2014

Question 1
What is the function of collectors in the froth floatation process for the concentration of ores? [1]

Answer:
Collectors as the name suggest are used for collecting the ore particles in the sulphide ore. They are phallic to the ores. They are normally pine oil, fatty acids etc. they get separated from the froth mixture and helps to eliminate the ore from the gangue particles.

Question 2
What type of forces are responsible for the occurrence of physisorption? [1]

Answer:
Van der Waals forces.

Question 3
Why is the single N – N bond weaker than the single P – P bond? [1]

Answer:
N-N single bond is weaker than P-P bond due to smaller size of N as compared to P. Smaller size of N leads to smaller N-N bond length. As a result, the lone pair of electrons on the N atoms repel each other leading to unstability or weakening of N-N bond. Because of larger size of P atom, P-P bond length is more and lone pair-lone pair repulsion between P atoms is less which makes the P-P bond stronger than N-N bond.

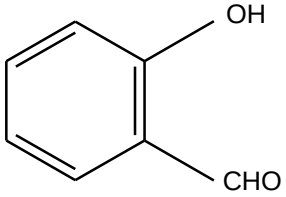
Question 4
What type of isomerism is shown by the following complex: [1]
$[Co(NH_3)_6][Cr(CN)_6]$

Answer:
Coordination isomerism.

Question 5
Express the relationship between atomic radius (r) and the edge length (a) in the b.c.c. unit cell. [1]

Answer:
$r = \frac{\sqrt{3}}{4}$

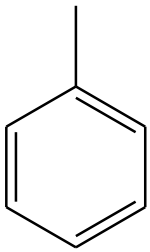
Question 6
Write the IUPAC name of the following compound: [1]



Answer:
2-hydroxybenzaldehyde

Question 7
Which of the two is more basic and why? [1]

CH_3NH_2 or NH_2



Answer:

Aniline has *resonance character* which delocalises the lone pair on nitrogen making it less available for a proon acceptor so it less basic than methylamine

Question 8

Name the two components of α-glucose which constitute starch. [1]

Answer:

amylopectin and amylose

Question 9

A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 5.0 ampere for 20 minutes. What mass of nickel will be deposited at the cathode?
(Given: At. Mass of Ni = 58.7 g mol^{-1}, 1 F = 96500 C mol^{-1}) [2]

Answer:

I=5ampere
t=20mins=1200s
mass of Ni deposited=?
At.mass of Ni=58.7
1F=96500
using the formula Q=It
we get 600^0C
now reaction
Ni^{2+} + 2e------>Ni
=2*86500=193000
Therefore mass deposited =58.7*60000/193000

Question 10

Define half-life of a reaction. Write the expression of half-life for [2]

i. Zero order reaction and
ii. First order reaction.

Answer:

The half-life of a reaction is the time in which the concentration of a reactant is reduced to one half of its initial concentration.
zero order reaction
$t_{1/2}=[R_o]/2k$
first order reaction
$t_{1/2}=0.693/k$

Question 11

Write the chemical reactions involved in the extraction of silver from silver ore. [2]

Answer:

CH_3CH_2Cl + aq. KOH --------> CH_3CH_2OH + KCl

Ethyl chloride when treated with aq. KOH gives ethanol

Question 12

Name the two most important allotropes of sulphur. Which one of the two is stable at room temperature? What happens when the stable form is heated above 370 K? [2]

Answer:

Two most important allotropes of sulphur are rhombic sulphur and monoclinic sulphur. The stable form at room temperature is rhombic sulphur. When rhombic sulphur is heated above 370 K it gets converted into monoclinic sulphur.

OR

a. Write the conditions to maximize the yield of H_2SO_4 by contact process. [2]

b. Why is K_{a_2} << K_{a_1} for H_2SO_4 in water?

Answer:

K_{a2} << K_a, because the negatively charged HSO_4^- ion has much less tendency to donate a proton to H_2O as compared to neutral H_2SO_4.

Question 13

Complete the following equations: [2]

i. $2MnO_4^- + 5S^{2-} + 16H^+ \rightarrow$

Answer:

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

$S^{2-} \longrightarrow S + 2e^-] \times 5$

$2MnO_4^- + 5S^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 5S + 8H_2O$

---

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

Answer:

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

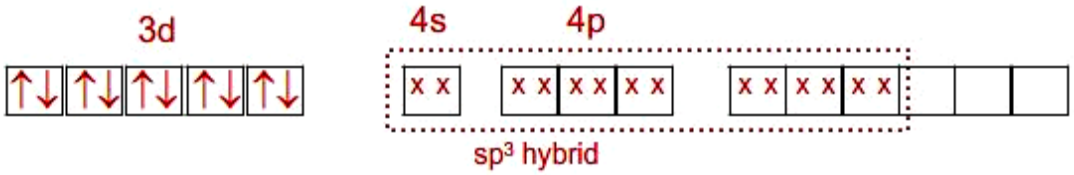
Question 14

Write the state of hybridization, shape and IUPAC name of the complex. [2]

$[CoF_6]^{3-}$. (Atomic no. of Co = 27)

Answer:

$[CoF_6]^{3-}$. Hexafluoridocobaltate (III) ion; Co^{3+} = $[Ar]3d^6$



XX = Electron pair from ligand F^-
Hybridisation = sp^3d^2, Shape = Octahedral

Question 15

Write chemical equations when [3]

i. Ethyl chloride is treated with aqueous KOH.

Answer:

$$CH_3 - CH_2 - Cl + KOH(aq) \longrightarrow CH_3 - CH_2 - OH + KCl$$

Ethyl chloride Ethyl alcohol

ii. Chlorobenzene is treated with CH_3COCl in presence of anhydrous $AlCl_3$. (**)

Question 16

a. Which alkyl halide from the following pairs would you expect to react more rapidly by an S_N2 mechanism and why? [2]

$CH_3 - CH_2 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$ $CH_3 - CH_2 - CH_2 - CH_2 - Br$

Answer:

$CH_3CH_3CH_3CH_2Br$ reacts more rapidly by an SN2 reaction as it is a primary alkyl halide.

b. Racemisation occurs in S_N1 reactions. Why?

Answer:

The incoming nucleophile can attack the carbocation formed from step 1 from either side.

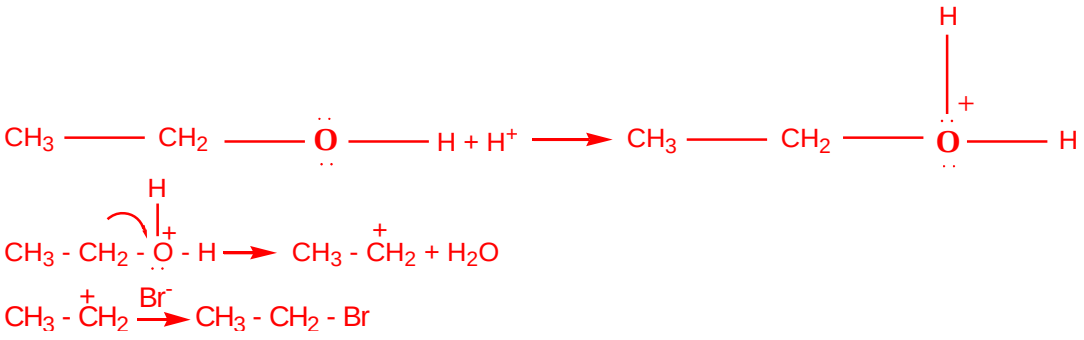
Question 17

Write the mechanism of the following reaction: [2]

$$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$$

Answer:

$HBr \rightarrow H^+ + Br^-$



Question 18

Name the reagents used in the following reactions: [3]

i. Bromination of phenol to 2,4,6-tribromophenol

Answer:

bromine water

ii. Butan-2-one to Butan-2-ol

Answer:

$NaBH_4$,$LiAlH_4$

iii. Friedel − Crafts alkylation of anisole.

Answer:

anhyd. $ALCl_3$,CS_2

iv. Oxidation of primary alcohol to carboxylic acid

Answer:

$KMnO_4$

Question 19

a. What type of stoichiometric defect is shown by KCl and why? [3]

Answer:

KCl show schottky defect in which no. pf missing anions and cations are equal. This occurs in those ionic substances in which the size of ions are equal.

b. What type of semiconductor is formed when silicon is doped with As?

Answer:

n-type semiconductor

c. Which one of the following is an example of molecular solid: CO_2 or SiO_2.

Answer:

CO_2

d. What type of substances would make better magnets, ferromagnetic or ferrimagnetic ?

Answer:

Ferromagnetic

Question 20

a. Write two advantages of $H_2 – O_2$ fuel cell over ordinary cell [3]

Answer:

Fuel cells produce electricity with an efficiency of 70% compared to thermal plants whose efficiency is about 40%. Fuel cells are pollution free.

b. Equilibrium constant (Kc) for the given cell reaction is 10.

Calculate E^{o}_{cell}

$A(s)+B^{2+}(aq) \rightleftharpoons A^{2+}(aq)+B(s)$

Answer:

$A(s) + B2+ (aq) \rightleftharpoons + A^{2+}(aq) + B(s)$

Here, n = 2, K = 10

$$E^{o}_{cell} = \frac{0.059}{n} x \log Kc$$

$$E^{o}_{cell} = \frac{0.059}{2} x \log 10 = \frac{0.059}{2} x 1$$

= 0.02965V

Question 21

The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume: [3]

$$SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$$

Experiment	Tim/s^{-1}	Total pressure/atm
1	0	0.4
2	100	0.7

Calculate the rate constant.
(Given: log 4 = 0.6021, log 2 = 0.3010)

Answer:

$SO_2\ Cl_2 \rightarrow SO_2 + Cl_2$

At t = 0s 0.4 atm 0 atm 0 atm

At t = 100s (0.4 – x) atm x atm x atm

Pt = 0.4 – x + x + x

Pt = 0.4 + x

0.7 = 0.4 + x

x = 0.3

$$k = \frac{2.303}{t} \log\left(\frac{pi}{2pi - pt}\right)$$

$$k = \frac{2.303}{t} \log\left(\frac{0.4}{0.8 - 0.7}\right)$$

$$k = \frac{2.303}{100} \log \frac{0.4}{0.1}$$

$$k = \frac{2.303}{100} \times 0.6021 = 1.39 \times 10^{-2} s^{-1}$$

Question 22

a. Write the expression for the Freundlich adsorption isotherm for the adsorption of gases on solids, in the form of an equation.

Answer:

$x/m = kP^{1/n}$

b. What are the dispersed phase and dispersion medium of butter?

Answer:
Liquid in solid

c. A delta is formed at the meeting place of sea and river water. Why?

[3]

Answer:
River water is a colloidol solution of clay. Sea water contains a no. of electrolytes. When river water meets the sea water, the electrolytes present in sea water coagulate the colloidal solution of clay resulting in its deposition with the formation of delta.

Question 23 [3]

a. What are the different oxidation states exhibited by the lanthanoids?

Answer:
+2,+3,+4

b. Write two characteristics of the transition elements.

Answer:
All the lanthanoids are silvery white soft metals and tarnish rapidly in air. Many trivalent lanthanoids are coloured both in solid and in aqueous state.

c. Which of the 3d-block elements may not be regarded as the transition elements and why?

Answer:
zinc. cadmium and mercury

OR

Assign suitable reasons for the following:

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

Answer:
The electronic configuration of Mn^{2+} is $[Ar]3d^5$ which is half filled and hence stable. So Mn^{2+} cannot lose third electron easily. On the other hand, Fe^{2+} has electronic configuration [Ar] $3d^6$. It tends to lose one electron to acquire stable $[Ar]3d^5$ electronic configuration. Hence Mn^{2+} is more stable than Fe^{2+} towards oxidation.

b. In the 3d series from Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomization of Zn is the lowest.

Answer:
Zn has no unpaired electons in its outermost orbit so covalent bonding is not possible amongst its atoms.so metallic is only there.the net result is weaker attractive force and lowest enthalpy of atomization

c. Sc^{3+} is colorless in aqueous solution whereas Ti^{3+} is colored.

Answer:
Only those ions are coloured which have incomplete filled d-orbital. Therefore Sc^{3+} is colourless while Ti^{3+} is colured.

Question 24
Give the structures of A, B and C in the following reactions: [3]

i. $CH_3Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273K]{HNO_2} C$

Answer:

$CH_3Br \xrightarrow{KCN} CH_3CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2 \xrightarrow[273K]{HNO_2} CH_3CH_2OH$

ii. $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{Br_2+KOH} B \xrightarrow{CHCl_3+NaOH} C$

Answer:

$CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow{Br_2+KOH} CH_3NH_2 \xrightarrow{CHCl_3+NaOH} CH_3NC$

Question 25

Define the following terms: [3]

a. Anomers

Answer:

The carbohydrates which differ in configuration at the glycosidic carbon (*i.e.*, C1 in aldoses and C_2 in ketoses) are called anomers e.g.,α–D-(+)-glucose and β–D-(+)-glucose.

b. Denaturation of proteins

Answer:

When a protein in its native form is subjected to a change, such as change in temperature or change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation, 2° and 3° structures are destroyed but 1° structures remain intact, *e.g.,* coagulation of egg while on boiling, curdling of milk, etc.

c. Essential amino acids

Answer:

The amino acids which cannot be synthesised in our body and must be obtained through diet are known as essential amino acids e.g. valine, lysine, histidine.

Question 26 [3]

a. Define Antihistamine with an example.

Answer:

The drugs which interfere with the natural action of histamine by competing with histamine for binding of receptor where histamine exerts its effect are called anti histamine e.g., brompheniramine, terfenadine, cetrizine etc.

b. Which one of the following drugs is an antibiotic: Morphine, Equanil, Chloramphenicol, Aspirin

Answer:

Chloramphenicol.

c. Why is use of aspartame limited to cold food and drink?

Answer:

Use of aspartame is limited to cold foods because it is unstable at cooking temperature.

Question 27

After the ban on plastic bags, students of one school decided to create awareness among the people about the harmful effects of plastic bags on the environment and the Yamuna River. To make it more impactful, they organized a 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 the Yamuna River.

After reading the above passage, answer the following questions: [3]

i. What values are shown by the students?

Answer:

Concern towards water pollution, concern for environmental protection, team work, socially aware.

ii. What are biodegradable polymers? Give one example.

Answer:

The polymers which can be broken into small segments by enzyme catalysed reactions or to some extent by oxidation over a period of time are called biodegradable polymers. The required enzymes are produced by microorganism e.g., poly-b-hydroxybutyrate-co-b-hydroxyvalerate (PHBV), nylon-2-nylon-6 etc.

iii. Is polythene a homopolymer or copolymer?

Answer:

Polyethene is an addition polymer.

Question 28

a. State Raoult's law for a solution containing volatile components. Name the solution which follows Raoult's law at all concentrations and temperatures.

Answer:

It states that for a solution of volatile liquids, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction. Thus, for a solution of volatile liquids *A* and *B*, $P_A \propto x_A$ and $P_B \propto x_B$ or $PA = P_A^o \chi_A$ and $P_B^o \chi_B$ where P_A and P_B are partial vapour pressures, x_A and x_B are mole fractions, P_A^o and P_B^o are vapour pressure of pure components *A* and *B* respectively.

b. Calculate the boiling point elevation for a solution prepared by adding 10 g of $CaCl_2$ to 200 g of water. (K_b for water = 0.512 K kg mol^{-1}, Molar mass of $CaCl_2$ = 111 g mol^{-1}) [3]

Answer:

The given quantities are:

W_B = 10 g, WA = 200 g, K_b = 0.512 K Kg mol_{-1},

M_B = 111 g mol^{-1}

$$CaCl_2 \longrightarrow Ca^{2+} + 2Cl^-$$

On assuming complete dissociating of $CaCl_2$ $i = \frac{3}{1} = 3$

Substituting these values in the formula, $\Delta T_b = \frac{i \times K_b \times W_B \times 1000}{M_B \times W_A}$

$$\Delta T_b = \frac{3 \times 0.512 \text{K Kg mol}^{-1} \times 10 \text{g} \times 1000 \text{ g kg}^{-1}}{111 \text{g mol}^{-1} \times 200 \text{ g}}$$

ΔT_b = 0.692 K.

OR

a. Define the following terms:
   i. Azeotrope

Answer:

The binary mixtures of liquids having same composition in liquid and vapour phase and boil at a constant temperature are called azeotropes.

   ii. Osmotic pressure

Answer:

The excess of pressure which must be applied to the solution side to prevent the passage of solvent into it through a semipermeable membrane is called osmotic pressure.

   iii. Colligative properties

Answer:

The properties of solutions which depend only on the number of solute particles in the solution but independent of their nature are called colligative properties.

b. Calculate the molarity of 9.8% (w/w) solution of H_2SO_4 if the density of the solution is 1.02 g ml^{-1}. (Molar mass of H_2SO_4 = 98 g mol^{-1})

Answer:

Question 29 [3]

a. Account for the following :
   i. Bi is a strong oxidizing agent in the + 5 state.

Answer:

Due to inert pair effect Bi in +3 state is much more stable than in +5 state. Therefore, Bi in +5 state accepts two electrons and get reduced to more stable +3 state. Hence Bi is strong oxidising in +5 state.'

   ii. PCl_5 is known but NCl_5 is not known.

Answer:

Nitrogen with n = 2, has s and p orbitals only. It does not have d orbitals to expand its covalency beyond four. Hence, NCl5 is not known. PCl5 is known as P has vacant 3d orbital to which 3s electrons can be excited to make available five half filled orbitals needed for the formation of five P—Cl bonds.

   iii. Iron dissolves in HCl to form $FeCl_2$ and not $FeCl_3$

Answer:

Iron reacts with HCl to form $FeCl_2$ and H_2.

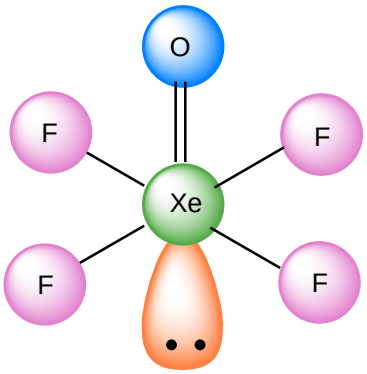
$Fe + 2HCl \longrightarrow FeCl_2 + H_2$

H_2 thus produced prevents the oxidation of $FeCl_2$ to $FeCl_3$.

b. Draw the structures of the following:

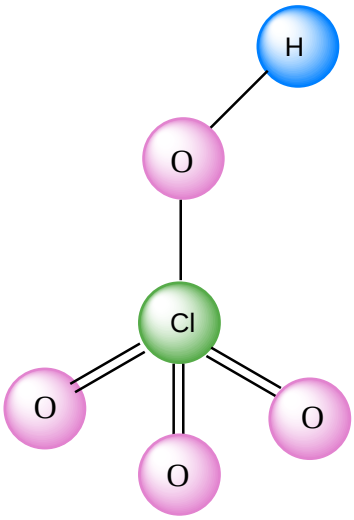
i. $XeOF_4$

Answer:



Square pyramidal

ii. $HClO_4$



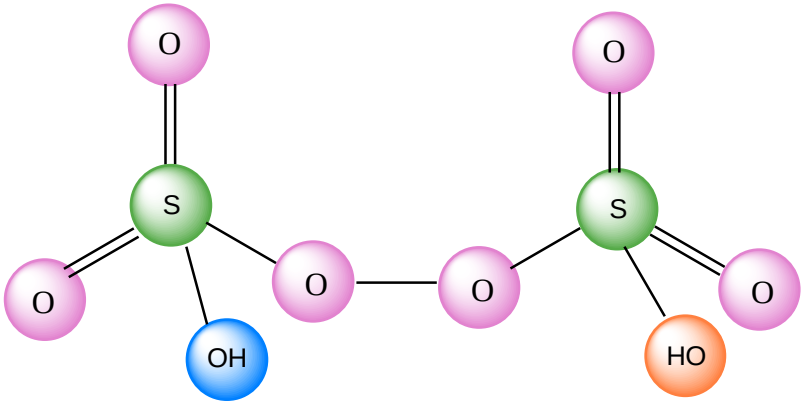
Perchloric acid

OR

a. Draw the structures of the following: [3]

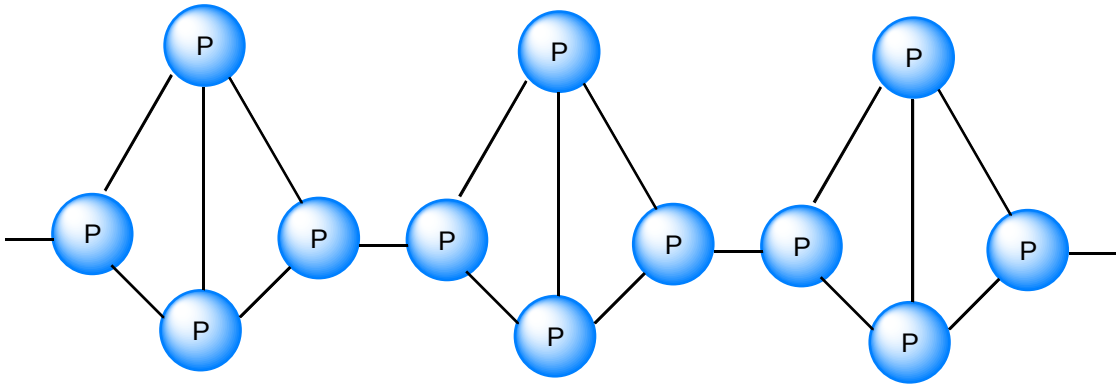
i. $H_2S_2O_8$

Answer:



ii. Red P_4

Answer:



b. Account for the following:

i. Sulphur in vapour state exhibits paramagnetism.

Answer:

In vapour form sulphur partly exists as S_2 molecules which have two unpaired electrons in the antibonding p * molecular orbitals like O_2 molecule and hence, exhibits paramagnetism.

ii. Unlike xenon, no distinct chemical compound of helium is known.

Answer:

This is due to the following reasons:
He does not have d-orbitals in the valence shell and hence electron cannot be excited to higher energy levels like in Xe to form bonds.
Ionisation enthalpy of He is sufficiently higher than those of oxygen and fluorine.

iii. H_3PO_2 is a stronger reducing agent than H_3PO_3

Answer:

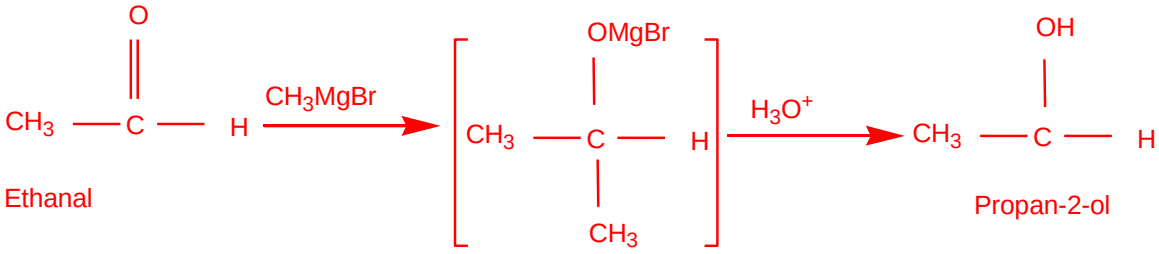
Acids which contains P—H bonds have reducing character. Since H_3PO_2 contains two P—H bonds while H_3PO_3 contains only one P–H bond therefore H_3PO_2 is a stronger reducing agent than H_3PO_3.

Question 30 [3]

a. Write the products formed when ethanal reacts with the following reagents:

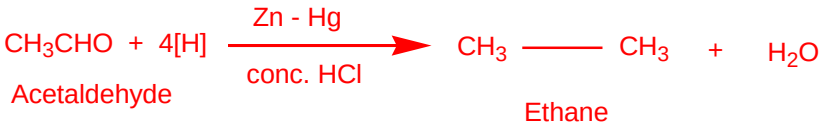
i. CH_3MgBr and then H_3O^+

Answer:



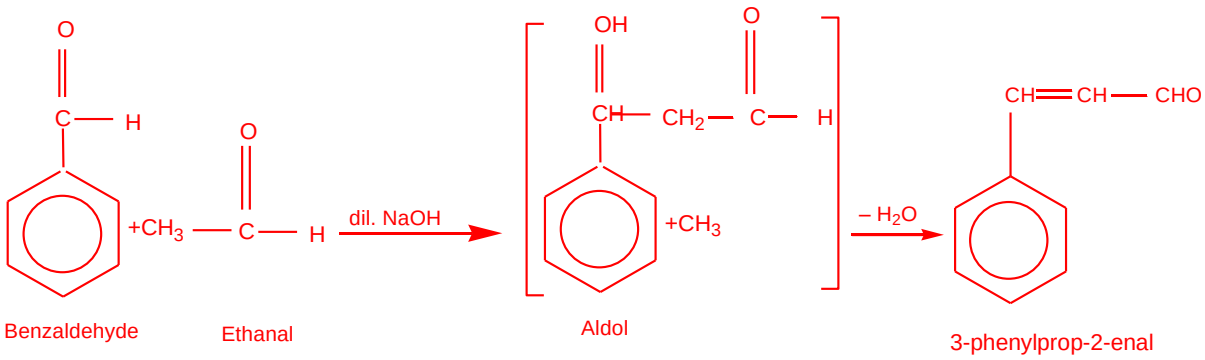
ii. Zn-Hg/conc. HCl

Answer:



iii. C_6H_5CHO in the presence of dilute NaOH

Answer:

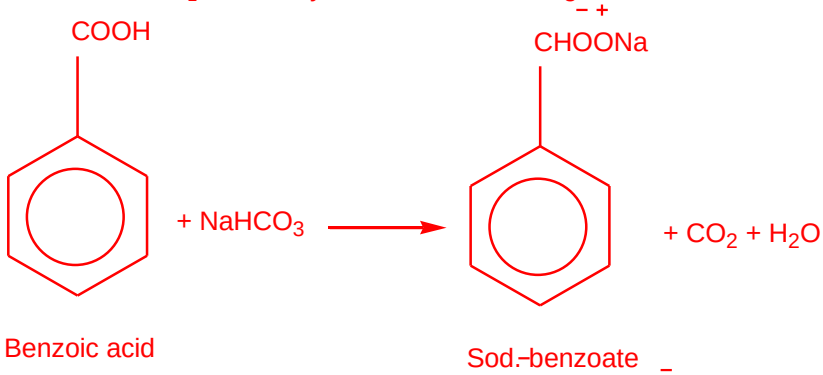


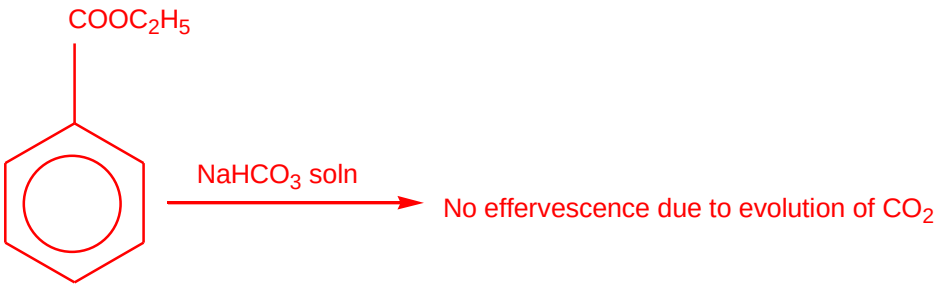
b. Give simple chemical tests to distinguish between the following pairs of compounds:

i. Benzoic acid and Ethyl benzoate

Answer:

Benzoic acid being an acid reacts with $NaHCO_3$ solution to produce brisk effervescence due to evolution of CO_2 while ethyl benzoate does not give this test.





Ethyl benzoate

ii. Propanal and Butan-2-one

Answer:

Propanal being an aldehyde reduces Tollens' reagent to silver mirror but butan-2-one being a ketone does not.

$CH_3CH_2CHO + 2[Ag(NH_3)2]^+ + 3OH^- \rightarrow CH3\text{-}CH_2\text{-}COO^- + 2Ag \downarrow + 2H_2O + 4NH_3$

Propanal Tollens' reagent Silver mirror

$CH_3CH_2COCH_3 +$ Tollens' reagnet $\longrightarrow$ No silver mirror

OR

a. Account for the following:

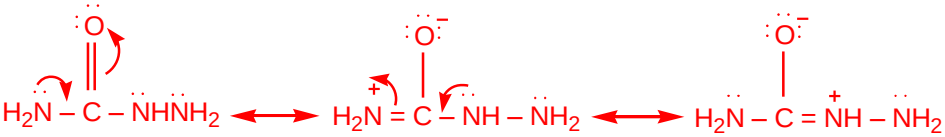
i. (CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.

Answer:

The methyl group due to its +I effect reduce the magnitude of positive charge on carbonyl carbon atom. Moreover it also hinder the approach of nucleophile CN^-. Since in acetaldehyde there is one methyl while in acetone there are two methyl groups attached to carbonyl group therefore acetaldehyde is more reactive than acetone towards nucleophilic addition with HCN.

ii. There are two $– NH_2$ groups in semicarbazide ($H_2NNHCONH_2$). However, only one is involved in the formation of semicarbazone.

Answer:

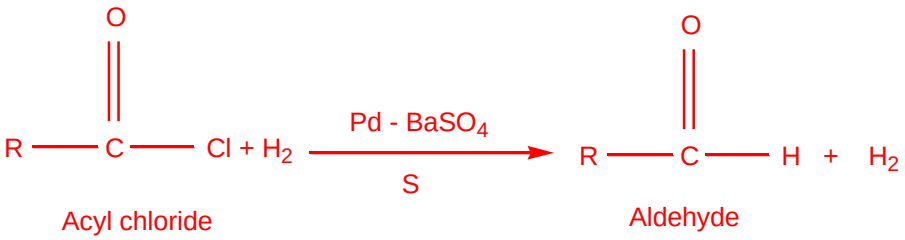


Semicarbazide has two $–NH_2$ groups but one of them (i.e., directly attached to C = O) is involved in resonance as shown above. Thus, electron density on this NH_2 group decreases hence it does not act as a nucleophile. In contrast, the lone pair of electrons on the other NH_2 group (i.e., attached to — NH) is not involved in resonance and hence is available for nucleophilic attack on the C = O group of aldehydes and ketones.

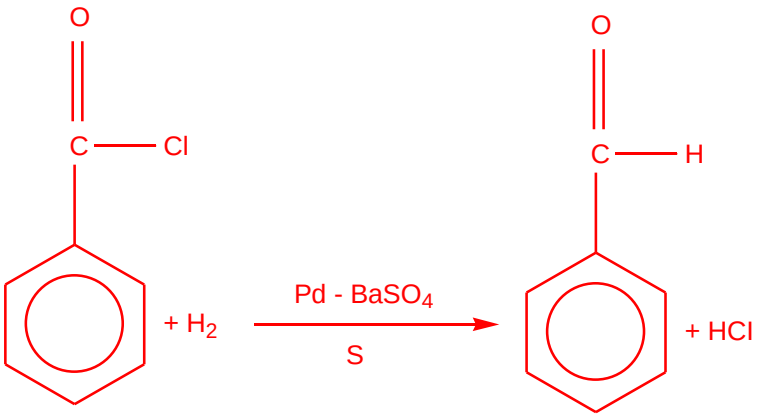
b. Write the chemical equation to illustrate each of the following name reactions:

i. Rosenmund reduction

Answer:



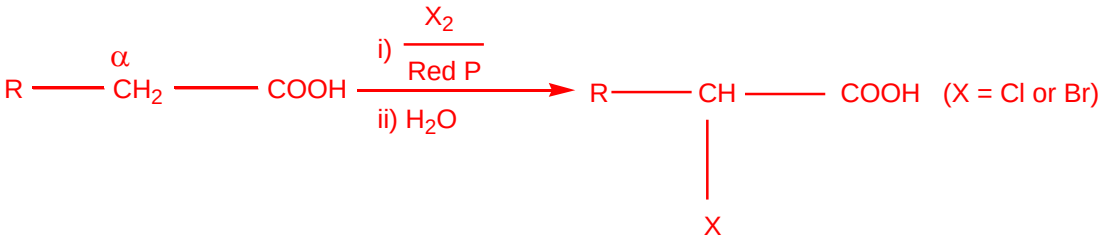
Acyl chloride Aldehyde



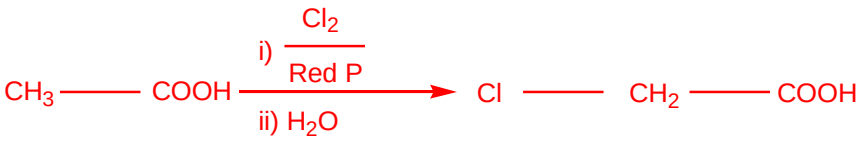
Benzoyl chloride Benzaldehyde

ii. Hell-Volhard-Zelinsky reaction

Answer:



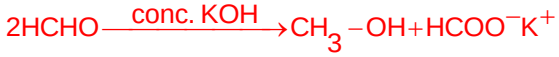
α - Halocarboxylic acid



Carboxylic acid Chloroacetic acid

iii. Cannizzaro reaction

Answer:



Formaldehyde Methyl alcohol Potassium formate