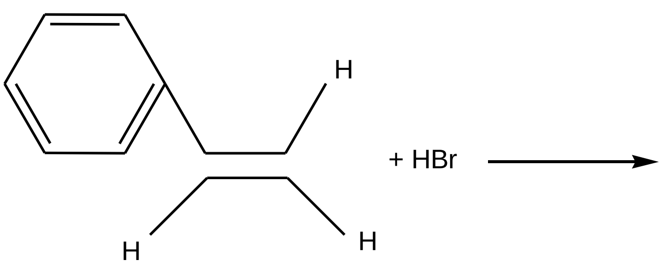
Complete the following reaction equations: [3]



i.

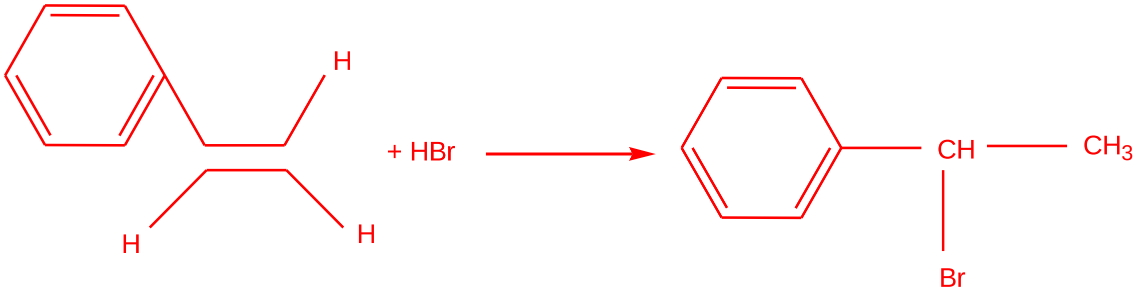
Answer:





ii.

Answer:



iii. $CH_3CH_2CH = CH_2 + HBr \rightarrow$

Answer:

$CH_3CH_2CH = CH_2 + HBr \rightarrow CH_3CH_2CH(Br){-}CH_3$

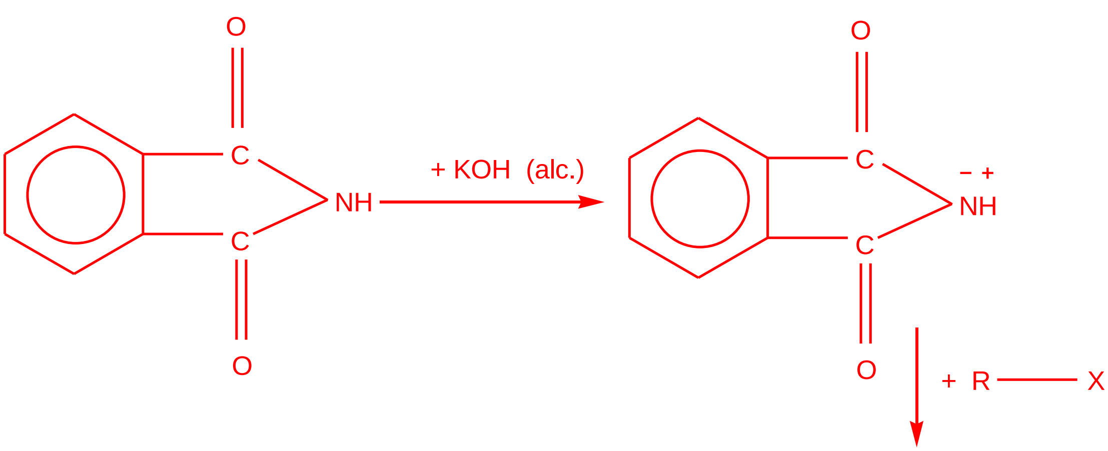
Question 25

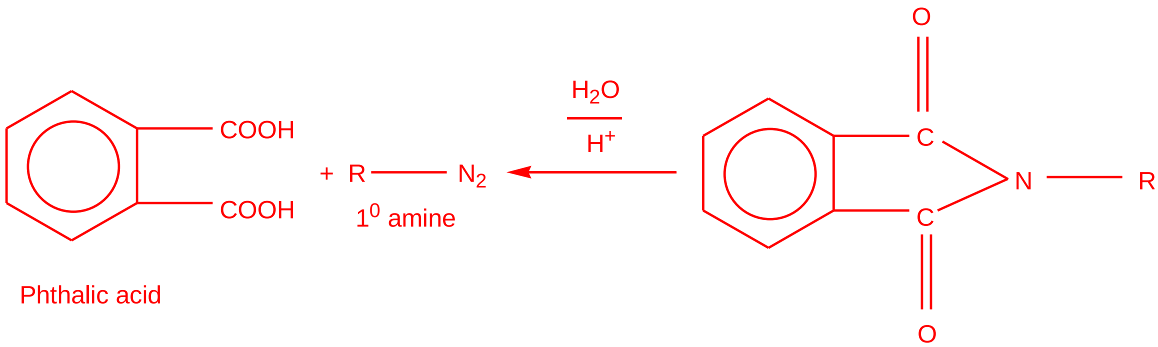
Illustrate the following reactions giving a chemical equation in each case: [3]

i. Gabriel phthalimide synthesis

Answer:

Gabriel phthalimide synthesis: This reaction is used for the preparation of aliphatic primary amines. In this reaction, phthalimide is first of all treated with ethanolic KOH to form potassium phthalimide. Potassium phthalimide on treatment with alkyl halide gives N-alkyl phthalimide, which on hydrolysis with dilute hydrochloric acid gives a primary amine as the product.



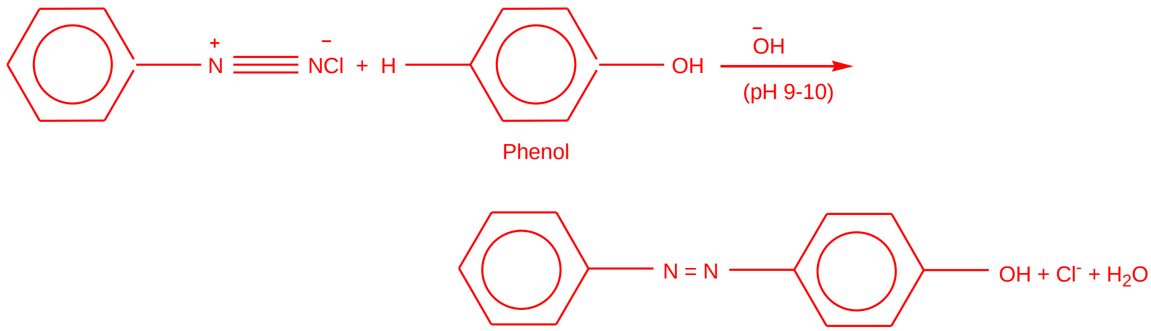


ii. A coupling reaction

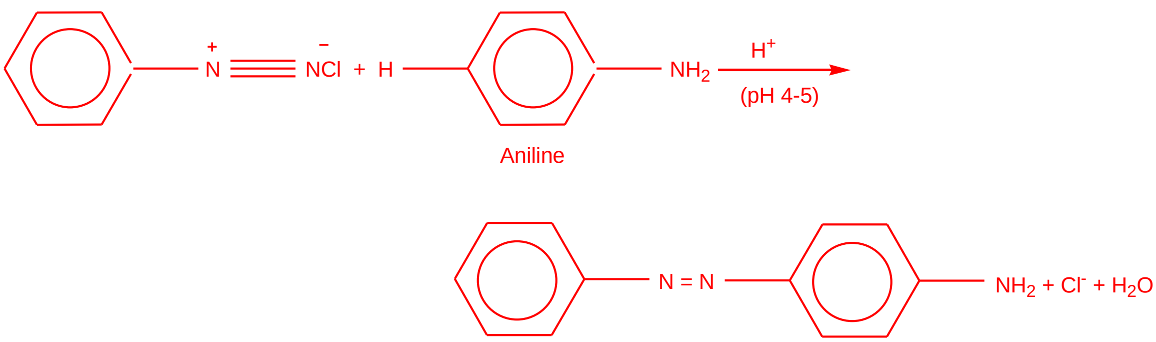
Answer:

Coupling reactions:

Diazonium salts react with aromatic amines in weakly acidic medium and phenols in weakly alkaline medium to form coloured compounds called azo dyes by coupling at *p*-position of amines or phenol. The mechanism is basically that of electrophilic aromatic substitutions where the diazonium ion is electrophile.



p - Hydroxy - azobenzene
(orange dye)



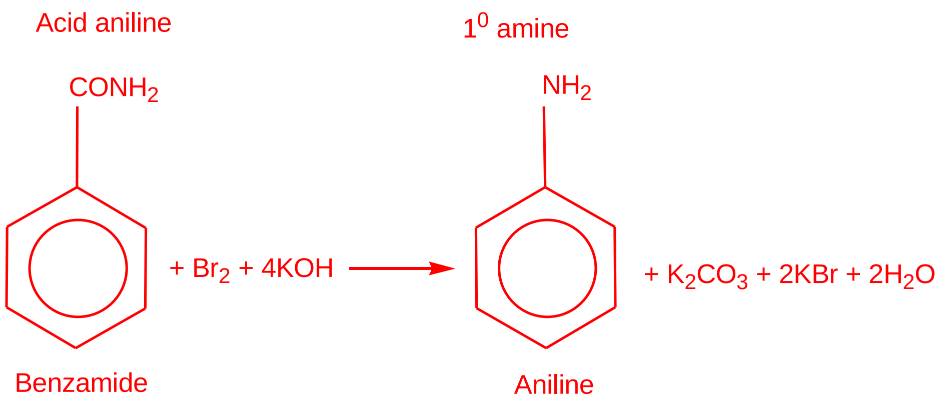
p - Amino azobenzene
(yellow dye)

iii. Hoffmann's bromamide reaction

Answer:

Hoffman's bromamide reaction: When a primary acid amide is heated with an aqueous or ethanolic solution of NaOH or KOH and bromine (i.e., NaOBr or KOBr), it gives a primary amine with one carbon atom less.

$$R\text{-}CONH_2 + Br_2 + 4NaOH \rightarrow R\text{-}NH_2 + Na_2CO_3 + 2NaBr + 2H_20$$

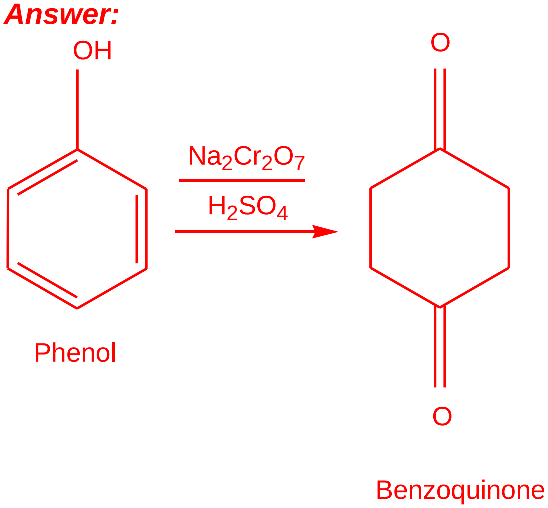


Question 26

How would you obtain [3]

i. Benzoquinone from phenol?

Answer:



ii. Propan-2-ol from propene?

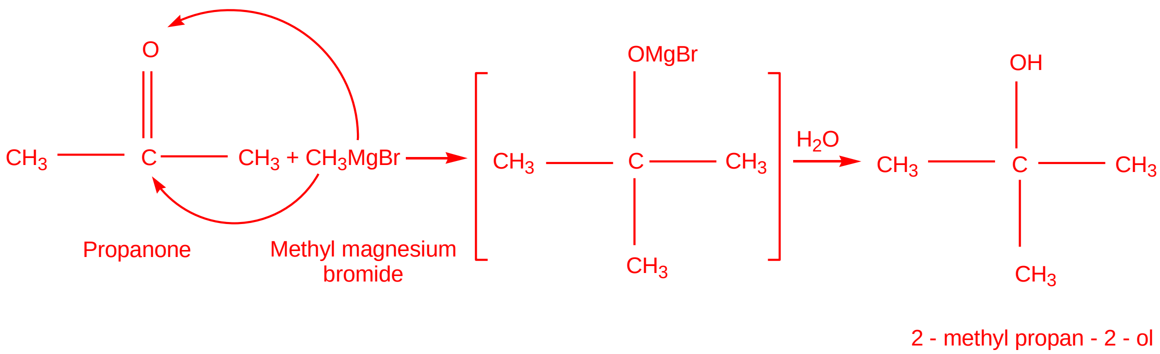
Answer:

$$CH_3-CH=CH_2 + H_2O \xrightarrow[\text{Markovnikov's addition}]{H^+} CH_3-\underset{\substack{|\\ OH}}{CH}-CH_3$$

Propan - 2 - ol

iii. 2-Methylpropan-2-ol from methyl magnesium bromide?

Answer:



Question 27

Mention two important uses of each of the following polymers: [3]

i. Bakelite

Answer:

i. It is used for making combs, fountain pen barrels, phonograph records.
ii. It is used widely in making electrical goods such as switches, plugs, handles of various utensils.

ii. Nylon 6,6

Answer:

i. It is used in making bristles for brushes, ropes.
ii. It is used for making carpets and fabrics in textile industry.

iii. PVC

Answer:

It is used in the manufacture of rain coats, hand bags, water pipes, vinyl flooring.
It is used for insulating electric wires.

Question 28 [5]

a. Express clearly what you understand by ‘rate expression’ and ‘rate constant’ of a reaction.

Answer:

An experimentally determined expression which relates the rate of reaction with the concentration of reactants is called rate law while the rate of reaction when concentration of each reactant is nity in a rate law expression is called rate constant.

(i) Comparing power of mole in L^{-1} mol s^{-1} and $(mol\ L^{-1})^{1-n}\ s^{-1}$,
We get

$1 = l - n \quad \Rightarrow \quad n = 0$ i.e., zero order reaction

(ii) Again comparing power of mole in L $mol^{-1}s^{-1}$ and $(mol\ L^{-1})^{1-n}\ s^{-1}$, we get

$-1 = 1 - n \quad \Rightarrow \quad n = 2$, i.e., second order reaction

b. Nitrogen pentoxide decomposes according to the equation

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

This first order reaction was allowed to proceed at 400C and the data given below were collected:

$[N_2O_5]$(M)	Time (min)

0.400	0.00
0.289	20.00
0.209	40.00
0.151	60.00
0.109	80.00

i. Calculate the rate constant for the reaction. Include units with your answer.

Answer:

When t = 20 min, [A] = 0.289 mol L^{-1}

Also, $[A]_0 = 0.400$ mol L^{-1}

For a first order reaction

$$k = \frac{2.303}{t} \log \frac{[A]_O}{[A]}$$

$$\therefore \quad k = \frac{2.303}{20} \log \frac{0.400}{0.289}$$

$$\Rightarrow \quad k = \frac{2.303}{20} \log \frac{4.00}{2.89}$$

$$\Rightarrow \quad k = \frac{2.303}{20} [\log 4.00 - \log 2.89]$$

$$\Rightarrow \quad k = \frac{2.303}{20} [0.6021 - 0.4609]$$

$$\Rightarrow \quad k = \frac{2.303}{20} \times 0.1412$$

$$\Rightarrow \quad k = 2.303 \times 0.00706 = 0.016259 \text{ min}^{-1}$$

$$\Rightarrow \quad k = 1.6259 \times 10^{-2} \text{ min}^{-1}$$

ii. Calculate the initial rate of reaction.

Answer:

Initial rate, i.e., rate of reaction when t = 0

When, t = 0.00 min, [A] = 0.400 mol L^{-1}

Also, k = 1.626 × 10^{-2} min^{-1}

$\therefore$ Initial rate = k [A] = 1.626 × 10^{-2} min^{-1} × 0.400 mol L^{-1}

= 6.504 × 10^{-3} mol L^{-1} min^{-1}.

iii. After how many minutes will $[N_2O_5]$ be equal to 0.350 m?

Answer:

$$t = \frac{2.303}{k} \log \frac{[A]_o}{[A]}$$

Here, $K = k = 1.6259 \times 10^{-2}\ \text{min}^{-1}$, $[A]_o = 0.400$ M, $[A] = 0.350$ M

Substituting these values in the above equation, we get

$$t = \frac{2.303}{1.6259 \times 10^{-2}} \log \frac{0.400}{0.350} = \frac{2.303}{1.6259 \times 10^{-2}} [\log 40 - \log 35]$$

= 141.583 [1.6021 – 1.5441]
= 141.583 × 0.0580
= 141.583 × 0.0580 = 8.21 min.

OR

a. Define:
   i. Order of a reaction.

Answer:
Order of a reaction may be defined as the sum of the powers of the concentration terms of the reactants in the rate law expression.

   ii. Elementary step in a reaction

Answer:
Elementary step: Each step of a complex reaction is called an elementary step.

b. A first order reaction has a rate constant value of 0.00510 min^{-1}. If we begin with 0.10 M concentration of the reactant, how much of the reactant will remain after 3.0 hours? [5]

Answer:

$$t = \frac{2.303}{k} \log \frac{[A]_o}{[A]}$$

Here, $K = 5.10 \times 10^{-3}\ \text{min}^{-1}$, $t = 3 \times 60 \times 60$ min= 10800 min

$$[A]_o = 0.1 \text{ M}$$

Substituting these values in the above equation,

We get

$$10800 \text{ min} = \frac{2.303}{5.1 \times 10^{-3} \text{min}^{-1}} \log \frac{0.1}{[A]}$$

$$\log \frac{0.1}{[A]} = \frac{10800 \times 5.1 \times 10^{-3}}{2.303} = 23.9166$$

$$\frac{0.1}{[A]} = \text{Antilog } 23.9166 = 8.255 \times 10^{23}$$

$$[A] = \frac{0.1}{8.255 \times 10^{23}} = 1.21 \times 10^{-25} \text{M}$$

Question 29 [5]

a. Complete the following reactions in an aqueous medium:

i. $MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow$

Answer:

$MnO_4^- + 8H^+ + 5\bar{e} \rightarrow Mn^{2+} + 4H_2O] \times 2$

$C_2O_4^{2-} \rightarrow 2CO_2 + 2\bar{e}] \times 5$

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

ii. $Cr_2O_7^{2-} + H_2S + H^+ \rightarrow$

Answer:

$Cr_2O_7^{2-} + 14H^+ + 6\bar{e} \rightarrow 2Cr^{3+} + 7H_2O$

$H_2S \rightarrow 2H^+ + S + 2e^-] \times 3$

$C_2O_7^{2-} + 3H_2S + 8H^+ \rightarrow 2Cr^{3+} + 3s + 7H_2O$

b. How would your account for the following:

i. Metal-metal bonding is more extensive in the 4d and 5d series of transition elements than the 3d series.

Answer:

The catalytic activity of transition metals and their compounds is attributed to the following reasons:
Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation for the reaction. In some cases, the transition metal provides a suitable large surface area with free valencies on which reactants are adsorbed. In general in the same group of *d* block elements, the 4*d* and 5*d* transition element has larger size than that of 3*d* elements. Thus, the valence electrons are less lightly held and hence can form metal-metal bond more frequently.

ii. Mn(III) undergoes disproporationation reaction easily.

Answer:

Mn^{3+} is less stable and changes to Mn^{2+} which is more stable due to half filled d-orbital configuration. That is why, Mn^{3+} undergoes disproportionation reaction.

iii. Co(II) is easily oxidized in the presence of strong ligands.

Answer:

Co (III) has electric configuration 3*d*, 4*s*, *i.e.,* it has three unpaired electron. In the presence of strong ligands, two unpaired electrons in 3d subshell pair up and third unpaired electron shift to higher energy subshell from where it can be easily lost and hence oxidised to Co(III).

OR

a. Complete the following chemical equations: [2]

i. $Fe^{3+} + I^- \rightarrow$

Answer:

$2Fe^{3}+ + 2I^{-} \rightarrow 2Fe^{2+} + I_2$

ii. $CrO_4^{2-} + H^{+} \rightarrow$

Answer:

$2CrO_4^{2-} + 2H^{+} \rightarrow Cr_2O_7^{2-} + H_2O$

b. Explain the following: [3]

i. Copper (I) ion is not stable in an aqueous solution.

Answer:

In aqueous solution Cu+ undergoes disproportionation to form a more stable Cu2+ ion.

$$2\ Cu^{+}\ (aq) \rightarrow 2\ Cu^{2+}(aq) + Cu(s)$$

The higher stability of Cu^{2+} in aqueous solution may be attributed to its greater negative D hydH° than that of Cu^{+}. It compensates the second ionization enthalpy of Cu involved in the formation of Cu^{2+} ions.

ii. With same (d^4) configuration Cr (II) is reducing whereas Mn (III) is oxidizing.

Answer:

Cr^{2+} is reducing as its configuration changes from d^4 to d^3, a more stable half-filled t_{2g} configuration while Mn3+ is oxidising as Mn^{3+} to Mn2+results a more stable half-filled d^5 configuration.

iii. Transition metals in general act as good catalysts.

Answer:

The catalytic activity of transition metals and their compounds is attributed to the following reasons: Because of their variable oxidation states transition metals form unstable intermediate compounds and provide a new path with lower activation for the reaction. In some cases, the transition metal provides a suitable large surface area with free valencies on which reactants are adsorbed.

Question 30

a. Give the simple chemical tests to distinguish between the following: [2]

i. Propanal and propanone

Answer:

Propanal and propanone

Tollen's reagent test: Propanal being an aldehyde reduces Tollen's reagent to silver mirror but propanone being a ketone does not.

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + 2[Ag(NH_3)_2]^{+} + 3\overline{O}H \rightarrow CH_3CH_2CO\overline{O} + \underset{\text{Silver Mirror}}{2Ag\downarrow} + 4NH_3 + 2H_20$$

$$CH_3COCH_3 \xrightarrow[\text{reagent}]{\text{Tollen's}} \text{No silver mirror}$$

ii. Benzaldehyde and acetophenone

Answer:

Benzaldehyde and acetophenone

Iodoform test: Acetophenone being a methyl ketone on treatment with I_2/NaOH undergoes Iodoform reaction to give yellow ppt. of iodoform but benzaldehyde does not.

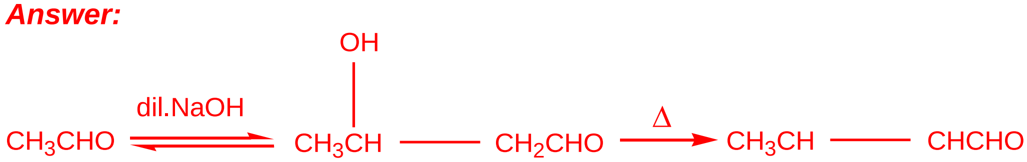
$$C_6H_5COCH_3 + 3NaOI \rightarrow C_6H_5COONa + CHI_3 \downarrow + 2NaOH$$

Acetophenone — Iodoform (yellow ppt.)

b. How woul you obtain [3]

i. But-2-enal from ethanol

Answer:



Ethanal — But - 2 -enal

ii. Butanoic acid from butanol

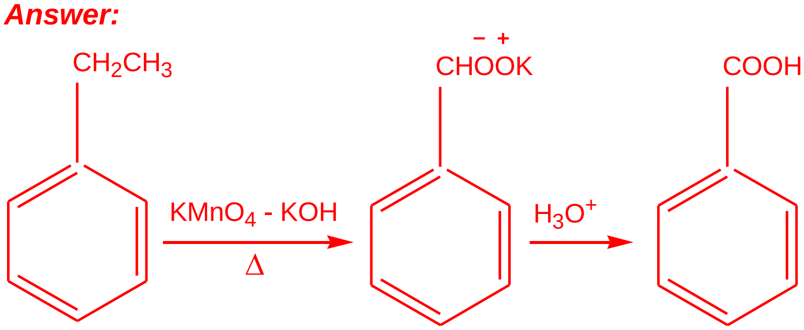
Answer:

$$CH_3CH_2CH_2CH_2OH\ CH\ CH\ CH \xrightarrow{CrO_3 - H_2SO_4} CH_3CH_2CH_2COOH$$

Butan – I – ol — Butanoic acid

iii. Benzoic acid from ethylbenzene

Answer:



Ethyl benzene — Benzoic acid

OR

a. Describe the following reactions giving a chemical equation in each case: [2]

i. Cannizzaro's reaction

Answer:

Cannizzaro reaction: Aldehydes which do not have an a-hydrogen atom undergoes disproportionation reactions on treatment with concentrated alkali to give a mixture of carboxylic acid salt and alcohol.

$$2HCHO \xrightarrow{CONC.NaOH} HCOO\overset{+}{N}a + CH_3-OH$$

Formaldehyde   Sod.formate   Methyl alcohol

ii. Decarboxylation reaction

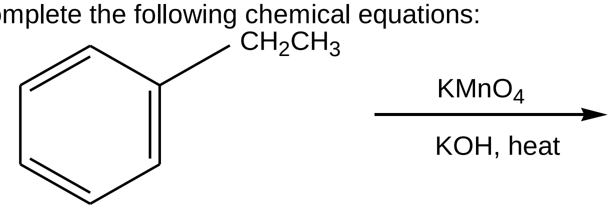
Answer:

Decarboxylation: Carboxylic acids lose carbon dioxide to form hydrocarbons when their sodium salts are heated with sodalime.

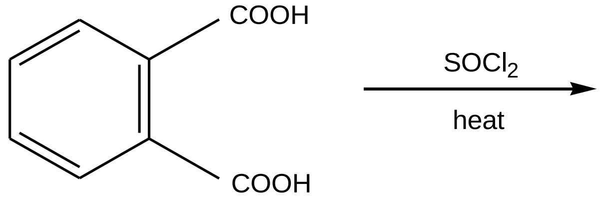
$$RCO\overline{O}\overline{N}a \xrightarrow[\Delta]{NaOHandCao} RH + Na_2CO_3$$

b. Complete the following chemical equations: [3]

i.

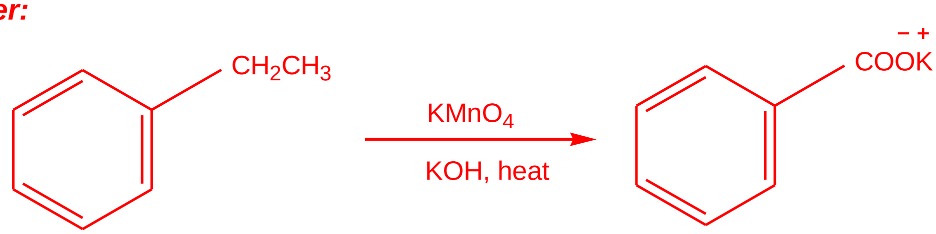


ii.

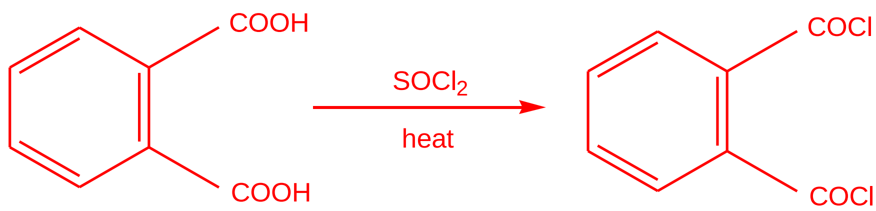


iii. $C_6H_5CONH_2 \xrightarrow[heat]{H_3O^+}$

Answer:



i. Ethyl benzene   Pot. benzoate



ii. Phthalic acid   Phthaloyl chloride

iii. $C_6H_5CONH_2 \xrightarrow[heat]{H_3O^+} C_6H_5COOH + NH_3$