Study of Compounds

Hydrogen Chloride

Questions
2005

Question 1.
Write balanced equations for the following reactions :

1. Copper oxide and dilute Hydrochloric acid.
2. Manganese (IV) oxide and concentrated Hydrochloric acid.

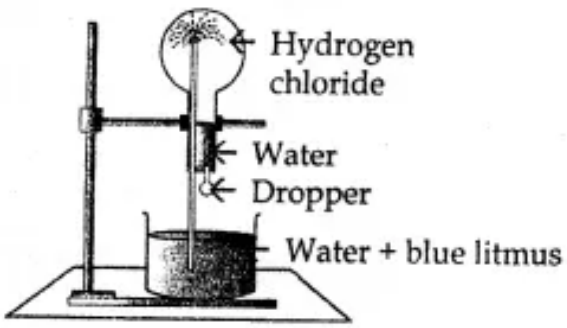
Answer:

(i) $CuO(s) + 2HCl\ (dil.) \rightarrow CuCl_2\ (aq) + H_2O(l)$

(ii) $MnO_2\ (s) + 4HCl\ (conc.) \rightarrow MnCl_2\ (aq) + 2H_2O\ (l) + Cl_2 \uparrow$

Question 2.

1. Name the experiment illustrated aside.
2. Which property of hydrogeii chloride is demonstrated by this experiment.



3. State the colour of the water that has entered the round-bottomed flask.

Answer:

1. Fountain experiment.
2. Hydrogen chloride is soluble in water.
3. Red.

2006

Question 1.
From the list — Ammonia, Copper oxide, Copper sulphate, Hydrogen chloride, Hydrogen sulphide, Lead bromide — select the compound which can be oxidized to chlorine.

Answer:
Hydrogen chloride

Question 2.
Write balanced chemical equation for the reaction of zinc and dilute hydrochloric acid.

Answer:
$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

Question 3.
State what is observed when hydrochloric acid is added to silver nitrate solution.

Answer:
A white ppt. of silver chloride is formed.

Question 4.
Write a balanced chemical equation for the reaction of calcium bicarbonate and dil. hydrochloric acid.

Answer:
$Ca(HCO_3)_2 + 2HCl \rightarrow CaCl_2 + 2CO_2 + 2H_2O$.

2007

Question 1.
Write a balanced equation for the following reaction :
Sodium chloride from sodium carbonate solution and dilute hydrochloric acid.

Answer:
$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

Question 2.
Of the two gases, NH_3 and HCl, which is more dense.
Name the method of collection of this gas.

Answer:
Hydrogen chloride gas ; by upward displacement of air.

Question 3.
Give one example of a reaction between the above two gases which produces a solid.

Answer:
NH_3 (g) + HCl (g) $\rightarrow$ NH_4 Cl (s-solid)

Question 4.
Write equations for the reaction of dil. HCl with each of the following :

1. iron
2. sodium hydrogen carbonate
3. iron [II] sulphide
4. sodium sulphite

Answer:

(i) $Fe + 2HCl \longrightarrow FeCl_2 + H_2$

(ii) $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$

(iii) $Fe\ (II)\ S + HCl \longrightarrow FeCl_2 + H_2S$

(iv) $Na_2SO_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2$

2008

Question 1.
What property of hydrogen chloride is demonstrated when it is collected by downward delivery (upward displacement)? Why is hydrogen chloride not collected over water.

Answer:
Hydrogen chloride is heavier than air.
Hydrogen chloride cannot be collected over water because hydrogen chloride is highly soluble in water.

Question 2.
Write the equations for the following reactions :

1. dil. HCl and sodium thiosulphate.
2. dil. HCl and lead nitrate solution.

Answer:

(i) $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + SO_2 + S + H_2O$

Sod. Thiosulphate

(ii) $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

White ppt.

2009

Question 1.
Name the gas evolved (formula is not acceptable). The gas produced by the action of concentrated sulphuric acid on sodium chloride.

Answer:
Hydrogen chloride (HCl)

Question 2.
Match each substance A to E listed below with the appropriate description given below :
(A) Sulphur
(B) Silver chloride
(C) Hydrogen chloride
(D) Copper (II) sulphate
(E) Graphite.
(i) A Covalent compound which behaves like an ionic compound in aqueous solution.
(ii) A compound which is insoluble in cold water but soluble in excess of ammonia solution.

Answer:

1. **(C)** Hydrogen chloride
2. **(B)** Silver chloride

Question 3.
Write a fully balanced equation for each of the following :

1. Red lead is warmed with concentrated hydrochloric acid.
2. Magnesium metal is treated with dilute hydrochloric acid.

Answer:

$$(i)\quad \underset{\text{Red lead}}{Pb_3O_4} + 8HCl \longrightarrow 3PbCl_2 + 4H_2O + O_2\uparrow$$

$$(ii)\quad Mg + 2HCl \longrightarrow MgCl_2 + H_2\uparrow$$

Question 4.
Correct the following statements.
HCl is prepared in the laboratory by passing hydrogen chloride directly through water.

Answer:
Hydrochloric acid is prepared in the laboratory by passing hydrogen chloride gas through inverted funnel arrangement in water.

2010

Question 1.
Select the correct answer from A, B, C and D.

(i) Aqua regia is a mixture of :

A : Dilute hydrochloric and cone, nitric acid
B : Cone, hydrochloric acid and dilute nitric acid
C : One part of cone, hydrochloric acid 3 parts of cone, nitric acid.
D : 3 parts of Cone, hydrochloric acid and 1 part of cone, nitric acid

Answer:
D : 3 parts of Cone, hydrochloric acid and 1 part of cone, nitric acid

Question 2.
State your observation when :
A glass rod dipped in NH_4OH soln. is brought near an open bottle containing cone. HCl

Answer:
Dense white fumes of – ammonium chloride are formed.

$$\underset{\text{[aq.]}}{NH_3} + \underset{\text{[vapour]}}{HCl} \longrightarrow \underset{\text{[dense white fumes]}}{NH_4Cl}$$

Question 3.

1. State the salt and the acid, used in the laboratory preparation of hydrogen chloride.
2. Give the equation for the preparation.
3. State a method to prove that the gas jar used for collection of HC1 gas is filled with hydrogen chloride?
4. Observing the method of collection of the gas, state what you can tell about the density of hydrogen chloride ?

Answer:

1. Sodium chloride and Sulphuric acid

$$NaCl + H_2SO_4 \xrightarrow[200°C]{\text{Below}} \underset{\text{Sodium bisulphate}}{NaHSO_4} + \underset{\text{Hydrogen Chloride gas}}{HCl}$$

2. .
3. In order to know that the jar is filled with the gas, bring a glass rod dipped in ammonium hydroxide solution near its mouth. If dense white fumes of ammonium chloride are produced, it indicates that the gas jar is full of HCl gas.

$$HCl + NH_3 \rightarrow NH_4Cl(s)$$

4. The method used to collect HCl is "Upward displacement of air". This clearly indicates that HCl gas is heavier than air.

Question 4.
How would you distinguish between dilute HCl and dilute HNO_3, by addition of only one solution.

Answer:
HCl (dilute)

HNO_3 (dilute) [To differentiate between HCl and HNO_3 we can use $AgNO_3$ solution]

$$HCl + AgNO_3 \rightarrow \underset{\text{white ppt.}}{AgCl\downarrow} + HNO_3$$

$$HNO_3 + AgNO_3 \rightarrow \text{No reaction}$$

By adding $AgNO_3$, HCl gives white ppt. whereas no such reaction takes place with HNO_3.

Question 5.
Name two gases which can be used in the study of the fountain experiment. State the common property demonstrated by the fountain experiment ?

Answer:

1. Hydrogen chloride gas (HCl)
2. Ammonia (NH_3)
   Solubility of gases is the common property demonstrated by the fountain experiment.

2011

Question 1.
Choose the correct answer from the choices given :
Hydrogen chloride gas being highly soluble in water is dried by :
(A) Anhydrous calcium chloride
(B) Phosphorous pentaoxide
(C) Quick lime
(D) Concentrated sulphuric acid.

Answer:
(D) Concentrated sulphuric acid.

Question 2.
Write balanced equations of dil. HCl with – Calcium bicarbonate.

Answer:

$$Ca(HCO_3)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O + 2\,CO_2\uparrow$$

Question 3.
In the laboratory preparation of hydrochloric acid, Hydrogen chloride gas is dissolved in water.
(i) Draw a diagram to show the arrangement used for the absorption of HCl in water.
(ii) State why such an arrangement is necessary? Give two reasons for the same.
(iii) Write balanced chemical equations for the laboratory preparation of HCl gas when the reactants are :

(A) below 200°C
(B) above 200° C

Answer:
(i) Refer to page 335 of this book.
(ii) Two reasons for the use of funnel arrangement are :

(A) Prevents back suction of water into the flask.
(B) Provides a large surface area for the absorption of the gas (HCl).

(iii) (A) Below 200°C

$$NaCl + H_2SO_4 \xrightarrow{<200^\circ C} NaHSO_4 + HCl$$

(B) Above 200°C

$$2\,NaCl + H_2SO_4 \xrightarrow{>200^\circ C} Na_2SO_4 + HCl$$

2012

Question 1.
Rewrite the correct statement with the missing word/s :
Aqua regia contains one part by volume of nitric acid and three parts by volume of hydrochloric acid.

Answer:
Aqua regia contains one part by volume of cone, nitric acid and three parts by volume of cone, hydrochloric acid.

Question 2.
Give reasons : Hydrogen chloride gas cannot be dried over quick lime.

Answer:
Hydrogen chloride is acidic while quick lime is basic, so they react.

Question 3.
Concentrated hydrochloric acid and Potassium permanganate solution.

Answer:

Question 4.
Give balanced equations with conditions, if any, for the following conversions A to D.
A : Sodium Chloride → Hydrogen Chloride
B : Hydrogen Chloride → Iron (II) chloride
C : Hydrogen Chloride → Ammonium chloride
D : Hydrogen Chloride → Lead chloride.

Answer:

$$A: NaCl + H_2SO_4 \text{ (conc.)} \longrightarrow NaHSO_4 + HCl$$

Sodium chloride — Hydrogen chloride

$$B: 2HCl \text{ (dil.)} + Fe \longrightarrow FeCl_2 + H_2\uparrow$$

Hydrogen chloride — Iron (II) chloride

$$C: HCl\,(g) + NH_3(g) \longrightarrow NH_4Cl(s)$$

$$D: PbO_2 + 4HCl \longrightarrow PbCl_2 + 2H_2O + Cl_2$$

2013

Question 1.
Identify the gas evolved when :

1. Potassium sulphite is treated with dilute hydrochloric acid.
2. concentrated hydrochloric acid is made to react with manganese dioxide.

Answer:

1. Sulphur dioxide gas
2. Chlorine gas

Question 2.
State one appropriate observation for

1. Copper sulphide is treated with dilute hydrochloric acid.
2. A few drops of dil. HCl are added to $AgNO_3$ soln, followed by addition of NH_4OH soln.

Answer:

1. A colourless gas with a smell of rotten eggs is given off and a green coloured solution is formed.
2. White ppt is formed which dissolves in ammonium hydroxide.

2014

Question 1.
Fill in the blanks from the choices in the bracket : Quicklime is not used to dry

HCl gas because _____ (CaO is alkaline, CaO is acidic, CaO is neutral)

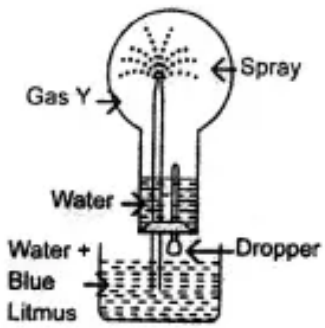
Answer:
Quicklime is not used to dry HCl gas because CaO is alkaline.

Question 2.
Write the balanced equation for : Action of dilute hydrochloric acid on sodium sulphide.

Answer:
Action of dilute hydrochloric acid on sodium sulphide.
$Na_2S + 2HCl \rightarrow 2NaCl + H_2S$

Question 3.
State your observation : Dilute HC1 is added to sodium carbonate crystals.
Answer:
$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2 \uparrow$
effervescence of CO_2 seen which turns lime water milky

Question 4.
Study the figure given below and answer the questions that follow :



1. Identify the gas Y.
2. What property of gas Y does this experiment demonstrate?
3. Name another gas which has the same property and can be demonstrated through this experiment.

Answer:

1. Identify the gas Y — It is HCl (Hydrogen chloride)
2. Property of Y —Highly solubility in water
3. The another gas has same property — NH_3 (Ammonia)

2015

Question 1.
Select from the gases — ammonia, ethane, hydrogen chloride, hydrogen sulphide, ethyne — The gas which produces dense white fumes with ammonia gas.

Answer:
Hydrogen chloride

Question 2.
Identify the acid which on mixing with silver nitrate solution produces a white precipitate which is soluble in excess ammonium hydroxide.

Answer:
Dilute hydrochloric acid

Question 3.
The following questions are pertaining to the laboratory preparation of hydrogen chloride gas:

1. Write the equation for its preparation mentioning the condition required.
2. Name the drying agent used in the above preparation and give a reason for the choice.
3. State a safety precaution you would take during the preparation of hydrochloric acid.

Answer:

1. The equation for the laboratory preparation of hydrogen chloride gas :

   $$NaCl + H_2SO_4 \xrightarrow{<200^oC} NaHSO_4 + HCl\uparrow$$

   Although it is a reversible reaction, it goes to completion as hydrogen chloride continuously escapes as a gas.
   The reaction can occur up to the stage of the formation of sodium sulphate on heating above 200°C.

   $$NaHSO + NaCl \xrightarrow[424]{\text{above}\,200^oC} Na\ SO + HCl\uparrow$$

2. The drying agent used in the laboratory preparation of hydrochloric acid is conc.sulphuric acid.
   The other drying agents such as phosphorus pentoxide (P_2O_5) and quick lime
   (CaO) cannot be used because they react with hydrogen chloride.

   $$2P_2O_5 + 3HCl \longrightarrow POCl_3 + 3HPO_3$$

   $$CaO + 2HCl \longrightarrow POCl_3 + 3HPO_3$$

3. A safety precaution which should be taken during the preparation of hydrochloric acid :
   Always wear chemical splash goggles, chemical-resistant gloves and a chemical resistant apron in the laboratory during the preparation of hydrochloric acid.

2016

Question 1.
Select the correct answer from A, B, C and D : The aim of the Fountain experiment is to prove that :
(A) HCl turns blue litmus red
(B) HCl is denser than air
(C) HCl is highly soluble in water
(D) HCl fumes in moist air.

Answer:
(C) HCl is highly soluble in water

Question 2.
Fill in the blank : _____ (AgCl / $PbCl_2$), a white precipitate is soluble in excess NH_4OH.

Answer:
AgCl (because of formation of diammine silver chloride), a white precipitate is soluble in excess NH4OH.

Question 3.
Write balanced chemical equation for : Action of hydrochloric acid on sodium bicarbonate.

Answer:
$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2 \uparrow$

Question 4.
State your observations when dilute hydrochloric acid is added to :

1. Lead nitrate soln. and the mixture is heated.
2. Copper carbonate.
3. Sodium thiosulphate.

Answer:

$$(i) \quad Pb(NO_3)_2 + 2HCl\ (dil) \rightarrow \underset{\text{Lead chloride (white precipitate)}}{PbCl_2 \downarrow} + 2HNO_3$$

When dilute hydrochloric acid is added to lead nitrate white precipitates of lead chloride is formed.

$$(ii) \quad CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + \underset{\text{Brisk effervescence}}{CO_2}$$

When dilute hydrochloric acid is added to copper carbonate brisk effervescence due to the liberation of carbon dioxide is observed.

(*iii*) $Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + H_2O + SO_2 \uparrow + S \downarrow$

(yellow residue)

When dilute hydrochloric acid is added to sodium thiosulphate pale yellow residue (due to formation of sulphur) is formed and a gas with choking odour is formed.

Question 5.
Identify the gas evolved and give the chemical test in when dilute hydrochloric acid reacts with :

1. Sodium sulphite.
2. Iron (II) sulphide.

Answer:

(*i*) $Na_2SO_3 + 2HCl \rightarrow 2NaCl + H_2O + SO_2 \uparrow$

Sulphur dioxide

Chemical test : Sulphur dioxide decolorises potassium permanganate solution.

(*ii*) $FeS + 2HCl \rightarrow FeCl_2 + H_2S$

Hydrogen sulphide

Chemical test : Hydrogen sulphide turns lead acetate paper black.

2017

Question 1.
Fill in the blanks from the choices given – Potassium sulphite on reacting with hydrochloric acid, releases gas. _____ [Cl_2, SO_2, H_2S]

Answer:
Potassium sulphite on reacting with hydrochloric acid, releases SO_2 gas.

Question 2.
Identify the substance underlined – A solid formed by the reaction of two gases, one of which is acidic and the other basic in nature.

Answer:
Ammonium chloride.

Question 3.
State one relevant observation – Action of dilute hydrochloric acid on iron [II] sulphide.

Answer:
A foul smelling gas like rotten eggs is given off.

Question 4.
Certain blanks spaces are left in the following tables as A & 8. Identify each of them.

Lab preparation of	Reactants used	Products formed	Drying agent	Method of collection
HCl gas	$NaCl + H_2SO_4$	A	Conc. H_2SO_4	B

Answer:
A : The products are sodium hydrogen sulphate ($NaHSO_4$) and HCl gas.
B : HCl gas as collected by the upward displacement of air.

Q. Complete the statements given below pertaining to hydrogen chloride gas or hydrochloric acid.

1. Hydrogen chloride gas is not dried using _____ (cone.H_2SO_4, CaO).
2. Hydrogen chloride gas on heating above 500°C gives hydrogen and chlorine.
   The reaction is an example of _____ (thermal decomposition, thermal dissociation).
3. Iron reacts with hydrogen chloride gas forming [iron (II) chloride, iron (III) chloride) and hydrogen. The reaction is an example of _____ (double decomposition, synthesis, simple displacement).
4. Hydrogen chloride and water are examples of (polar covalent compounds, non-polar covalent compounds) and a solution of hydrogen chloride in water _____ (contains, does not contain) free ions.
5. Addition of _____ (sodium nitrate, zinc nitrate, silver nitrate) to hydrochloric acid, gives an insoluble precipitate of the respective chloride. This precipitate is _____ (soluble,insoluble) in ammonium hydroxide and _____ (soluble, insoluble) in dilute taitric add.
6. Addition of _____ [iron (III) sulphide, iron (II) sulphide, iron pyrites] to dilute hydrochloric acid results in liberation of hydrogen sulphide gas.
7. Aqua regia is a mixture of _____ (one, two, three) part/s of concentrated nitric acid and)_____ (one, two, three) part/s of concentrated hydrochloric acid by _____ (weight, volume). In aqua regia, nitric acid _____ (oxidises, reduces) hydrochloric acid to chlorine.
8. Hydrochloric acid can be converted into chlorine by heating with _____ [calcium oxide, lead (H) oxide, lead (IV) oxide] which acts as a / an _____ (oxidising, reducing) agent.

Answer:

1. CaO
2. Thermal dissociation
3. Iron (II) chloride ; simple displacement
4. polar covalent compounds ; contains
5. silver nitrate ; soluble ; insoluble
6. iron (II) sulphide
7. one, three, volume, oxidises
8. Lead (II) oxide ; oxidisirig.

Additional Questions

Question 1.
Give a reason why
(a) gastric juices of luammals are acidic
(b) HCl is considered a polar covalent compound.

Answer:
(a) HCI gas occurs in free state in gastric juices of mammals.
(b) Due to difference in electronegativities of H and Cl ; The bond in HCl is a polar covalent.

Question 2.
Give the equation for preparation of HCI gas by Synthesis. State two conditions involved in the synthesis.

Answer:

$$H_2 + Cl_2 \xrightarrow[\text{Sunlight}]{\text{Diffused}} 2HCl$$

1. Sunlight 2. Jet of hydrogen.

Question 3.
Give a balanced equation for preparation of HCl gas in the laboratory from sodium chloride.

Answer:

$$NaCl + H_2SO_4 \text{ (conc.)} \xrightarrow{<200^\circ C} NaHSO_4 + HCl\ (g)$$

Question 4.
In the laboratory preparation of HCl frem sodium chloride, state why the following are preferred –

1. Cone. H_2SO_4 as a reactant
2. Temp, below 200°C
3. Cone. H_2SO_4 as a drying agent.

Answer:

1. Since it is non-volatile and has a high boiling point.
2. The glass apparatus does not crack, no hard crust is formed, fuel is not wasted.
3. It only removes moisture content of the gas but not react with it.

Question 5.
State with reasons the method of collection of HCl gas in the laboratory.

Answer:
HCl gas is collected by upward displacement of air because it is 1.28 times heavier than air. It is not collected in water because it is highly soluble in water.

Question 6.
Compare the density of HCl gas with air and state the solubility of HCl gas in water.

Answer:
V.D of HCl = 18.25, V.D of air = 14.4. It is highly soluble in water.

Question 7.
State why HCl gas forms a mist of droplets of HCl acid in moist air.

Answer:
Due to high solubility, HCl gas fumes in moist air and forms a mist of droplets of HCl acid.

Question 8.
State what the fountain experiment demonstrates with reference to HCl gas.

Answer:
Fountain experiment demonstrates the solubility of HCI gas in water and its acidic nature.

Question 9.
State the colour change in three different indicators in presence of HCl gas.

Answer:

Indicator	Change in colour	
	from	to
1. Moist litmus	Blue	Red
2. Methyl orange	Orange	Pink
3. Phenolphthlein	no change	
4. Phenophthlein (alkaline)	Pink	colourless

Question 10.
Give a balanced equation for the thermal dissociation of

1. a gas
2. a solid (both containing the chloride ion).

Answer:

(i) $2HCl\ (g) \xrightarrow[>500°C]{Heat} H_2\ (g) + Cl_2\ (g)$

(ii) $NH_4Cl\ (s) \xrightarrow{Heat} NH_3\ (g) + HCl\ (g)$

Question 11.
Give the equation and state the observation seen when HCl gas reacts with ammonia.

Answer:
When a gas jar containing hydrogen chloride gas is inverted over ajar full of ammonia gas, dense white fumes are formed.

$NH_3\ (g) + HCl\ (g) \longrightarrow NH_4Cl\ (S\text{-solid})$

Question 12.
Convert iron to iron (II) chloride using HCl gas.

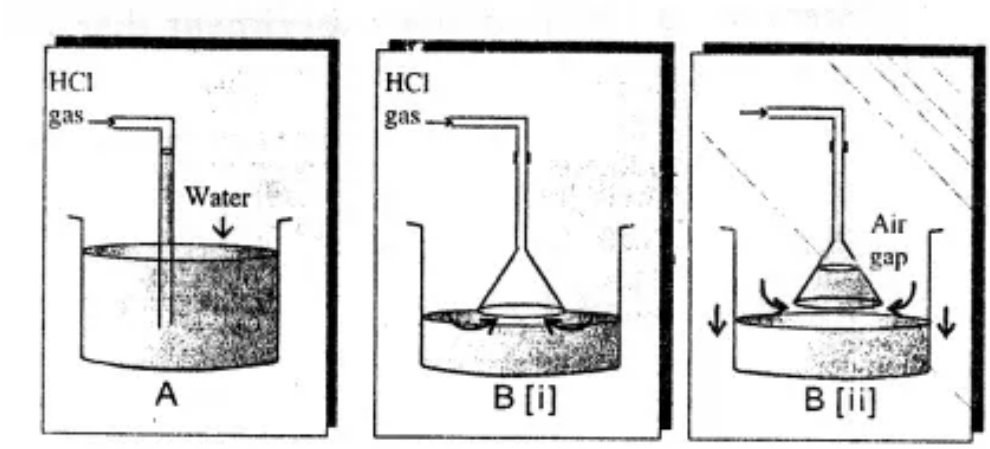
Answer:

$Fe + 2HCl\ (dil.) \longrightarrow FeCl_2 + H_2$

Question 13.
Explain the arrangement (i) not used (ii) used – for converting HCl gas into HCl acid.

Answer:

Hydrochloric acid is prepared by dissolving hydrogen chloride gas in water usi ig a special funnel arrangement.



1. Direct absorption of HCl gas in water using a delivery tube i.e., arrangement (i) causes back suction.
Hydrogen chloride gas is extremely soluble in water. If a delivery tube through which HCl gas is passed is directly immersed in water, the rate of absorption of HCl gas is high and hence a partial vacuum is created in the tube. The pressure outside being higher causes the water to be pushed up into the delivery tube and damages the apparatus. This is called back-suction.

2. Special funnel arrangement, i.e., arrangement (ii) is used for avoiding back suction.
The funnel arrangement :

(a) Prevents or minimizes back-suction of water.
(b) Provides a large surface area for absorption of HCl gas.

The rim of the funnel is placed so that it just touches the trough containing water. If back-suction occurs, the water rises up the funnel and the level outside the funnel falls, thus creating an air gap between the rim of the funnel and the surface of water. The pressure outside and inside equalize and the water which had risen in the funnel falls down again. This process continues till the water in the trough is saturated with hydrogen chloride gas resulting information of hydrochloric acid.
Hence hydrochloric acid is not prepared in the laboratory by passing hydrogen chloride gas directly through water, but prepared using a special funnel arrangement.

Question 14.
Explain the term 'constant boiling mixture'.

Answer:
A solution of HCl in water forms a constant boiling mixture with water.

Question 15.
State why dilute HCl cannot be concentrated beyond a certain concentration by

boiling.

Answer:
On boiling the mixture evolves out the vapours of both acid and water in the same proportion as in the liquid. Hence dil HCl cannot be concentrated beyond a certain concentration.

Question 16.
Name the ions obtained when HCl dissociates in aqueous solution.

Answer:
Hydronium ions.

Question 17.
Name the ion responsible for acidic nature of HCl acid.

Answer:
The presence of hydrogen ions |H+| imparts acidic nature to HCl.

Question 18.
State which of two – a solution of HCl in water or in toluene is an electrolyte, giving reasons.

Answer:
A solution of hydrogen chloride in water; water being a covalent solvent ionizes aqueous solution of HCl shows acidic properties and is an electrolyte, whereas toluene is not; being not a polar solvent.

Question 19.
Give four different word equations relating to acidic properties of an aq. soln. of HCl gas.

Answer:
Zinc + Hydrochloric acid → Zinc chloride + Hydrogen
Sodium hydroxide + Hydrochloric acid → Sodium chloride + Water
Sodium carbonate + Hydrochloric acid → Sodium chloride + Carbon dioxide + Water
Calcium oxide + Hydrochloric acid → Calcium chloride + Water

Question 20.
Give balanced equations to obtain

1. H_2
2. CO_2
3. SO_2
4. H_2S from dil. HCl.

Answer:

1. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
2. $Na_2CO_2 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$
3. $Na_2SO_3 + 2HCl \rightarrow 2NaCl + H_20 + SO_2$
4. $FeS + 2HCl \rightarrow FeCl_2 + H_2S$

Question 21.
Convert two soluble metallic nitrates to insoluble metallic chlorides using dil. HCl.

Answer:

$$\underset{\text{[Silver nitrate]}}{AgNO_3} + HCl \rightarrow \underset{\text{[white ppt.]}}{AgCl\downarrow} + HNO_3$$

$$\underset{\text{[Lead nitrate]}}{Pb(NO_3)_2} + 2HCl \rightarrow \underset{\text{[white ppt.]}}{PbCl_2\downarrow} + 2HNO_3$$

Question 22.
State how you would prove that HCl contains

1. hydrogen – using an active metal below magnesium
2. chlorine – using an oxidising agent not containing lead.

Answer:

(i) $Fe + 2HCl \longrightarrow FeCl_2 + H_2$

(ii) $MnO_2 + 4HCl \xrightarrow{\Delta} MnCl_2 + 2H_2O + Cl_2$

Question 23.
State the composition of aqua regia. State which component is the oxidising agent in aqua regia.

Answer:

$HNO_3 + HCl$ both are conc.

$$\underbrace{\text{One part} \quad \text{3 part}}_{\text{Aqua regia}}$$

Hydrochloric acid is oxidising agent in aqua regia.

Question 24.
Convert hydrochloric acid to nascent chlorine.

Answer:

$$\underbrace{HNO_3 + 3HCl}_{\text{Aqua regia}} \longrightarrow 2H_2O + NOCl + 2\underbrace{|Cl|}_{\text{nascent}}$$

(Conc. Conc.)

Question 25.
State why aqua regia dissolves gold, which is insoluble in all other acids.

Answer:
In aqua regia (a mixture of 1 part cone. HNO3 and 3 parts cone. HCl by volume), nitric acid oxidises hydrochloric acid to give nascent chlorine. This nascent chlorine is very reactive. It reacts with gold to give gold (III) chloride, which is soluble in water.

$$HNO_3 \text{ (conc.)} + 3HCl \text{ (conc.)} + NOCl + 2H_2O + 2(Cl)$$

$$Au + 3(Cl) \longrightarrow AuCl_3$$

Gold — Gold (III) chloride

Question 26.
Give three tests for hydrochloric acid. Convert silver nitrate to a soluble salt of silver using hydrochloric acid and an alkali.

Answer:

1. If glass rod dipped in ammonia soln. (NH_4OH) brought near vapours of hydrochloric acid.
   Dense white fumes of – ammonium chloride are formed.
2. Addition of silver nitrate soln. to dil. HCl (acidified with dil. HNO_3)
   Curdly white precipitate – of silver chloride obtained.

$$AgNO_3 + HCl \longrightarrow AgCl \downarrow + HNO_3$$

(aq.) — (white ppt.)

3. Action of heat on a mixture of manganes dioxide and cone. HCl Greenish yellow gas (chlorine).

Question 27.
State two industrial products manufactured from hydrochloric acid, which are also manufactured from nitric and sulphuric acid. Give two general uses of hydrochloric acid.

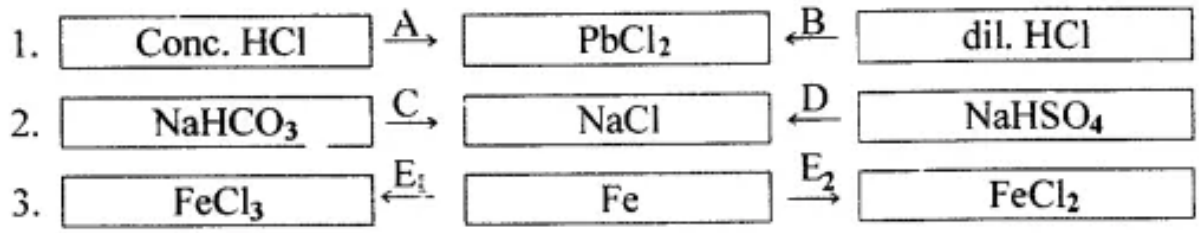
Answer:
Industrial products manufactured from HCl acid are : Dyes, paints, drugs.
General uses of hydrochloric acid are :

1. Hydrochloric acid dissolves the calcium phosphate present in bones.

2. Hydrochloric acid dissolves the metallic oxides coating on the surface of metals. Thereby cleans the metallic surface.

Unit Test Paper 7A — Hydrogen Chloride

Q.1. Give balanced equations for the conversions A, B, C, D and E given below :



Answer:

1. $PbO_2 + 4HCl \xrightarrow{\Delta} PbCl_2 + 2H_2O + Cl_2$
2. $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$
3. $2Fe + 6HCl \longrightarrow 2FeCl_3 + 3H_2$

Q.2. Give reasons for the following :

Question 1.
In the laboratory preparation of HCl acid from NaCl and cone. H_2SO_4, the residual salt formed at temperatures above 200°C forms a hard crust and sticks to the glass.

Answer:
When sodium chloride and cone, sulphuric acid is heated above 200°C ; sodium sulphate forms a hard crust, sticks to the glass and is difficult to remove.

Question 2.
Dense white fumes are obtained when a jar of HCl gas is inverted over a jar of ammonia gas.

Answer:
When a gas jar containing hydrogen chloride gas is inverted over of jar full of ammonia gas dense white fumes are formed. These fumes consists of particles of solid ammonium chloride suspended in air.

Question 3.
In the fountain experiment to demonstrated the high solubility of HCl gas in water, dry HCl gas is filled in the round bottom flask.

Answer:
HCl gas present in the flask dissolves in water due to high solubility, creating a

partial vacuum in the flask. The outside pressure being higher pushes the water up the jet tube which emerges as fountain.

Question 4.
Iron sheets are cleaned with hydrochloric acid before dipping into molten zinc for galvanizing.

Answer:
Hydrochloric acid dissolves the metallic oxide coating on the surface of the metal, thereby cleans the metallic surface.

Question 5.
Hydrogen chloride gas fumes in moist air but hydrogen sulphide gas does not.

Answer:
HCl gas fumes in moist air due to its high solubility and forms a mist of droplets of HCl acid while H_2S does not.

Q.3. Complete the statements given below using the correct word/s

1. An aqueous solution of HCl gas is named _____ (aqua fortis/muriatic acid/oil of vitriol)
2. The salt obtained when rock salt reacts with cone. H_2SO_4 at temperatures below 200°C is a/an _____ (acid/normal) salt.
3. In the preparation of HCl acid from HCl gas, a funnel arrangement provides _____ (less/more) surface area for absorption of the gas.
4. The ions which impart acidic properties to an aqueous solution of hydrogen chloride are _____ (chloride/hydrogen/hydronium)
5. The indicator which does not change colour on passage of hydrogen chloride gas is _____ (moist blue litmus/phenolphthalein/methyl orange)

Answer:

1. mutriatic acid
2. normal
3. more
4. hydrogen
5. phenolphthalein

Q.4. Choose from the letters A, B, C, D and E, to match the descriptions 1 to 5 given below.
A : NH_4 Cl
B : AgCl
C : $PbCl_2$
D : FeCl2
E : $Ag(NH_3)_2$ Cl

1. A solubl salt obtained on reaction of a metallic chloride with liquor ammonia.

2. A salt which is insoluble in dilute nitric acid but soluble in ammonium hydroxide.
3. A salt obtained on reaction of an active metal with hydrogen chloride gas.
4. A salt obtained when a basic gas reacts with hydrogen chloride gas.
5. A salt soluble in hot water but not in cold, obtained on heating an oxidising agent with cone. HCl.

Answer:

1. E [Ag $(NH_3)_2$ Cl]
2. B (AgCl)
3. D ($FeCl_2$)
4. A (NH_4Cl)
5. C ($PbCl_2$)

Q.5. Select the correct word or formula from the same given in bracket :

1. The substance reacted with cone. HCl and heated to prove that cone. HCl contains Cl_2. ($PbCl_2$/PbO_2/Pb0)
2. The metal reacted with dil. HCl to prove that dil. HCl contains hydrogen. (Cu/Fe/Ag/Pb)
3. The gas/es which is / are heavier than air and highly soluble in water. (NH_3 / HCl/CO_2/H_2S)
4. The acid which is not an oxidising agent. (Cone. HNO_3/ Cone. HCl/Conc. H_2SO_4)
5. The acid which is not a monobasic acid. (Acetic/ Sulphurous/Hydrochloric/Nitric/Formic acid)

Answer:

1. PbO_2
2. Fe
3. HCl(g)
4. Cone. HNO_3
5. Sulphurous acid

Q.6. Select the correct words from the list given below to complete the following word equations :
Metallic oxide, active metal, metallic carbonate, metallic bisulphite, active metal, metallic hydroxide, metallic bicarbonate, metallic sulphate, metallic sulphide.

1. _____ + hydrochloric acid (dil) → salt + hydrogen
2. _____ + hydrochloric acid (dil) → salt + water
3. _____ + hydrochloric acid (dil) → salt + water + carbon dioxide
4. _____ + hydrochloric acid (dil) → salt + water + sulphur dioxide
5. _____ + hydrochloric acid (dil) → salt + hydrogen sulphide

Answer:

1. active metal
2. metallic hydroxide
3. metallic carbonate / bicarbonate
4. metallic sulphite
5. metallic sulphide

Ammonia

Questions
2001

Question 1.
State what do you observe when :
Neutral litmus solution is added to an alkaline solution.

Answer:
The litmus solution turns to blue.

Question 2.

Name (formula is not acceptable) the gas produced in the following reaction :
Warming ammonium sulphate with sodium hydroxide solution.

Answer:
Ammonia gas.

Question 3.
Write the equation for the preparation of NH3 from ammonium chloride and calcium hydroxide.

Answer:
$2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2NH_3 + 2H_2O$

Question 4.
What are the products formed when ammonia is oxidized with copper oxide.

Answer:

$$\underset{\text{Copper(II) oxide}}{3CuO} + \underset{\text{Ammonia}}{2NH_3} \longrightarrow \underset{\text{copper}}{3Cu} + \underset{\text{nitrogen}}{N_2} + \underset{\text{water}}{3H_2O}$$

2002

Question 1.
From the following gases – ammonia, chlorine, hydrogen chloride, sulphur dioxide, select the gas that turns moist red litmus paper blue.
Write the equation for the reaction – when the gas is passed over heated CuO.

Answer:
Ammonia gas.
$3CuO + 2NH_3 \rightarrow 3Cu + N_2 + 3H_2O$

2003

Question 1.
Name a gas whose solution in water is alkaline.

Answer:
Ammonia

Question 2.
How would you distinguish between Zn^{2+} and Pb^{2+} using ammonium hydroxide solution.

Answer:
Zinc salt gives white gelatinous ppt. and Pb^{2+} gives chalky white ppt. with ammonium hydroxide.

Question 3.
Write the equation for the formation of ammonia by the action of water on mangesium nitride.

Answer:
$Mg_3N_2 + 6H_2O \rightarrow 2NH_3 + 3Mg(OH)_2$

Question 4.
How is ammonia collected. Why is ammonia not collected over water.

Answer:
Ammonia gas is lighter than air and hence collected by the downward displacement of air.
Ammonia is not collected over water because it is highly soluble in water.

Question 5.
Which compound is normally used as a drying agent for ammonia.

Answer:
Quicklime(Calcium oxide CaO).

2004

Question 1.
From the gases ammonia, hydrogen chloride, hydrogen sulphide, sulphur dioxide – Select the following :

1. When this gas is bubbled through copper sulphate soln., a deep blue coloured solution is formed.
2. This gas burns in oxygen with a green flame.

Answer:

1. ammonia
2. ammonia

Question 2.
Write the equation for the reaction in the Haber's process that forms ammonia.

Answer:
$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Question 3.
State the purpose of liquefying the ammonia produced in the process.

Answer:
By liquefying ammonia, it can be easily seperated from unreacted N_2 and H_2 gases.

Question 4.
Write an equation for the reaction of chlorine with excess of ammonia.

Answer:
$$\underset{\text{(excess)}}{8NH_3} + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$$

2005

Question 1.
Name the ion other than ammonium ion formed when ammonia dissolves in water.

Answer:
Hydroxyl ion ($NH_3 + H_2O \rightarrow NH^+_4 + OH^-$)

Question 2.
Write the equations for the following reactions which result in the formation of ammonia.

1. A mixture of ammonium chloride and slaked lime is heated.
2. Aluminium nitride and water.

Answer:

. (i) $2NH_4Cl\,(s) + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2H_2O\,(l) + 2NH_3$

Ammonium chloride slaked lime Calcium Chloride Water Ammonia

(ii) $AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3(g)$

Ammonium nitride Water Alminium Hydroxide Ammonia

2006

Question 1.
Select the correct compound from the list given — Ammonia, Copper oxide, Copper sulphate, Hydrogen chloride, Hydrogen sulphide, Lead bromide — which matches the description given below :
The compound is not a metal hydroxide, its aqueous solution is alkaline in nature.

Answer:
Ammonia.

Question 2.
From the list of substances given — Ammonium sulphate, Lead carbonate, Chlorine, Copper nitrate, Ferrous sulphate — State :
A compound which on heating with sodium hydroxide produces a gas which forms dense white fumes with hydrogen chloride.

Answer:
Ammonium sulphate.

Question 3.
State what is observed when excess of ammonia is passed through an aq. solution of lead nitrate.

Answer:
Chalky white insoluble ppt. is formed.

Question 4.
Name the substance used for drying ammonia,

Answer:
Quick lime (CaO).

Question 5.
Write a balanced chemical equation to illustrate the reducing nature of ammonia.

Answer:
Reducing nature of ammonia.
$2NH_3 + 3CuO \rightarrow 3Cu + 3H_2 + N_2$ (g)

Question 6.
With reference to Haber's process for the preparation of ammonia, write the equation and the conditions required.

Answer:

$$N_2 + 3H_2 \underset{200-900 \text{ atm.}}{\overset{400^\circ - 500^\circ C}{\rightleftharpoons}} 2NH_3 + 22,400 \text{ cal.}$$

Conditions for maximum yield of ammonia

1. High Pressure (700-900 atm)
2. Optimum temperature (450-500°C)
3. Use of a catalyst : Iron (Fe) and use of a promotor : Molybdenum (Mo)

2007

Question 1.
Write a balanced equation for the following reaction :
Ammonium sulphate from ammonia and dilute sulphuric acid.

Answer:

$$\underset{\text{Ammonia}}{2NH_3} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Ammonium Sulphate}}{(NH_4)_2\,SO_4}$$

Question 2.
Give equation for – reaction in which NH_3 is oxidized by :

1. a metal oxide ;
2. a gas which is not oxygen.

Answer:

$$(i)\ 2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2 + N_2(g)$$

$$(ii)\ \underset{\text{(excess)}}{8NH_3} + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$$

Question 3.
You enter a laboratory after a class has completed the Fountain Experiment. How will you be able to tell whether the gas used in the experiment was hydrogen chloride or ammonia.

Answer:
If the colour of the litmus solution in the round bottomed flask is blue the gas used was ammonia and if the colour of the litmus solution in the round bottomed flask is red, the gas used was hydrogen chloride. This is because hydrogen chloride(aq) is acidic in nature and turns purple litmus solution red and ammonia (aq) is basic in nature and turns purple neutral litmus solution blue.

2008

Question 1.
Ammonia can be obtained by adding water to : [Select the correct word]
A Ammonium chloride
B Ammonium nitrite
C Magnesium nitride
D Magnesium nitrate

Answer:
C Magnesium nitride

Question 2.
Name : An alkaline gas A which gives dense white fumes with hydrogen chloride.

Answer:
NH_3 (Ammonia)

Question 3.
Write the equation for the following reaction : Aluminium nitride and water.

Answer:

$$\underset{\text{Aluminium nitride}}{AlN} + \underset{\text{Water}}{3H_2O} \longrightarrow \underset{\text{Aluminium hydroxide}}{Al(OH)_3} + \underset{\text{Ammonia}}{NH_3(g)}$$

Question 4.
Complete the table relating to an important industrial processes. [Output refers to the product of the process].

Name of process	Inputs	Catalyst	Equation for catalysed reaction	Output
Haber Process	Hydrogen+			

Answer:

Name of process	Inputs	Catalyst	Equation for catalysed reaction	Output
Haber Process	Hydrogen+ Nitrogen	Iron + Molybdenum (Promoter)	$N_2 + 3H_2 \underset{200-900atm.}{\overset{450-500^\circ C}{\rightleftharpoons}} 2NH_3 + 22.4KCal$ (Fe + Mo)	Ammonia

2009

Question 1.
Name the gas – that burns in oxygen with a green flame.

Answer:
Ammonia (NH_3)

Question 2.
Write a fully balanced equation for the following : Magnesium nitride is treated with warm water.

Answer:

$$Mg_3N_2 + 6H_2O \xrightarrow{\Delta} 3Mg(OH)_2 + 2NH_3 \uparrow$$

Question 3.
Identity the substances 'Q' based on the information given :
The white crystalline solid Q is soluble in water, it liberates a pungent smelling gas when heated with sodium hydroxide solution.

Answer:
Q is Ammonium chloride and pungent smelling gas is ammonia.

2010

Question 1.
Complete the blanks (a) to (e) in the passage given, using the following words. (Ammonium, reddish brown, hydroxyl, nitrogen dioxide, ammonia, dirty green, alkaline, acidic) in the presence of a catalyst, nitrogen and hydrogen combine to give (a) _____ gas. When the same gas is passed through water, it forms a solution which will be _____ (b) in nature, and will contain the ions (c) _____

and (d) _____ (e) _____ coloured precipitate of iron [II] hydroxide is formed when the above solution is added to iron [II] sulphate solution, sssssss

Answer:

(a) Ammonia
(b) Alkaline
(c) Ammonium
(d) Hydroxyl
(e) Dirty green

Question 2.
State your observation when – in the absence of a catalyst ammonia gas is burnt in an atmosphere of oxygen.

Answer:
Greenish yellow flame is observed.

Question 3.
Give the equation for the reaction : ammonium chloride is heated with sodium hydroxide.

Answer:
$NH_4Cl + NaOH \rightarrow NaCl + NH_3 + H_2O$

Question 4.
In the manufacture of ammonia.

1. Name the process.
2. State the ratio must the reactants taken ?
3. State the catalyst used.
4. Give the equation for the manufacture of the gas ammonia.

Answer:

(*i*) Habers process

(*ii*) N_2 and H_2 in the ratio (1 : 3)

(*iii*) Finely divided iron and molybdenum promotor.

(*iv*) $N_2 + 3H_2 \underset{200-900\ atm}{\overset{450-500^{\circ}C}{\rightleftharpoons}} 2NH_3 + 22.4\ K\ Cal$
Fe + Mo

Question 5.
Write a relevant equation, to show that ammonia can act as a reducing agent

Answer:
$2NH_3 + 3Cl_2 \rightarrow N_2 + 6HCl$

Question 6.
Name two gases you have which can be used to study the fountain experiment. State the common property demonstrated by the fountain experiment ?

Answer:
Two gases which are used to study the fountain experiment are Hydrogen chloride gas (HCl) and Ammonia (NH3)
The common property of these two gases demonstrated by the fountain experiment is the solubility of gases

2011

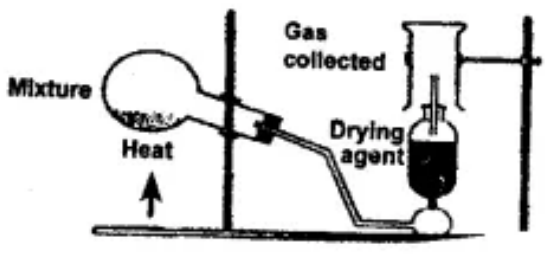
Question 1.
State what is observed when – Ammonium hydroxide is first added in a small quantity and then in excess to a solution of copper sulphate.

Answer:
On adding ammonium hydroxide in small amount, pale blue precipitates will appear. On adding ammonium hydroxide in excess, blue precipitates will dissolve forming deep blue solution.

$$CuSO_4 + 2NH_4OH \rightarrow \underset{\text{Blue ppt.}}{Cu(OH)_2 \downarrow} + (NH_4)_2SO_4$$

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \rightarrow \underset{\text{Deep Blue Solution}}{[Cu(NH_3)_4]SO_4} + 4H_2O$$

Question 2.
The diagram shows set up for the laboratory preparation of a pungent alkaline gas.



1. Name the gas collected in the jar.
2. Write the balanced equation for the above preparation
3. State how the gas is collected?
4. Name the drying agent used.

5. State how you will find out that the jar is full of pungent gas?

Answer:

1. Ammonia (NH_3)
2. $NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O + 2NH_3 \uparrow$
3. Downward displacement of air
4. Quicklime (CaO)
5. Bring a rod dipped in HCl near it. Dense white fumes of ammonium chloride will be formed.

Question 3.
Write a balanced chemical equation – Chlorine reacts with excess of ammonia.

Answer:

$$8NH_3 \text{ (excess)} + 3Cl_2 \longrightarrow N_2 \uparrow + 6NH_4Cl + N_2$$

Question 4.
State your observation when – Water is added to the product formed, when aluminium is burnt in a jar of nitrogen gas.
Answer:
Pungent smelling and alkaline gas (NH_3) is evolved.

$$2Al + N_2 \longrightarrow 2AlN \text{ [Burning of aluminium]}$$

$$AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3 \uparrow \text{ [Pungent gas]}$$

2012

Question 1.
Name the gas produced when excess ammonia reacts with chlorine.

Answer:
Nitrogen.

Question 2.
Rewrite the correct statement with the missing word/s Magnesium nitride reacts with water to liberate ammonia.

Answer:
Magnesium nitride reacts with warm water to liberate ammonia along with magnesium hydroxide.

Question 3.
Give balanced equation for the reaction : Ammonia and Oxygen in the presence of a catalyst.

Answer:

$$4NH_3 + 5O_2 \xrightarrow[800°C]{Pt} 4NO + 6H_2O$$

Question 4.
The following questions are based on the preparation of ammonia gas in the laboratory:

1. Explain why ammonium nitrate is not used in the preparation of ammonia.
2. Name the compound normally used as a drying agent during the process.
3. How is ammonia gas collected ? Explain why it is not collected over water.

Answer:

1. Ammonium nitrate does not undergo a reversible sublimation reaction, it melts and then decompses into nitrogen oxide gas and water vapour. Thus it is not used in the preparation of ammonia.
   $NH_4NO_3 \rightarrow N_2O + 2H_2O$
2. Calcium oxide
3. Ammonia is collected in an inverted dry gas jar by downward displacement of air.
   It is highly soluble in water and hence cannot be collected by downward displacement of water.

2013

Question 1.
State one appropriate observation for :
Excess of chlorine gas is reacted with ammonia gas.

Answer:
A yellow explosive liquid (Nitrogen trichloride) is formed.

Question 2.
Nitrogen gas can be obtained by heating :

(a) Ammonium nitrate
(b) Ammonium nitrite
(c) Magnesium nitric
(d) Ammonium chloride

Answer:

(b) Ammonium nitrite

Question 3.
State two relevant observations for :

Ammonium hydroxide solution is added to zinc nitrate solution in minimum quantities and then in excess.

Answer:
A white gelatin like precipitate of zinc hydroxide is formed which dissolves in excess of ammonium hydroxide.

Question 4.
Give balanced equations for :
Reduction of hot Copper (II) oxide to copper using ammonia gas.
Answer:

$$3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$$

Copper(II) oxide — Ammonia — Copper — Water — Nitrogen

Question 5.
Copy and complete the following table relating to im¬portant industrial process :

Name of the process	Temperature	Catalyst	Equation for catalyzed reaction
Haber's process			

Answer:

Name of the process	*Temperature*	*Catalyst*	*Equation for the catalyzed reaction*
Haber's proces	450°–500°C	Fe + Mo	$N_2 + 3H_2 \longrightarrow 2NH_3$

Question 6.
Identify : An alkaline gas which produces dense white fumes when reacted with HCl gas.

Answer:
Ammonia gas.

2014

Question 1.
Fill in the blank from the choices given in bracket : Ammonia gas is collected by _____ (upward displacement of air, a downward displacement of water, a downward displacement of air)

Answer:
Ammonia gas is collected by a downward displacement of air.

Question 2.
Write balanced equation for : Action of warm water on magnesium nitride.

Answer:
Action of warm water on magnesium nitride.

$$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$$

Question 3.
Distinguish between the following pairs of compounds using the test given within bracket :

1. Iron(II)sulphate and iron (III) sulphate (using ammonium hydroxide)
2. A lead salt and a zinc salt (using excess ammonium hydroxide)

Answer:

(*i*) Iron (II) sulphate and iron (III) sulphate (using NH_4OH)

Iron (II) sulphate (Fe^{2+} ion)

$$FeSO_4 + 2NH_4OH \longrightarrow Fe(OH)_2\downarrow + (NH_4)_2\,SO_4$$

green — dirty green ppt. — colourless sol.

Iron (III) Salt (Fe^{3+} ion)

$$Fe_2(SO_4)_3 + 6NH_4OH \longrightarrow 2Fe(OH)_3\downarrow + 3(NH_4)_2\,SO_4$$

reddish brown ppt.

(*ii*) A lead salt and a zinc salt (using excess NH_4OH)

$$Pb(NO_3)_2 + 2NH_4OH \longrightarrow Pb(OH)_2\downarrow + 2NH_4NO_3$$

Chalky white ppt.

Insoluble in excess of NH_4OH

$$ZnSO_4 + 2NH_4OH \longrightarrow Zn(OH)_2\downarrow + (NH_4)_2\,SO_4$$

White gelatinous ppt.

With excess of NH_4OH ppt. dissolves

$$Zn(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \longrightarrow [Zn(NH_3)_4]\,SO_4 + 4H_2O$$

Tetra amine zinc sulphate

Question 4.
State your observation : Calcium hydroxide is heated with ammonium chloride crystals.

Answer:

$$Ca(OH)_2 + 2NH_4Cl \longrightarrow CaCl_2 + H_2O + 2NH_3$$

ammonia gas is evolved which fumes strongly in moist air.

Question 5.
Name the other ion formed when ammonia dissolves in water. Give one test that can be used to detect the presence of the ion produced.

Answer:

(*i*) When Ammonia dissolves in water.

$$NH_3 + H_2O \longrightarrow NH_4OH$$

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

ions formed are ammonium and hydroxyl.

(*ii*) Test — $NH_4OH + HCl$ or $Cl_2 \longrightarrow NH_4Cl + H_2O$

(White fumes)

Question 6.
State the conditions required for : Catalytic oxidation of ammonia to nitric oxide.

Answer:
Catalytic oxidation of ammonia to nitric oxide.

$$4NH_3 + 5O_2 \xrightarrow{\text{Pt. 800°C}} 6H_2O + 4NO\uparrow$$

Conditions for catalytic oxidation of ammonia to nitric oxide : Platinum catalyst and 800°C temperature.

2015

Question 1.
From the list the gases — Ammonia, ethane, hydrogen chloride, hydrogen sulphide, ethyne
Select the gas which is used as a reducing agent in reducing copper oxide to copper.

Answer:
Hydrogen

Question 2.
State one relevant observation — Ammonia gas is burnt in an atmosphere of excess oxygen.

Answer:
Ammonia gas bums to form nitrogen gas and steamy fumes of water.

Question 3.
A metal 'X' has valency 2 and a non-metal 'Y' has a valency 3.
If 'Y ' is a diatomic gas, write an equation for the direct combination of X and Y to from a compound.

Answer:
The equation for the direct combination of X and Y to form a compound is

$$3X + 2Y \xrightarrow{\text{Heat}} X_3Y_2.$$

Question 4.
Give balanced chemical equations —

1. Lab. preparation of ammonia using an ammonium salt.
2. Reaction of ammonia with excess chlorine.
3. Reaction of ammonia with sulphuric acid.

Answer:

1. Ammonia is prepared in the laboratory by using ammonium chloride.

$$2NH_4Cl + Ca(OH)_2 \xrightarrow{CaO} CaCl_2 + 2H_2O + 2NH_3$$

Ammonium chloride — Calcium chloride — Ammonia gas

2. When ammonia reacts with excess of chlorine, it forms nitrogen trichloride and HCl

$$NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$$

(Nitrogen trichloride)

3. Ammonia reacts with sulphuric acid to form ammonium sulphate.

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

(Excess) — Ammonium sulphate

2016

Question 1.
Write balanced equations for :

1. Action of warm water on AIN.

2. Excess of ammonia is treated with chlorine.
3. An equation to illustrate the reducing nature of ammonia.

Answer:

(*i*) $AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3$

(*ii*) $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

(*iii*) $3CuO + 2NH_3 \longrightarrow 3Cu + N_2 + 3H_2O$

Question 2.
Name the gas evolved when the following mixtures are heated :

1. Calcium hydroxide and Ammonium chloride.
2. Sodium nitrite and Ammonium chloride.

Answer:

1. Ammonia gas
2. Nitrogen gas

2017

Question 1.
Write the balanced chemical equation for each of the following –

1. Reaction of ammonia with heated copper oxide.
2. Laboratory preparation of ammonia from ammonium chloride.

Answer:

(*i*) $3CuO + 2NH_3 \xrightarrow{heat} 3Cu + 3H_2O + N_2(g)$

(*ii*) $2NH_4Cl + Ca(OH_2) \xrightarrow{CaO} CaCl_2 + 2H_2O + 2NH_3$

Question 2.
State one relevant observation for the following reaction – Burning of ammonia in air.

Answer:
Ammonia bums with a yellowish green flame.

Question 3.
Certain blanks spaces are left in the following tables as C, D & E. Identify each of them.

Lab preparation of	Reactants used	Products formed	Drying agent	Method of collection
NH_3 gas	C	$Mg(OH)_2 NH_3$	D	E

Answer:

C : Reactants are Magnesium nitride(Mg_3N_2) and water(H_2O).
D : Drying agent is anhydrous calcium oxide (Quick lime).
E : NH_3 gas is collected by the downward displacement of air.

Question 4.
Give a balanced chemical equation for each of the following –

1. Catalytic oxidation of ammonia.
2. Reaction of ammonia with nitric acid.

Answer:

$$(i)\quad 4NH_3 + 5O_2 \xrightarrow{\text{catalyst}} 4NO(g) + 6H_2O$$

$$(ii)\quad NH_3 + HNO_3 \longrightarrow NH_4NO_3$$

Additional Questions

Question 1.
State why nitrogenous matter produces ammonia. State a liquid source of ammonia.

Answer:
When nitrogenous matter (such as animal and vegetable protiens) decays in the absence of air, the putrefying bacteria on the organic matter in the soil or ammonifying bacteria in organic matter produces ammonia.
The liquid souce of ammonia is decaying urine of animals.

Question 2.
Give the word equation and balanced molecular equation for the laboratory preparation of ammonia from NH4Cl and calcium hydroxide.

Answer:
Ammonium Chloride + Calcium Hydroxide → Calcium Chloride + Water + Ammonia

$$2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$$

Question 3.
Convert ammonium sulphate to ammonia using two different alkalis.

Answer:

$$(NH_4)_2SO_4 + 2NaOH \xrightarrow{Heat} Na_2SO_4 + 2H_2O + 2NH_3$$

$$(NH_4)_2SO_4 + 2Ca(OH)_2 \xrightarrow{Heat} CaSO_4 + 2H_2O + 2NH_3$$

Question 4.
State why ammonia is not obtained in the laboratory from NH_4NO_3 and NaOH.

Answer:
Ammonium nitrate on heating decomposes explosively with the formation of nitrous oxide and water.

$$NH_4NO_3 \xrightarrow{Heat} 2H_2O + N_2O$$

Question 5.
State the method used with reasons for drying and collecting ammonia gas.

Answer:
Calcium oxide (quick lime) is used for drying ammonia. It is because, calcium oxide being basic in nature does not react chemically with ammonia.
$CaO + H_2O \rightarrow Ca(OH)_2$
Chemicals such as $CaCl_2$ (anhydrous), P_2O_5 and cone H_2SO_4 are not used for drying ammonia, because they react chemically with it as shown in the equation below :

$$(i)\ CaCl_2 + 8NH_3 \longrightarrow CaCl_2.8NH_3$$

$$(ii)\ P_2O_5 + 3H_2O + 6NH_3 \longrightarrow 2(NH_4)_3PO_4$$

$$(iii)\ H_2SO_4 + 2NH_3 \longrightarrow (NH_4)_2SO_4$$

Ammonia is collected by downward displacement of air. Ammonia gas is highly soluble in water, as such it cannot be collected over water. Further, ammonia is lighter than air. As such ammonia is collected by downward displacement of air.

Question 6.
State how you would convert **(i)** Mg **(ii)** Ca **(iii)** Al – to ammonia.

Answer:

(*i*) Magnesium is burnt in nitrogen so as to obtain magnesium nitride.

$$3Mg + N_2 \xrightarrow{\Delta} Mg_3N_2 + \text{heat}$$

The magnesium nitride is treated with warm water, so as to obtain ammonia.

$$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$$

(*ii*) Calcium is burnt in nitrogen so as to obtain calcium nitride.

$$3Ca + N_2 \xrightarrow{\Delta} Ca_3N_2 + \text{heat.}$$

The calcium nitride is treated with warm water, so as to obtain ammonia.

$$Ca_3N_2 + 6H_2O \longrightarrow 3Ca(OH)_2 + 2NH_3$$

(*iii*) Aluminium is burnt in nitrogen so as to obtain aluminium nitride.

$$2Al + N_2 \xrightarrow{\Delta} 2AlN + \text{heat}$$

Aluminium nitride is treated with warm water, so as to obtain ammonia.

$$AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3$$

Question 7.
Give a balanced equation with all conditions to obtain NH_3 from N_2 and H_2.

Answer:

$$N_2 + H_2 \underset{450^\circ - 500^\circ C,\ 200 - 900\ atm.}{\overset{\text{Finely divided (Fe + MO)}}{\rightleftharpoons}} 2NH_3 + \text{heat.}$$

Conditions for maximum yield of ammonia :

- **Pressure :** 200-900°C (High pressure)
- **Temperature :** 450-500°C (Optimum temperature)
- **Catalyst :** Finely divided iron, Fe
- **Promotor :** Molybdenum, Mo

Question 8.
State two physical properties of NH_3 which enable separation of NH_3 from a mixture of NH_3, N_2 and H_2.

Answer:

1. Ammonia liquifies at a pressure 8 atmosphere at -33°C, but not hydrogen and nitrogen.
2. Ammonia is extremely soluble in water, but not hydrogen and nitrogen.

Question 9.
Compare the density of ammonia with that of air. Name two gases lighter than ammonia.

Answer:
The vapour density of ammonia is 8.5 and that of air is 14.4. The two gases lighter than ammonia are

1. hydrogen
2. helium.

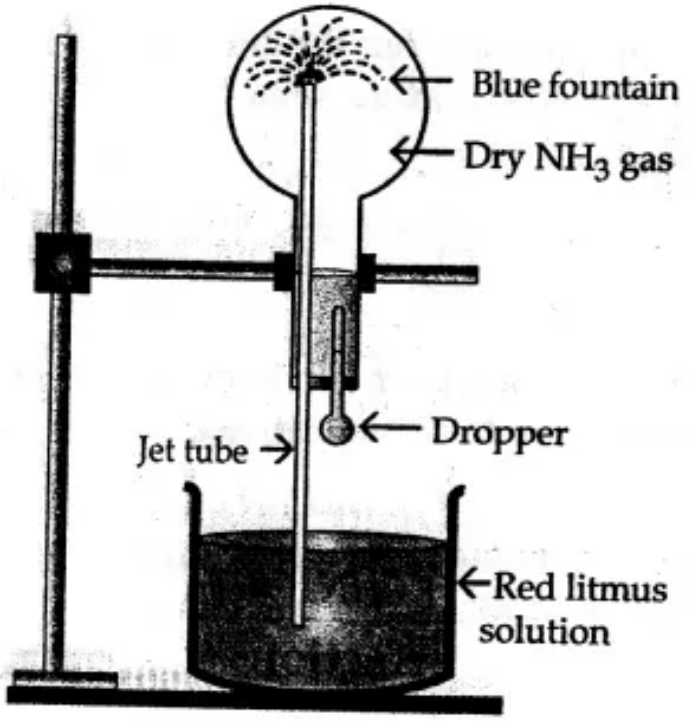
Question 10.
'Ammonia is highly soluble in water'. Name two other gases showing similar solubility.

Answer:
The other highly soluble gases in water are :

1. Hydrogen chloride
2. Sulphur trioxide.

Question 11.
Name the experiment and state its procedure to demonstrate the high solubility of ammonia.

Answer:
Highly solubility of ammonia can be shown by Fountain Experiment.
To demonstrate the high solubility of ammonia gas in water.



Fountain Experiment

Apparatus :

1. Round bottomed flask filled with ammonia gas.
2. Mouth of the flask with a rubber stopper with two holes, one for jet tube and other for dropper containing water.
3. Trough below contains red litmus solution.

Procedure :

1. The dropper containing water is squeezed and few drops of water enters the flask.
2. Ammonia gas present in the flask gets dissolved in water due to its high solubility, which creates a partial vacuum in the flask.
3. Since outside pressure is higher, so red litmus solution rush up the jet tube and emerge as a fountain. (Ammonia gas being basic changed red litmus blue.)
   Ammonia gas is lighter than air, hence it is collected by downward displacement of air.
4. Easily liquified at low temperatures.
5. Liquid ammonia boils at – 33.5°C
6. Solid ammonia melts at – 77.5°C

Question 12.
Give an equation for the burning of ammonia in oxygen. State the observation seen.

Answer:
Ammonia bums in the atmosphere of oxygen with a pale blue flame, forming nitrogen gas and water vapour.

$$4NH_3 + 3O_2 \xrightarrow{\text{burning}} 2N_2 + 6H_2O$$

Question 13.
Convert ammonia to nitric oxide by catalytic oxidation of ammonia. State all conditions.

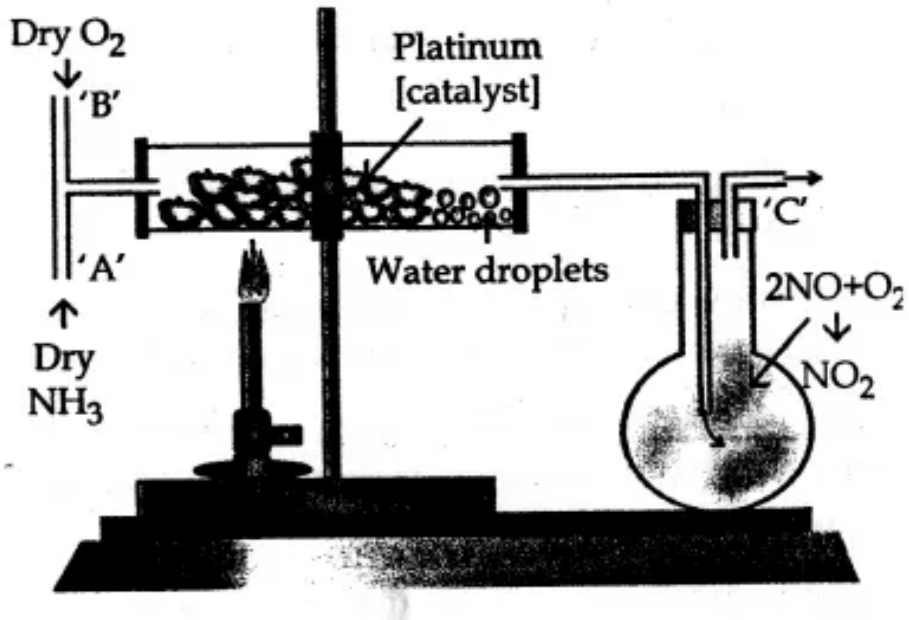
Answer:
When a mixture of 2 (vols.) of oxygen and l(vols.) of ammonia is passed over platinum gauze maintained at 800°C, it reacts to form nitric oxide and water vapour.

$$4NH_3 + 5O_2 \xrightarrow[800^\circ C]{Pt} 4NO + 6H_2O + \Delta$$

- **Conditions for the reaction :** Ostwald's process
- **Temperature :** 800°C
- **Catalyst :** Platinum (Pt)

Question 14.
Draw a simple diagram for the catalytic oxidation of ammonia in the laboratory.

Answer:



Question 15.
Give reasons for the observation seen during catalytic oxidation of ammonia.

Answer:
The colourless nitric oxide formed undergoes further oxidation to give reddish brown vapours of nitrogen oxide.
The platinum(catalyst) continues to emit a reddish glow even after the heating is discontinued since the catalytic oxidation of ammonia is an exothermic reaction.

Question 16.
Name an industrial process which involves ammonia, oxygen and a catalyst as its starting reactants.

Answer:
The industrial process is called Ostwald's process for preparing nitric acid.

Question 17.
State what an aqueous solution of NH_3 is called. State how it is prepared giving reasons.

Answer:
The aqueous solution of ammonia is chemically ammonium hydroxide(NH_4OH) (Liquor Ammonia).
It is prepared by connecting the delivery tube of the apparatus generating ammonia with an inverted funnel whose rim is just dipping in water contained in beaker.
This arrangement provides

1. large surface area for the absorption of ammonia and
2. prevents back suction
   $NH_3 + H_2O \rightarrow NH_4\ OH$

Question 18.
State why an aq. soln. of NH_3

1. turns red litmus blue
2. is a weak base and a weak electrolyte.

Answer:

1. Ammonia on dissolving in water furnishes ammonium (NH_4^+) ions and hydroxyl (OH^-) ions.

   $$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

   The presence of OH^- turns the red litmus blue.
2. When ammonia dissolves in water, it forms ammonium hydroxide. The ammonium hydroxide dissociates to NH_4^+ ions and OH^- ions.
   However, the degree of dissociation of ammonium hydroxide molecules is

very low. Thus, due to the presence of few OH- ions it is a weak base, as well as weak electrolyte.

Question 19.
State two different methods of preparing NH_4Cl using hydrochloric acid.

Answer:

1. When ammonium hydroxide is treated with hydrochloric acid, neutrilisation reaction takes place with formation of Ammonium chloride
   $NH_4OH + HCl\ (dil.) \rightarrow NH_4Cl + H_2O$
2. When ammounium carbonate is treated with hydrochloric acid, it forms ammonium chloride, carbon dioxide and water.
   $(NH_4)_2\ CO_3 + 2HCl\ (dil.) \rightarrow 2NH_4Cl + CO_2 + H_2O$

Question 20.
Convert **(i)** ammonia **(ii)** ammonium hydroxide to an ammonium salt using **(a)** HNO_3 **(b)** H_2SO_4.

Answer:

(*i*) From ammonia

$$NH_4 + HNO_3 \longrightarrow NH_4NO_3$$
$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)2SO_4$$

(*ii*) From ammonium hydroxide

$$NH_4OH + HNO_3 \longrightarrow NH_4NO_3 + H_2O$$
$$2NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2H_2O$$

Question 21.
State a reason why reaction of liquor ammonia with nitric acid is a neutralization reaction.

Answer:
Liquor ammonia is a saturated solution of ammonia in water. Ammonia, NH_3 dissolves in water to give ammonium hydroxide which dissociates partially to give NH_4^+ and OH^- ions. Due to presence of OH^- ions, ammonium hydroxide acts as an alkali.

$$NH_3\ (aq) + H_2O\ (l) \longrightarrow NH_4OH\ (aq)$$
$$NH_4OH\ (aq) \rightleftharpoons NH_4^+\ (aq) + OH^-\ (aq)$$

The reaction between an acid (nitric acid) and an alkali or base is a neutralisation reaction.

$$NH_4OH\ (aq) + HNO_3\ (aq) \longrightarrow NH_4NO_3\ (aq) + H_2O\ (l)$$

Hence, the reaction between liquor ammonia and nitric acid is a neutralisation reaction.

Question 22.
State why an aqueous solution of ammonia (NH_4OH) is used for identifying cations.

Answer:
Because of its colour and solubility in excess NH_4OH.

Question 23.
State how NH_4OH is used for identify :

1. Fe^{2+}
2. Fe^{3+}
3. pb^{2+}
4. Zn^{2+}
5. Cu^{2+} cations.

Give also a balanced equation in each case for a known example.

Answer:

(*i*) A solution with Fe^{2+} ions, forms dirty green ppt. which is insoluble in excess of NH_4OH.

The balanced equation is as follows :

$$FeSO_4\ (aq) + 2NH_4OH \longrightarrow Fe(OH)_2 + (NH_4)_2SO_4$$

Iron(II) sulphate — Dirty green ppt.

(ii) A solution with Fe^{3+} ions, forms reddish brown ppt. which is insoluble in excess of NH_4OH.

The balanced equation is as follows :

$$FeCl_3 + 3NH_4OH \longrightarrow Fe(OH)_3 + 3NH_4Cl$$

Iron(III) chloride — Reddish brown ppt.

(iii) A solution with Zn^{2+} ions, forms gelatin white ppt. which dissolves in excess of NH_4OH to form colourless solution.

The balanced equation is as follows :

$$ZnSO_4 + 2NH_4OH \longrightarrow Zn(OH)_2 + (NH_4)_2SO_4$$

Zinc sulphate — Chalki white ppt.

$$Zn(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \longrightarrow [Zn(NH_3)_4]SO_4 + 4H_2O$$

(iv) A solution with Pb^{2+} ions, forms a chalky white ppt. which is insoluble in excess of NH_4OH.

The balanced equation is as follows :

$$\underset{\text{Lead(II) sulphate}}{Pb(NO_3)_2} + 2NH_4OH \longrightarrow \underset{\text{Chalky white ppt.}}{Pb(OH)_2} + 2NH_4NO_3$$

(v) A solution with Cu^{2+} ions, forms a bluish white ppt which dissolves in excess of NH_4OH to form deep blue solution.

The balanced equation is as follows :

$$\underset{\text{Copper(II) sulphate}}{CuSO_4} + 2NH_4OH \longrightarrow \underset{\text{Pale blue ppt.}}{Cu(OH)_2} + (NH_4)_2SO_4$$

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \longrightarrow \underset{\text{Soluble (Deep blue sol.)}}{[Cu(NH_3)_4]SO_4} + 4H_2O$$

Question 24.
State why the blue ppt. formed on addition of NH_4OH to $CuSO_4$ soln. dissolves to give a deep blue solution with excess of NH_4OH. Give an equation for the reaction. State why $Zn(OH)_2$ is soluble in excess of NH_4OH.

Answer:
$CuSO_4$ when reacts with excess of ammonia it produces needle shape crystals of tetraammine copper(II) sulphate complex which possess a beautiful deep blue colour.

$$CuSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + \underset{\text{Pale blue. ppt.}}{Cu(OH)_2 \downarrow}$$

Question 25.
Give balanced equations for the reducing reactions of ammonia with **(i)** copper (II) oxide, **(ii)** lead (II) oxide, **(iii)** chlorine using, **(a)** excess NH_3, **(b)** excess Cl_2.

Answer:

(i) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2[g]$

[basic oxide]

(ii) $2NH_3 + 3PbO \longrightarrow 3Pb + 3H_2O + N_2[g]$

[amphoteric oxide]

(iii) (a) Ammonia [in excess]

$$2NH_3 + 3Cl_2 \longrightarrow 6HCl + N_2$$

$$6NH_3 + 6HCl \longrightarrow 6NH_4Cl$$

$$8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$$

[excess]

(b) $NH_3 + 3Cl_2 \longrightarrow 3HCl + NCl_3$

[Nitrogen trichloride]

Question 26.
State five tests for ammonia where a colour change is involved.

Answer:
Tests for ammonia :

1. Ammonia turns red (or purple) litmus solution to blue.
2. Ammonia turns methyl orange solution to yellow.
3. Ammonia turns phenolphthalein (colourless) solution to pink.
4. Ammonia turns Nesseler' reagent (colourless) solution to pale brown.
5. Ammonia (when in excess) gives a deep blue coloured solution with $CuSO_4$ (aq.)

Question 27.
State **(i)** a light neutral gas **(ii)** an acid **(iii)** an explosive **(iv)** a fertilizer — obtained from ammonia.

Answer:

1. Hydrogen
2. Nitric acid
3. NH_4NO_3
4. Ammonium sulphate.

Question 28.
Name an ammonium salt which is a constituent of **(a)** smelling salts **(b)** dry cells.
Give reasons for the use of the named ammonium salt for the same.

Answer:

(a) Smelling salts : Ammonium carbonate, $(NH_4)_2CO_3$ is used as smelling salt. It is an unstable white solid decomposes to give pungent smellingNH_3 gas.
$(NH_4)_2CO_3 \rightarrow 2NH_3 + CO_2 + H_2O$
The pungent smelling NH_3 gas revives a fainted person. $(NH_4)_2CO_3$ is always kept in a tightly closed container to prevent it from decomposition.
(b) Dry cells : Ammonium chloride(NH_4Cl) is used in dry cells. It oxidises Zn to Zn^{2+} ions. The electrons so produced constitute the electric current.

Question 29.
Give one use with reason of

1. an aqueous solution of NH_3
2. liquefied NH_3.

Answer:
(i) Use of an Aqueous solution of Ammonia (NH_3) : An aqueous solution of NH_3 is called liquor ammonia. Being a base, it can easily emulsify oils and fats. Therefore, it is used for removing oil and fat stains from clothes carpets, upholstery etc. It is also used for cleaning window panes, porcelain articles etc.
(ii) Use of Liqueified Ammonia (NH_3) : Liquid ammonia is used as refrigerant i.e. for producing low temperature. This is due to the following reasons:

(a) It is highly volatile.
(b) It can be easily liquefied under high pressure and low temperature.
(c) It's latent heat of evaporation is very high.

Question 30.
State what are chlorofluorocarbons and give their use. Give a reason why they are ozone depleting. State a suitable alternative to chlorofluorocarbons which are non-ozone depleting.

Answer:
Chlorofluorocarbons (CFC's) are compounds of carbon with chlorine or fluorine. CFC are chemicals which like liquefied ammonia gas are used in refrigeration gas. They are also used as coolants in refrigeration and A/c Plants and aerosol sprays and cleansing agents.
These CFC's deplete ozone layer and also contribute to global warming. Thus these CFC's are harmful to life. The CFC's are decomposed by ultraviolet rays coming from sun to produce highly reactive chlorine atoms i.e. free Cl radicals.

Suitable alternatives to chloroflurocarbons which are not depleting ozone are :
HCFC – Hydrochloroflurocarbons; and HFC – 125 Hydrochloroflurocarbons ; which act as a substitute for CFCs, which are non-ozone depleting.

Unit Test Paper 7b —Ammonia

Q.1. Choose the letter corresponding to the correct answer from — A : NO_2, B : NO, C : N_2, D : N_2O.
The gas obtained when –
1. Dry ammonia and dry oxygen gas are ignited together.
2. Ammonia is passed over heated litharge.
3. A greenish yellow gas reacts with excess ammonia.
4. (a) Dry NH_3 and O_2 are passed over heated Pt.
(b) The gaseous product obtained is further oxidised.
5. Ammonium nitrite undergoes thermal decomposition.

Answer:

1. C(N_2)
2. C(N_2)
3. C(N_2)
4. (a) B(NO),(b) A(NO_2)
5. D(N_2O)

Q.2. State the colour of :

Question 1.
Phenolphthalein solution after passage of ammonia through it.

Answer:
Colourless phenolphthalein changes to pink colour.

Question 2.
Copper (II) hydroxide solution after-addition of ammonium hydroxide in excess to it.

Answer:
The pale blue precipitate turns into a deep blue coloured solution.

Question 3.
The flame obtained on burning dry ammonia in oxygen.

Answer:
Greenish yellow flame.

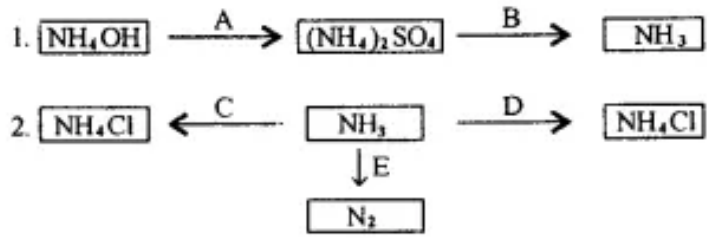
Question 4.
The solution obtained on addition of excess ammonium hydroxide to zinc sulphate solution.

Answer:
White gelantinous precipitate dissolves.

Question 5.
The vapours obtained when ammonia-oxygen gas mixture is passed over heated Pt.

Answer:
The colourless NO gas first produced is further oxidises to brown coloured NO_2.

Q.3. Give balanced equations for the following conversions — A, B, C, D and E.



(C, D and E are three different gases)

Answer:

1. $NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2\ SO_4$

   $(NH_4)_2\ SO_4 + 2NaOH \xrightarrow{\Delta} Na_2SO_4 + 2H_2O + 2NH_3$

2. $NH_3 + HCl \longrightarrow NH_4Cl$

   $6NH_3 + 3Cl_2 \longrightarrow NH_4Cl + N_2$

   (excess)

Q.4. Give reasons for the following.

1. An aqueous solution of ammonia acts as a weak base.
2. A mixture of ammonium nitrate and slaked lime are not used in the lab. preparation of ammonia gas.
3. Finely divided iron catalyst does not affect the percentage yield of ammonia in Haber's process.
4. Ammonium salts are formed when ammonia reacts with dilute acids in the gaseous or aq. medium.
5. Aqueous solution of lead and zinc nitrate can be distinguished using an aqueous solution of ammonia.

Answer:

1. Ammonia molecule contains a lone pair of electrons on N- atom, which accepts a proton from water, and forms ammonium ion and hydroxide ion, this makes ammonia solution alkaline and thus, it acts as a base.
   $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$
   However, as the concentration of the hydroxyl ions that are furnished is less, therefore aqueous solution of ammonia acts as a weak base.
2. Because ammonium nitrate is explosive and decomposes itself.
3. Formation of NH_3 from N_2 and H_2 in haber's process is a reversible reaction. In a reversible reaction, a catalyst does not increase the yield of the product. It only helps in attaining the equilibrium in a shorter time.
   $$N_2(g) + 3H_2(g) \xrightarrow[450-500°C,\ 900atm]{Fe+Mo} 2NH_3$$
4. Ammonia in gaseous form neutralises acids to form salts.
5. Zinc nitrate forms white gelatinous ppt. while lead nitrate forms chalky white ppt.

Q.5. Complete the statements by selecting the correct word from the words in brackets.

1. The salt solution which does not give an insoluble precipitate on addition of ammonium hydroxide in small amount is _____ ($Mg(NO_3)_2$ / $NaNO_3$/$Cu(NO_3)_2$]
2. The alkaline behaviour of liquor ammonia is due to the presence of _____ ions, (ammonium / hydronium / hydroxyl)
3. Ammonia in the liquefied form is _____ (acidic / basic / neutral)
4. Ammonia reduces chlorine to _____ (nitrogen / hydrogen chloride / ammonium chloride)
5. The chemical not responsible for ozone depletion is _____ [methyl chloride / ammonia / chloroflourocarbons]

Answer:

1. $NaNO_3$
2. Hydroxyl
3. basic
4. Ammonium chloride .
5. Ammonia

Q.6. Select the most probable substance from A, B, C, D and E which need to be added to distinguish :

1. Ammonium sulphate and ammonium chloride	**A. Conc. hydrochloric acid**
2. Potassium sulphate and ammonium sulphate	**B. Ammonia gas**
3. Liquor ammonia and liquid ammonia	**C. Barium chloride**
4. Ammonia and sulphur dioxide gas	**D. Phenolphthalein**
5. Copper (II) oxide and copper (II) chloride	**E. Sodium hydroxide**

Answer:

1. Ammonium sulphate and ammonium chloride	C. Barium chloride
2. Potassium sulphate and ammonium sulphate	E. Sodium hydroxide
3. Liquor ammonia and liquid ammonia	D. Phenolphthalein
4. Ammonia and sulphur dioxide gas	A. Conc. hydrochloric acid
5. Copper (II) oxide and copper (II) chloride	B. Ammonia gas

Nitric Acids

QUESTIONS
2000

Question 1.
What do you see when concentrated nitric acid is added to copper.

Answer:
A pungent smelling reddish brown coloured gas (NO_2) is produced and the solution turns greenish blue.
$Cu + 4HNO_3$ (cone.) $\rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

2001

Question 1.
Name the gas produced in the reaction:
Action of concentrated nitric acid on copper.

Answer:
Nitrogen dioxide.

Question 2.
Choose the correct word from the brackets to complete the sentence. Sodium nitrate reacts with — (concentrated / dilute) sulphuric acid to produce nitric acid. Write equation for the same.

Answer:
Sodium nitrate reacts with concentrated sulphuric acid to produce nitric acid.

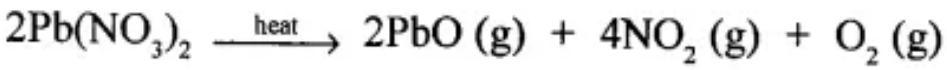
$$NaNO_3 + H_2SO_4(conc.) \xrightarrow{< 200^\circ C} NaHSO_4 + HNO_3$$

Question 3.
Write the equations for the following reaction : Between copper and concentrated nitric acid.

Answer:
$Cu + 4HNO_3$ (cone.) $\rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

Question 4.
From the formulae listed below, choose, one, corresponding to the salt having the given description:
AgCl, $CuCO_3$, $CuSO_4$. $5H_2O$, KNO_3, NaCl, NaHSO,, $Pb(NO_3)_2$, $ZnCO_3$, $ZnSO_4.7H_2O$.
This salt gives nitrogen dioxide on heating.

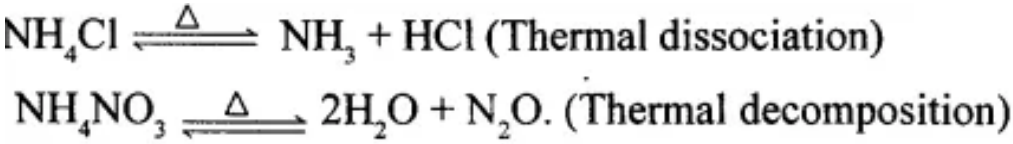
Answer:
$Pb(NO_3)_2$



2002

Question 1.
Give equations for the action of heat on –
(1) NH_4Cl
(2) NH_4NO_3.
State whether each reaction is an example of thermal decomposition or thermal dissociation.
(1) Dissociation
(2) decomposition

Answer:

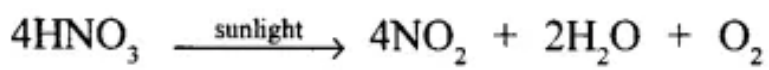


Question 2.
What compounds are required for the laboratory preparation of nitric acid.

Answer:
Potassium nitrate and cone, sulphuric acid.

Question 3.
State why pure nitric acid takes on a yellowish brown colour when exposed to light.

Answer:
In the presence of sunlight nitric acid decomposes even at room temperature to give nitrogen dioxide, water and oxygen.



The NO_2 so produced dissolves in cone. HNO_3. The yellow colour of cone, nitric acid is due to NO_2 dissolved in it.

Question 4.
Write an equation for the following reaction:
Copper and concentrated nitric acid.

Answer:
$Cu + 4HNO_3$ (cone.) $\rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$.

Question 5.
The first step in the manufacture of HNO_3 is the catalytic oxidation of NH_3. Name the catalyst used.

Answer:
Platinum.

2003

Question 1.
Name a solution which gives nitrogen dioxide with copper.

Answer:
Concentrated nitric acid (HNO_3).

Question 2.
When nitric acid is prepared by the action of concentrated sulphuric acid on potassium nitrate, what is the special feature of the apparatus used.

Answer:
All glass apparatus is used in the laboratory preparation of nitric acid.

Question 3.
Write the equation for the lab. preparation of H_2NO_3 from potassium nitrate and cone. H_2SO_4.

Answer:
$$KNO_3 + H_2SO_4 \text{ (conc.)} \xrightarrow[\text{Heat}]{<200^\circ C} KHSO_4 + HNO_3$$

Question 4.
Potassium nitrate prepared from KOH and nitric acid. State the type of reaction involved.

Answer:
Neutralization reaction.

Question 5.
State the cone, acid which will oxidise sulphur directly to H_2SO_4. Write the equation for the same.

Answer:
Hot and cone, nitric acid will oxidises sulphur directly to sulphuric acid.
$S + 6HNO_3 \rightarrow H_2SO_4 + 2H_2O + 6NO_2$

2004

Question 1.
X, Y and Z are three crystalline solids which are soluble in water and have a common anion. To help you
to identify X, Y and Z, you are provided with the following experimental observations. Copy and complete the corresponding inferences in.
A reddish-brown gas is obtained when X, Y and Z are separately warmed with concentrated sulphuric acid and copper turnings added to the mixture. The common anion is the ion.

Answer:
[NO^{-}] Nitrate

Question 2.
Write a balanced equation for the reaction of cone. HNO_3 when added to copper turnings kept in a beaker.

Answer:
$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

Question 3.
Write a balanced equation for the reaction of cone. $HN0_3$ when added to copper turnings kept in a beaker.

Answer:
$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

2005

Question 1.
Write a balanced equation for the reaction of – sulphur and hot concentrated nitric acid.

Answer:

$$S + \underset{\text{(Hot and conc.)}}{6HNO_3} \longrightarrow H_2SO_4 + 2H_2O + 6NO_2$$

Question 2.
Dilute nitric acid is generally considered a typical acid except for its reaction with metals. In what way is dilute nitric acid different from other acids when it reacts with metals.

Answer:
Metals, lying above hydrogen in the electro chemical series, give hydrogen from the acid. In case of nitric acid which is a strong oxidising agent, hydrogen

produced in the nascent state reduces excess nitric acid and produces water and a reduction productof nitric acid. The reduction product depends on the dilution of the acid.

Question 3.
Write the equation for the reaction of dilute nitric acid with copper.

Answer:
$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$

Question 4.
State why a yellow colour that appears in concentrated nitric acid when it is left standing in an ordinary glass bottle.
Ans.
It turns yellow because cone. HNO_3 decomposes by the action of sunlight to give brown coloured NO_2

$$4HNO_3 \xrightarrow{\text{Sunlight}} 4NO_2 + 2H_2O + O_2$$

The brown coloured NO_2 dissolves in cone. HNO_3, to give it a yellow colour.

2006

Question 1.
From the substances – Ammonium sulphate, Lead carbonate, Chlorine, Copper nitrate, Ferrous sulphate — State:
A compound which releases a reddish brown gas on reaction with concentrated sulphuric acid and copper turnings.

Answer:
Copper Nitrate.

Question 2.
State what is observed when nitric acid is kept in a reagent bottle for a long time.

Answer:
Brown vapours are seen in the reagent bottle and nitric acid turns yellowish in colour.

Question 3.
Explain why only all-glass apparatus should be used for the preparation of nitric acid by heating concentrated sulphuric acid and potassium nitrate.

Answer:
Nitric acid is highly corrossive and a strong oxidising agent. It attacks rubber and wooden corks. Therefore, all glass apparatus should be used for the preparation of nitric acid in the laboratory.

2007

Question 1.
In the laboratory preparation of nitric acid: Name the reactants A (a liquid) and B (a solid) used.

Answer:
(A) Cone, sulphuric acid **(B)** Potassium nitrate (Nitre)

Question 2.
Write an equation to show how nitric acid undergoes decomposition.

Answer:
$$4HNO_3 \xrightarrow{\text{Sunlight}} 4NO_2 + 2H_2O + O_2$$

Question 3.
Write the equation for the reaction in which copper is oxidized by concentrated nitric acid.

Answer:
$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

2008

Question 4.
Identify the following substances: a dilute acid B which does not normally give hydrogen when reacted with metals but does give a gas when it reacts with copper.

Answer:
HNO_3 (Nitric acid)

Question 2.
Copy and complete the following table relating to an important industrial process. Output refers to the product of the process not the intermediate steps.

Name of process	Inputs	Catalyst	Equation for catalyzed reaction	Output
	Ammonia + air			Nitric acid

Answer:

Name of process	Inputs	Catalyst catalysed	Equation for reaction	Output
Ostwald's process	Ammonia + air	Platinum	$4NH_3 + 5O_2 \xrightarrow[800^\circ C]{pt.} 4NO + 6H_2O$ + heat	Nitric acid

...

Question 3.
What is the property of nitric acid which allows it to react with copper ?

Answer:
Nitric acid works as an oxidising agent.

Question 4.
Write the equations for the following reactions: Dilute nitric acid and copper.

Answer:

$$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

Copper Dil.nitric acid Copper nitrate Nitrogen monoxide

2009

Question 1.
Name the gas evolved (formula is not acceptable). The gas produced by the action of dilute nitric acid on copper.

Answer:
Nitric oxide (NO)

Question 2.
Match each substance A to E listed below with the appropriate description given below.|

(A) Sulphur
(B) Silver chloride
(C) Hydrogen chloride
(D) Copper (II) sulphate
(E) Graphite.
A non-metal which reacts with concentrated nitric acid to form its own acid as one of the product.

Question 3.
Correct the following statements.Copper reacts with nitric acid to produce nitrogen dioxide.

Answer:
Copper reacts with concentrated nitric acid to produce nitrogen dioxide.

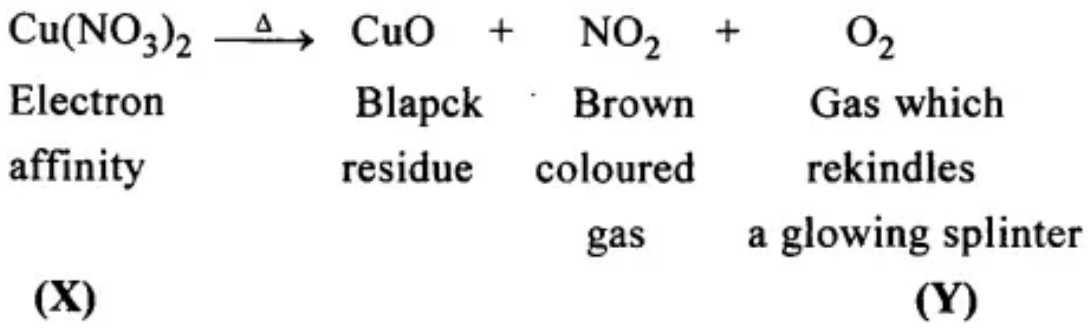
2010

Question 1.
Select the correct answer from A, B, C D and E

(A) Nitroso Iron (II) sulphate
(B) Iron (III) chloride
(C) Chromium sulphate
(D) Lead (II) chloride
(E) Sodium chloride.
The compound which is responsible for the brown ring in the brown ring test for identify the nitrate ion.

Question 2.
A blue crystalline solid X on heating gave a reddish brown gas Y, a gas which re-lights a glowing splint and a residue is black Identify X, Y and write the equation for the action of heat on X.

Answer:



(1) **X** = Copper nitrate [$Cu(NO_3)_2$]
Y = Nitrogen gas (NO_2)
(2) $Cu(NO_3)_2 \xrightarrow{\Delta} CuO + NO_2 + O_2$
(3) $Cu(NO_3)_2 + H_2S \rightarrow CuS \downarrow + 2HNO_3$

2011

Question 1.
Choose from the list substances – Acetylence gas, aqua fortis, coke, brass, barium chloride, bronze, platinum. A catalyst used in the manufacture of nitric acid by Ostwald's process.

Answer:
Platinum

Question 2.
State your observation when copper is heated with concentrated nitric acid in a hard glass test tube.

Answer:
At once reddish brown fumes of nitrogen dioxide gas are evolved. Gradually the copper dissolves in dilute nitric acid to form greenish blue solution of copper (II) oxide.

$$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + NO_2 \uparrow$$

Reddish brown gas

Question 3.
Choose the correct answer from the choices given – The brown ring test is used for detection of:
(A) $C0^{2-}_3$
(B) NO^-_3
(c) SO^{2-}_3
(D) cl-

Question 4.
(1) State the special feature of the apparatus used in the laboratory preparation of nitric acid?
(2) State why the temperature of the reaction mixture of HNO_3 is not allowed to rise above 200°C.

Answer:

1. All glass apparatus is used because the vapours of nitric acid are corrosive and destroy materials like rubber and cork.
2. The reaction mixture is not heated beyond 200 °C because at higher temperature:

   The nitric acid would decompose:
   $4\ HNO_3 \rightarrow 4NO_2 \uparrow + 2H_2O + O_2 \uparrow$
   The residue, sodium sulphate or potassium sulphate, forms a hard crust that sticks to the glass. Hence, its removal becomes difficult.

Question 5.
Write a balanced equation for – Ferric hydroxide reacts with nitric acid.
Ans.
$Fe(OH)_3 + 3HNO_3 \rightarrow Fe(NO_3)_3 + 3H_2O$

2012

Question 1.
Name the gas produced when copper reacts with concentrated nitric acid.

Answer:
Nitrogen dioxide.

Question 2.
State one observation for the following: Zinc nitrate crystals are strongly heated.

Answer:
Reddish brown gas is liberated residue is yellow when hot and white when cold.

Question 3.
Rewrite the correct statement with the missing word/s: Magnesium reacts with nitric acid to liberate hydrogen gas.

Answer:
With very dilute nitric acid.

Question 4.
Give reasons for the following: Iron is rendered passive with fuming nitric acid.

Answer:
Iron forms coating of its oxide and nitrate which stops further reaction.

Question 5.
Give a balanced equation for the reactions: Dilute nitric acid and Copper carbonate.

Answer:
$CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O + CO_2$

2013

Question 1.
Identify the gas evolved when:

1. Sulphur is treated with concentrated nitric acid.
2. A few crystals of KNO_3 are heated in a hard glass test tube.

Answer:

1. Nitrogen dioxide gas
2. Oxygen gas

Question 2.
State two relevant observations for : Lead nitrate crystals are heated in a hard

glass test tube.

Answer:

1. Brown coloured pungent smelling gas – nitrogen dioxide (NO_2) is produced.
2. Buff coloured residue of PbO is obtained in the test tube.
3. Oxygen produced relits a glowing splinter.

Question 3.
Give balanced equations for: Oxidation of carbon with concentrated nitric acid.

Answer:
$C + 4HNO_3 \rightarrow 2H_2O + 4NO_2 + CO_2$

2014

1. Fill in the blank from the choices given in the bracket:

Question 1.
Cold, dil. nitric acid reacts with copper to form_____(Hydrogen, nitrogen dioxide, nitric oxide).

Answer:
Cold, dilute nitric acid reacts with copper to form **nitric oxide.** }

Question 2.
Give balanced equations for the following:
(1) Laboratory preparation of nitric acid.
(2) Action of heat on a mixture of copper and concentrated nitric acid.

Answer:

1. Laboratory preparation of nitric acid.
2. Action of heat on a mixture of copper and concentrated nitric acid.
   $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO$

2015

Question 1.
State one appropriate observation for — When crystals of copper nitrate are heated in a test tube.

Answer:
The greenish blue crystals of copper nitrate will change to black residue of copper oxide and give reddish brown gas i.e., nitrogen dioxide on heating.

Question 2.
Identify the acid — The acid which is prepared by catalytic oxidation of ammonia.

Answer:
Nitric acid

Question 3.

Explain the following:

1. Dil. $HN0_3$ is generally considered a typical acid but not so in its reaction with metals.
2. When it is left standing in a glass bottle, concentrated nitric add appears yellow.
3. In the laboratory preparation of nitric acid, an all glass apparatus is used.

Answer:

1. It is because it does not liberate hydrogen gas when treated with metals. Instead it liberates oxides of nitrogen, such as nitric oxide, nitrogen dioxide, etc., as it is very powerful oxidising agent.
2. Cone. Nitric acid on exposure to sunlight, slowly decomposes to form nitrogen dioxide gas which is reddish brown in color/. Nitrogen dioxide gas redissolves in the nitric acid and imparts it yellow colour.
3. Nitric acid is a powerful oxidising agent and hence corrodes rubber or any other stoppers to avoid corrosion, we use all glass apparatus.

Question 4.
From the list of the following salts —
AgCl, $MgCl_2$, $NaHSO_4$, $PbCO_3$, $ZnCO_3$, KNO_3, $Ca(NO_3)_2$ State the salt which on heating, evolves a brown coloured gas.

Answer:
On heating this salt, a brown-coloured gas is evolved is $Ca(NO_3)_2$

2016

Question 1.
Write balanced chemical equation for: Action of hot and concentrated nitric acid on copper.

Answer:
$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2 \uparrow$

Question 2.
Fill in the blanks using the appropriate words given in the bracket below:
(sulphur dioxide, nitrogen dioxide, nitric oxide, sulphuric acid)

1. Cold, dilute, nitric acid reacts with copper to given **nitric oxide.**

2. Hot, concentrated nitric acid reacts with sulphur to form **sulphuric acid.**

2017

Question 1.
Write the balanced chemical equation for –

1. Action of cold and dilute nitric acid on copper,
2. Action of cone. nitric acid on sulphur.
3. Laboratory preparation of ni- trie acid.

Answer:

1. $3Cu + 8HNO_3$ (dil.) $\rightarrow 3Cu(NO_3)_2 + 2NO(g) + 4H_2O$
2. $S + 6HNO_3$(conc.) $\rightarrow H_2SO_4 + 2H_2O + 6NO_2$ (g)
3. $NaNO_3(s) + H_2SO_{4(conc.)} \xrightarrow{\text{below } 200^\circ C} NaHSO_4 + HNO_3$

ADDITIONAL QUESTIONS

Question 1.
State how atmospheric nitrogen converts itself to nitric acid.

Ans.

1. 1. During lightning discharge, nitrogen in the atmosphere reacts with oxygen to form nitric oxide and further to nitrogen dioxide.
   2. The nitrogen dioxide dissolves in atmospheric moisture forming nitric acid.

   $N_2 + O_2 \xrightarrow[\text{discharge}]{\text{lightning}} 2NO$

   $2NO + O_2 \rightarrow 2NO_2$
   $4NO_3 + 2HO + O_2 \rightarrow 4\ HNO_3$ (acid Rain)

Question 2.
Give a word equation and balanced molecular equation for the laboratory preparation of nitric acid from (1) $KN0_3$ (2) $NaNO_3$.

Answer:
(1)

Potassium Nitrate + Sulphuric acid (conc.) $\xrightarrow{<200^\circ C}$ Potassium bisulphate + Nitric acid

$KNO_3 + H_2SO_4$ (conc.) $\xrightarrow{<200^\circ C} KHSO_4 + HNO_3$

(2)
Sodium Nitrate + Sulphuric acid (conc.) Sodium Bisuiphate + Nitric acid
$NaNO_3 + H_2S0_4$ (conc.) $NaHSO_4 + HNO_3$

Question 3.
In the laboratory preparation of nitric acid from – KNO_3 or $NaNO_3$ State

1. The acid used
2. The type of apparatus used
3. The precautions to be taken during the preparation
4. The method of collection of the acid
5. The method of identification of the product i.e. acid formed.

Answer:

1. Cone, sulphuric acid
2. Glass retort
3. **Precautions are:**
    - Use all glass apparatus with no wooden or rubber cork.
    - Control the temperature carefully at nearly 200 °C.
4. Concentrated nitric acid vapours – condense and are collected in the water-cooled receiver.
5. The vapours obtained in the receiver on heating alone or with copper turnings evolve – reddish brown fumes of nitrogen dioxide which turns acidified ferrous sulphate solution brown – proving that the vapours are of nitric acid.

Question 4.
Give reasons for the following – pertaining to the above laboratory preparation of nitric acid

Question 4(1).
concentrated hydrochloric acid is not used as a reactant in the laboratory preparation.

Answer:
Cone. HCl is not used as a reactant in the laboratory preparation of nitric acid. It is due to the following reasons:

1. HCl is a volatile acid.
2. HNO_3, if formed, will oxidise HCl to Cl,. In the process, HNO_3 will get reduced to NO or NO,. This very little yield, if any, of HNO, will be obtained and that too will be contaminated with HCl.

Question 4(2).
The complete apparatus in the laboratory preparation does not contain parts made of rubber or cork.

Answer:
The complete apparatus is made of glass only – since the vapours of nitric acid being highly corrosive and attack rubber, cork, etc.

Question 4(3).
The reaction temperature is maintained below 200°C

Answer:
The reaction temperature is maintained below 200°C. This is because at higher temperatures, HNO_3decomposes to give NO_2. The brown coloured NO_2 dissolves in HNO_3 to give it a yellow colour. Thus, if the temperature is allowed to go beyond 200°C, the product (HNO_3) obtained is not pure (colourless).

Question 4(3).
At high temperatures the sodium sulphate or phtassium sulphate formed, forms a crust and sticks to the glass apparatus.

Answer:
Formation of a hard residual crust of the corresponding sulphate [Na_2SO_4 or K_2SO_4] which being a -poor conductor of heat, sticks to the glass and cannot be easily removed from the apparatus.

Question 5.
State the colour of
(1) pure nitric acid
(2) nitric acid obtained in the laboratory
(3) nitric acid obtained in the laboratory after passage of air or addition of water to it.

Answer:

1. Pure nitric acid is colourless.
2. Nitric acid obtained in laboratory is pale yellow in colour.
3. The pale yellow colour of nitric acid disappears and hence it becomes colourless.

Question 6.
State which reaction of ammonia forms the first step of Ostwald's process.

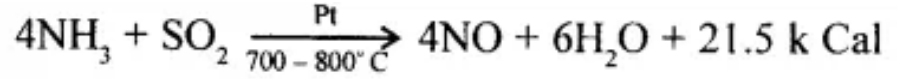
Answer:
The first step of Ostwald's process involves catalytic oxidation of ammonia to nitric oxide and water (steam).

$$4NH_3 + SO_2 \xrightarrow[700-800^\circ C]{Pt} 4NO + 6H_2O + 21.5 \text{ k Cal}$$

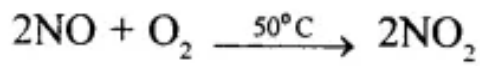
Question 7.
Convert ammonia to nitric acid by the above process giving all conditions.

Answer:

Step I



Step II



Step III

$4NO_2 + 2H_2O \rightarrow 4HNO_3$

Question 8.
State how —

1. a higher ratio of the reactant air
2. exothermicity of the catalytic reaction
3. use of low temp, in the conversion of NO to NO_2 – affects each related step in Ostwald's process.

Answer:

1. Excess of air carries the reactions in forward direction as oxygen is needed in all the three reactions, leading to the formation of nitric acid.
2. The exothermicity of catalytic reaction helps in stopping external heating, there by saving on energy.
3. Low temperature (less than 50°C)

Question 9.
State why nitric acid

1. Stains the skin
2. Cannot be concentrated beyond 68% by boiling.

Answer:

1. Nitric acid combines with protein of the skin forming a yellow compound Xanthoproteic acid, stains skin yellow.
2. It is because at 68% concentration it forms a constant boiling mixture, i.e., if heated beyond this concentration then proportion of water vapour and nitric acid vapour, leaving the dilute acid does not change. Thus, it cannot be concentrated by boiling.

Question 10.
State two conditions which affect the decomposition of nitric acid.

Answer:
The conditions which affect the decomposition of nitric acid are:

1. Presence of sunlight
2. Higher temperature.

Question 11.
State the change in colour of pure concentrated nitric acid on initial and prolonged decomposition.

Answer:
Yellowish brown colour is changed to dark yellowish brown colour on prolonged decomposition.

Question 12.
State the cation responsible for turning moist neutral litmus red on reaction with dil. HNO_3.

Answer:
Hydrogen $|H^+|$ ions and Nitrate ions.

Question 13.
State why nitric acid is a strong oxidising agent and yields varying products such as NO, NO_2 on reaction with metals,non-metals etc.

Answer:
The oxidising property of nitric acid is based on the fact that when nitric acid undergoes decomposition, it yields nascent oxygen, which is very reactive.
$2HNO_3$ (cone.) $\rightarrow H_2O + 2NO_2 + [O]$
$2HNO_3$ (dil.) $\rightarrow H_2O + 2NO + 3[O]$

This nascent oxygen oxidises metals, non-metals, organic and inorganic compounds. During the process, nitric acid itself gets reduced to various products (NO, NO_2, N_2O, NH_3, etc.) depending upon the concentration of the acid, reaction temperature and activity of the metal with which it is reacting.

Question 14.
Give an equation for reaction of cone. HNO_3 with
(1) carbon
(2) copper.

Answer:

1. $C + 4HNO_s \rightarrow CO_2 + 2H_2O + 4NO_2$
2. $3Cu + 8HNO_3 \rightarrow 3Cu\ (NO_3)_2 + 4H_2O + 2NO$

Question 15.
Convert nitric acid to sulphuric acid using a non-metal.

Answer:
$S + 6HNO_3 \rightarrow H_2SO_4 + 2H_2O + 6NO_2$

Question 16.
State how you would obtain
(1) Hydrogen
(2) Nitric oxide
(3) Nascent chlorine – from nitric acid. State the concentration of nitric acid used in each case.

Ans.

1. **Hydrogen from nitric acid:** Cold, very dilute (1%) nitric acid reacts with metals like Mg and Mn to give H_2.
   $$Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$$
   (1% dil. acid)
2. **Nitric oxide from nitric acid:** Dilute nitric acid reacts with metals like Cu, Ag to give nitric oxide (NO).
   $$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 4H_2 + 2NO$$
   (dil. and cold)
3. **Nascent chlorine from nitric oxide:** A mixture of cone, nitric acid (I part) and cone, hydrochloric acid (III parts) (by volume) reacts with noble metals like gold and platinum. In this reaction, nascent chlorine is formed as an intermediate.
   HNO_3 (cone.) + 3HCl (cone.) $\rightarrow 2H_2O + NOCL + 2|Cl|$

Question 17.
State why hydrogen is liberated when zinc reacts with dil.HCl but not with dil. HNO_3.

Answer:
Zinc displace hydrogen from dil. HCl.
$Zn + 2HCl(dil.) \rightarrow ZnCl_2 + H_2$
However, when zinc reacts with dil HNO_3, no hydrogen is obtained. This is because nitric acid is a strong oxidising agent. Nitric acid oxidises the hydrogen produced to water and hence no hydrogen is liberated.

Question 18.
State a reason for the inactivity of iron and aluminium on reaction with fuming HNO_3.

Answer:
Pure or fuming nitric acid renders metals like iron (Fe) and Al- passive i. e., inactive. This is due to the formation of a thin oxide coating on the surface of the metal which prevents further action.

Question 19.
State your observation when
(1) nitric acid is added to saw dust
(2) cone, nitric acid is heated
(a) in absence of copper
(b) in presence of copper.

Answer:

1. Nitric acid being a strong oxidising agent decomposes to give nascent oxygen, which being very reactive, oxidises organic compounds to carbon dioxide and water. Saw dust is organic in nature. When hot cone. HNO_3 is poured over saw dust, it burst into flames due to oxidation.
2. **(a)**
   When cone. HNO, is heated, it decomposes to give brown coloured pungent smelling gas nitrogen dioxide (NO_2).
   $4HNO_3(conc.) \xrightarrow{heat} 2H_2O + 4NO_2 + O_2$ **(b)**
   (b) When. "cone. HNO_3 is heated in the presence of copper, brown coloured, pungent smelling NO_2 is formed alongwith blue coloured copper nitrate.
   $Cu + 4HNO(cone.) \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

Question 20.
State how addition of nitric acid to acidified FeSO, serves as a test for the former.

Answer:
Nitric acid oxidises iron(II) sulphate to iron (III) sulphate with the liberation of nitric oxide gas.
$6FeSO_4 + 3H_2SO_4 + 2HNO_3$ (dil.) $\rightarrow 3Fe_2(SO_4)_3 + 4H_2O + 2NO$
The nitric oxide so formed reacts wtih more of iron(II) sulphate to form nitrosoferrous sulphate, which appears in the form of brown ring at the junction of liquids.
$FeSO_4 + NO \rightarrow FeSO_4.NO$

Question 21.
Name three chemical products manufactured from nitric acid. Give two general uses of HNO3.

Answer:

1. Three chemical products manufactured from nitric acid. Explosives (T.N.T., picric acid, nitrocellulose etc.)
2. Fertilizers (Ammonium nitrate, calcium ammonium nitrate or C.A.N.)
3. Dyes (Picric acid and other nitro dyes)

   Two general uses of nitric acid

   1. For refinning of noble metals like gold, platinum etc.
   2. For etching on stainless steel.

UNIT TEST PAPER 7C — NITRIC ACID

Question 1.
Select the letters A, B, C, D or E, which form the gaseous products of the reactions from 1 to 5.

A: Nitrogen dioxide only
B: Nitric oxide only
C: Hydrogen
D: Nitrogen dioxide and oxygen
E: Nitrogen dioxide and carbon dioxide.

1. Reaction of manganese with cold very dil. nitric acid.
2. Reaction of sulphur with cone, nitric acid.
3. Reaction of zinc with dil. nitric acid.
4. Reaction of carbon with cone, nitric acid.
5. Heat on nitric acid.

Answer:

1. **(C)** Hydrogen
2. **(A)** Nitrogen dioxide only
3. **(B)** Nitric oxide only
4. **(E)** Nitrogen dioxide and carbon dioxide.
5. **(D)** Nitrogen dioxide and oxygen.

Question 2.
Select the correct word from the list in bracket to complete each statement.

1. The oxidised product obtained on reaction of H_2S ghs with dil. HNO_3 is …… (sulphur dioxide / sulphur / sulphuric acid).
   Ans. sulphur

1. Aqua regia is a mixture of one part of…… and three parts of…… (cone, hydrochloric acid/conc. nitric acid) in which nitric acid…….. (reduces/oxidises) hydrochloric acid to chlorine.
   Ans. cone, nitric acid, cone, hydrochloric acid, oxidises

1. Pure cone, nitric acid or fuming nitric acid renders the metal……. (zinc/copper/iron) passive or inactive.
   Ans. Iron

1. A mineral acid obtained from cone, nitric acid on reaction with a non-metal is…….. (hydrochloric acid / sulphuric acid / carbonic acid).
   Ans. sulphuric acid

1. The reaction of…….. (calcium carbonate / calcium oxide/ calcium sulphite) with dilute nitric acid is an example of a neutralization reaction.
   Ans. calcium oxide

Question 3.
Give balanced equations for the following conversions A to E.

1. Copper $\xrightarrow{A}$ Copper nitrate $\xrightarrow{B}$ Copper oxide $\xrightarrow{C}$ Copper

2. Sulphur $\xrightarrow{D}$ Sulphuric acid (using an acid) $\xleftarrow{E}$ Sulphur dioxide

Answer:
1. A: $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO$

B: $2Cu(NO_3)_2 \xrightarrow{heat} 2CuO + O_2 + 4NO_2$

C : $CuO + C \xrightarrow{heat} Cu + CO$

2. D : $S + 6HNO_3 \rightarrow H_2SO_4 + 2H_2O + 6NO_2$

E : $3SO_2 + 2H_2O + 2HNO_3 \rightarrow 3H_2SO_4 + 2NO$

Question 4.
Name the oxidised product when the following 1 to 5 react with nitric acid

1. Sulphur (with cone, acid)
2. Zinc (with dil. acid)
3. Aqueous soln. of SO_2 (with dil. acid)
4. Acidified iron (II) sulphate (with dil. acid)
5. Carbon (with cone, acid)

Answer:
1. H_2SO_4
2. $Zn(NO_3)_2$
3. H_2SO_4
4. $Fe_2(SO_4)_3$ CO_2

Question 5.
Give reasons for the following:

1. Nitric acid is not manufactured from atmospheric nitrogen.
   Ans. Direct conversion of atmospheric N_2 into HNO_3 is highly energy intensive process and hence very expensive.

1. Nitric acid affects the skin if it accidently falls on it, staining the skin yellow.
   Ans. Nitric acid has an extremely corrosive action on the skin – and causes painful blisters. It combines with the protein of the skin forming a yellow compound xanthoproteic acid and hence stains the skin yellow.

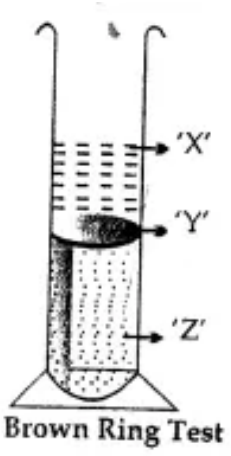
1. The yellow colour of nitric acid obtained in the laboratory is removed by babbling air through it.
   Ans. Yellow colour of the nitric acid is due to dissolved NO_2. On bubbling air through it the NO_2 is oxidised to HNO_3 and the yellow colour of the acid disappears.

1. Nitric acid finds application in the purification of gold.
   Ans. Nitric acid is used for purification of gold because it can dissolve away all impurities of baser metals (Ag, Cu, etc.), leaving behing pure gold.

1. Nitric acid is a stronger oxidising agent in the cone, state of the acid than in the dilute state.
   Ans. Cone. HNO_3 is a stronger oxidising agent than dil HNO_3. It is due to the ease with which cone. HNO_3 decomposes to give nascent oxygen, which acts as a powerful oxidising agent.

Question 6.

Answer the following questions pertaining to the brown ring test for nitric acid:



Brown Ring Test

1. Name the chemical constituent of the brown ring 'Y'.
   Ans. $FeSO_4.NO$

1. Which of the two solutions – iron (II) sulphate or cone, sulphuric acid, do 'X' and 'Z' represent.

Ans. X-$FeSO_4$ Z-H_2SO_4

2. State why the unstable brown ring decomposes completely on disturbing.
   Ans. When test tube is disturbed, cone. H_2SO_4 mixes with water (in Fe_2SO_4 solution). Dilution of cone. H_2SO_4 with water is an exothermic process. The heat so produced assists in the decomposition of unstable brown ring.

1. Give a reason why the brown ring does not settle down at the bottom of the test tube.
   Ans. Cone. H_2SO_4), (density 1.98) is twice as heavy as water (density : 1). As such cone. H_2SO_4 settles down and iron(II) sulphate layer remains alone it resulting in the formation of brown ring at the junction.

1. Name the gas evolved when acidified iron (II) sulphate reacts with dilute nitric acid in the brown ring test.
   Ans. Nitric oxide (NO)

SOMETHING MORE TO DO

Question 1.
Perform ring test in the laboratory in the presence of your teacher.

Answer:
Brown ring test: Procedure – Take a solution of – a nitrate or dilute nitric acid in a test tube.
Add to it – a freshly prepared saturated solution of iron [II] sulphate.
Add – cone, sulphuric acid carefully from the sides of the test tube.

Sulphuric Acid

QUESTIONS
2000

Question 1.
What do you see when concentrated sulphuric acid is added to copper sulphate 5-water.

Answer:
The colour of blue crystal of $CuSO_4.5H_2O$ changes to white amorphous as the compound loses its water of crystallisation.

$$CuSO_4.5H_2O \xrightarrow{\text{Conc. } H_2SO_4} CuSO_4 + 5H_2O$$

Question 2.
Name one catalyst used industrially which speeds up the conversion of SO_2 to SO_3 in the production of sulphuric acid in the laboratory or industrially. Write the equation for the conversion of sulphur dioxide to sulphur trioxide. Why does this reaction supply energy. What is the name of the compound formed between SO_4 and sulphuric acid.

Answer:
V_2O_5; It is exothermic reaction ; oleum.

2001

Question 1.
Write equations for:

1. H_2SO_4 – producing H_2,
2. Between $Pb(NO_3)_2$ and dil. H_2SO_4.

Answer:

1. $Zn + H_2SO_4(dil.) \rightarrow ZnSO_4 + H_2$
2. $Pb(NO_3)_2 + H_2SO_4 (dil.) \rightarrow PbSO_4 \downarrow + 2HNO_3$

Question 2.
Explain how a reagent chosen from: ammonium hydroxide, barium chloride, sodium chloride, sodium hydroxide, sulphuric acid and nitric acid enables to distinguish between the two acids mentioned there in.

Answer:
Barium chloride can be used to distinguish between sulphuric acid and nitric acid. Out of these two acids only sulphuric acid gives a white precipitate with barium chloride solution.

2002

Question 1.
State the substance/s reacted with dilute or concentrated sulphuric acid to form the following gases:

1. Hydrogen
2. Carbon dioxide.

State whether the acid used in each case is dilute or concentrated.

Answer:
(1) Zinc (or any other reactive metal) reacts with dil. H_2SO_4 to give hydrogen.
$Zn\ (s) + H_2SO_4\ (aq.) \rightarrow ZnSO_4\ (aq.) + H_2(g)$

(2) Sodium carbonate reacts with dil. H_2S0_4 to give $C0_2$
$Na_2C0_3(s) + H_2SO_4(aq.) \rightarrow Na_2SO_4(aq.) + H_2O(l) + CO_2(g)$
The above reaction can also be carried out with $NaHCO_3$ (sodium bicarbonate) or $KHCO_3$ (potassium bicarbonate)

Question 2.
Write the equations for the laboratory preparation of:

1. Sodium sulphate (Na_2SO_4) using dil. H_2SO_4,
2. Lead sulphate ($PbSO_4$) using dil. H_2SO_4.

Answer:

1. $2NaOH + H_2SO_4\ (dil) \rightarrow Na_2SO_4 + 2H_2O$
2. $Pb(NO_3)_2 + H_2SO_4\ (dil) \rightarrow PbSO_4 + 2HNO_3$

2003

Question 1.
State the name of the process by which H_2SO_4 is manufactured. Name the catalyst used.

Answer:
By Contact process — vanadium pentoxide (V_2O_5)

Question 2.
"Concentrated sulphuric acid is used in the laboratory preparation of nitric acid and hydrochloric acid because it is……. (less volatile / stronger) in comparison to these two acids."
Answer:
Less volatile

Question 3.
Write the equations for the laboratory preparation of the following salts

using sulphuric acid:

1. Copper sulphate from copper
2. Lead sulphate from lead nitrate

Answer:

1. $Cu + 2H_2SO_4$ (dil) $\rightarrow CuSO_4 + SO_2 + H_2O$
2. $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$

2004

Question 1.
Name the catalyst which helps in the conversion of sulphur dioxide to sulphur trioxide.

Answer:
Platinum or Vanadium pentoxide.

Question 2.
In the Contact process, sulphur trioxide is not converted to sulphuric acid by reacting it with water. Instead a two- step procedure is used. Write the equations for the two steps involved.

Answer:
The equations for the two steps involved are:

$$\underset{\text{Sulphur trioxide}}{SO_3} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

$$\underset{\text{Oleum}}{H_2S_2O_7} + \underset{\text{Water}}{H_2O} \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$

2005

Question 1.
Write balanced equations for the following:

1. Potassium hydrogen carbonate and dilute sulphuric acid.
2. Sodium nitrate and concentrated sulphuric acid.

Answer:

1. $2KHCO. + H_2SO_4$ (dil) $\rightarrow K_2SO_4 + 2H_2O + 2CO_2$
2. $2NaN0_3 + H_2S0_4$ (cone) $\rightarrow Na_2S0_4 + 2HNO_3$

Question 2.
Choose the property of sulphuric acid (A, B, C or D), which is relevant to each of the preparations
(1) to (2) : A: dil. acid (typical acid properties), B: Non-volatile acid, C: Oxidizing

agent, D: Dehydrating agent. Preparation of
(1) HCl
(2) ethene from ethanol
(3) copper sulphate from copper oxide.

Answer:

1. Non volatile acid (B)
2. Dehydrating agent (D)
3. dil. acid (A)

2006

Question 1.
Name the process used for the large scale manufacture of sulphuric acid.
Answer:
Contact process.

Question 2.
Which property of sulphuric acid accounts for its use as a dehydrating agent.

Answer:
Sulphuric acid removes water of crystallization.

Question 3.
H_2SO_4 is an oxidizing agent and a non volatile acid. Write an equation for each property.

Answer:

1. **Sulphuric acid as an Oxidising agent —**
   $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$
2. **Sulphuric acid as an Non-volatile acid —**

$$NaCl + H_2SO_4 \text{ (conc.)} \xrightarrow{< 200^\circ C} NaHSO_4 + HCl$$

Question 4.
Select the correct compound from the list — Ammonia, Copper oxide, Copper sulphate, Hydrogen chloride, Hydrogen sulphide, Lead bromide — This compound smells of rotten eggs.

Answer:
Hydrogen sulphide.

2007

Question 1.
Write balanced equation for the following reactions:

1. Lead sulphate from lead nitrate solution and dilute sulphuric acid.

2. Copper sulphate from copper and cone, sulphuric acid.

Answer:

1. $Pb(NO_3)_2 + H_2SO_4$ (dil) $\rightarrow PbSO_4 + 2HNO_3$
2. $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$
   (Cone)

Question 2.
Properties of H_2SO_4 are listed below. Choose the property A, B, C or D which is responsible for the reactions (i) to (v). A : Acid B: Dehydrating agent C: Nonvolatile acid D: Oxidizing agent

1. $C_{12}H_{12}O_{11} + nH_2SO_4 \rightarrow 12C + 11H_20 + nH_2SO_4$,
2. $S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$,
3. $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$,
4. $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$
5. $Na_2CO_3 + H_2SO_4$ $Na_2SO_4 + H_2O + CO_2$
   (Some properties may be repeated)

Answer:
(1) B **(2)** D **(3)** C **(4)** A **(5)** A

Question 3.
Dilute hydrochloric acid and dilute sulphuric acid are both colourless solutions. How will the addition of barium chloride solution to each help to distinguish between the two.

Answer:
Out of dilute hydrochloric acid and dilute sulphuric acid, Dilute hydrochloric acid will give a white ppt. of barium sulphate($BaSO_4$) with barium chloride solution.
H_2S0_4 (dil.) + $BaCl_2$ (aq.) $\rightarrow BaSO_4$ (s) + 2HCl
HCl(aq.) + $BaCl_2$ (aq.) $\rightarrow$ No reaction

Question 4.
From HCl, HNO_s, H_2SO_4, state which has the highest boiling point and which has the lowest.

Answer:
H_2SO_4 [358°C] has highest boiling point. HCl [-85°C] has lowest boiling point.

2008

Question 1.
Dilute sulphuric acid will produce a white precipitate when added to a solution of:
A.Copper nitrate
B. Zinc nitrate

C. Lead nitrate
D. Sodium nitrate

Question 2.
Identify the following substances :Liquid E can be dehydrated to product ethene.

Answer:
C_2H_5OH (Ethanol)

Question 3.
Copy and complete the following table relating to an important industrial processes and its final. Output refers to the product of the process not the intermediate steps.

Name of process	Inputs	Catalyst	Equation for catalysed reaction	Output
Contact Process	Sulphur dioxide + oxygen			

Answer:

Name of process	Inputs	Catalyst	Equation for catalysed reaction	Output
Contact process	Sulphur dioxide + oxygen	Vanadium pentoxide	$2SO_2 + O_2 \xrightleftharpoons[V_2O_5/K_2O]{450^\circ C} 2SO_3$	sulphuric trioxide

Question 4.
Making use only of substances given: dil. sulphuric acid, Sodium carbonate, Zinc, Sodium sulphite, Lead, Calcium carbonate: Give eqautions for the reactions by which you could obtain:
(1) hydrogen
(2) sulphur dioxide
(3) carbon dioxide
(4) zinc carbonate (2 steps)

Answer:

(1) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$

Zinc — Dil. sulphuric acid — Hydrogen

(2) $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + SO + H_2O$

Sodium Sulphite — dilute sulphuric acid — Sulphur dioxide

(3) $CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$

Calcium carbonate — Dilute sulphuric acid — Carbon dioxide

(4) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$

Zinc — Dil. sulphuric acid — zinc sulphate

$ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

Zinc sulphate — Sodium carbonate — Zinc carbonate

Question 5.

What property of cone. H_2SO_4 is used in the action when sugar turns black in its presence.

Answer:

Cone. Sulphuric acid is a dehydrating agent.

Question 6.

Write the equations for:

(1) dil. H_2SO_4 and barium chloride.

(2) dil. H_2SO_4 and sodium sulphide.

Answer:

$BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Barium chloride — Sulphuric acid — Barium sulphate

$Na_2S + H_2SO_4 \longrightarrow Na_2SO_4 + H_2S$

Sodium Sulphide — Sulphuric acid — Sodium Sulphate

Question 7.
Which property of cone. H_2SO_4 allows it to be used in the preparation of HCl and HNO3

Answer:
Non volatile acid.

2009

Question 1.
Name the gas evolved (formula is not acceptable). – The gas that can be oxidised to sulphur.

Answer:
Hydrogen sulphide (H_2S)

2010

Question 1.
Give the equation for:

1. Heat on sulphur with cone. H_2SO_4.
2. Reaction of – sugar with cone. H_2SO_4.

Answer:

1. Reaction of sulphur with cone. H_2SO_4
   $S + 2H_2SO_4$ (cone.) $\rightarrow 3SO_2 + 2H_2O$
2. Reaction of sugar with cone. H_2SO_4

$$C_{12}H_{22}O_{11} + H_2SO_4 \rightarrow 12C + 11H_2O$$

Sugar — Carbon — Water

Question 2.
Give a balanced equation for the conversion of zinc oxide to zinc sulphate.

Answer:

$$ZnO + H_2SO_4\ (dil.) \rightarrow ZnSO_4 + H_2O$$

zinc oxide — sulphuric acid — zinc sulphate — water

Question 3.
Select from A, B, C –
A: Sodium hydroxide solution.
B: A weak acid.
C: Dilute sulphuric acid.
The solution which liberates sulphur dioxide gas, from sodium sulphite.

2011

Question 1.
State your observation when – Sugar crystals are added to cone, sulphuric acid.

Answer:
A lot of effervescence takes place in the test tube. The test tube gets very hot. So in the end sugar crystals change in the black residue.

$$C_{12}H_{22}O_{11} \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Black residue}}{12C} + 11H_2O$$

Question 2.
Choose the correct answer from the choices – The gas evolved when dil. sulphuric acid reacts with iron sulphide.
(a) Hydrogen sulphide
(b) Sulphur dioxide
(c) Sulphur trioxide
(d) Vapour of sulphuric acid.

Question 3.
Give a balanced equation for – Dilute sulphuric acid is poured over sodium sulphite

Answer:
$Na_2SO_3 + H_2SO_4$ (dil.) $\rightarrow Na_2SO_4 + H_2O + SO_2 \uparrow$

Question 4.
With the help of balanced equations, outline the manufacture of sulphuric acid by the contact process.

Answer:
Contact process: Sulphur or Pyrite Burner
$S + O_2 \rightarrow SO_2$
Contact Tower

$$2SO_2 + O_2 \underset{V_2O_5 / K_2O}{\overset{450^\circ C}{\rightleftharpoons}} 2SO_3 \uparrow$$

Absorption Tower

$$SO_3 + H_2SO_4 \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

Dilution Tank
$H_2S_2O_7 + H_2O \rightarrow 2\ H_2SO_4$

Question 5.
State the property of sulphuric acid shown by the reaction of cone, sulphuric acid when heated with

(a) Potassium nitrate
(b) Carbon?

Answer:
(a) It behaves as a non volatile acid and helps in the production of a volatile acid.

$$KNO_3 + H_2SO_4 \xrightarrow{<200°C} NaHSO_4 + HNO_3$$

Non volatile acid — Voolatile acid

(b) It behaves as an oxidising agent and oxidises carbon to carbon dioxide
$C + 2H_2SO_4 \rightarrow CO_2 \uparrow + 2H_2O + 2SO_2 \uparrow$

2012

Question 1.
Name – The gas produced on reaction of dilute sulphuric acid with a metallic sulphide.

Answer:
Hydrogen sulphide (H_2S)

Question 2.
Some properties of sulphuric acid are listed below. Choose the role played by sulphuric acid – A, B, C, or D which is responsible for the reactions (i) to (v). Some role/s may be repeated.
A. Dilute acid
B. Dehydrating agent
C. Non-volatile acid
D. Oxidising agent

(1) $CuSO_4 \cdot 5H_2O \xrightarrow{\text{conc. } H_2SO_4} CuSO_4 + 5H_2O$

(2) $S + H_2SO_4 \text{ (conc)} \rightarrow 3SO_2 + 2H_2O$

(3) $NaNO_3 + H_2SO_4 \text{ (conc.)} \xrightarrow{<200°C} NaHSO_4 + HNO_3$

(4) $MgO + H_2SO_4 \rightarrow MgSO_4 + H_20$

(5) $Zn + 2H_2SO_4 \text{ (cone.)} \rightarrow ZnSO_4 + SO_2 + 2H_2O$

Answer:

1. B: Dehydrating agent
2. D: Oxidising agent
3. C: Non-volatile acid
4. A: Dilute acid
5. D: Oxidising agent

Question 3.
Give balanced equation for the reaction : Zinc sulphide and dilute sulphuric acid.

Answer:
$ZnS + H_2 SO_4$ (dil.) $\rightarrow ZnSO_4 + H_2S$

2013

Question 1.
State one appropriate observation for : Cone. H_2SO_4 is added to a crystal of hydrated copper sulphate.

Answer:
The blue coloured hydrated copper sulphate crystals disintegrate with a hissing sound, giving off steam and leaving behind white residue.

Question 2.
In the given equation $S + 2H_2SO_4 \rightarrow 3S0_2 + 2H_2O$: Identify the role played by cone. H_2S0_4 i.e.
(A) Non-volatile acid
(B) Oxidising agent
(C) Dehydrating agent
(D) None of the above.

Question 3.
Give a balanced equation for : Dehydration of concentrated sulphuric acid with sugar crystals.

Answer:
$$C_{12}H_{22}O_{11} \xrightarrow{\text{Conc. } H_2SO_4} 12C + 11H_2O$$

Question 4.
Identify the substance underlined: A dilute mineral acid which forms a white precipitate when treated with barium chloride solution.

Answer:.
Dilute sulphuric acid.

2014

Question 1.
Write balanced equations for the following: Action of concentrated sulphuric acid on carbon.

Answer:
Action of concentrated sulphuric acid on carbon.
$C + 2H_2SO \rightarrow CO_2 + 2H_20 + 2SO_2$

Question 2.
Distinguish between the following pairs of compounds using the test given within brackets:Dilute sulphuric acid and dilute hydrochloric acid (using barium chloride solution)

Answer:
Out of dilute H_2SO_4 and dilute HCl, only dilute H_2SO_4 gives white ppt. of $BaSO_4$ with barium chloride solution

$$BaCl_2 + H_2SO_4 \longrightarrow \underset{\text{White ppt.}}{BaSO_4\downarrow} + HCl$$

$BaCl_2$ + HCl → No ppt. formation

Question 3.
State – Any two conditions for the conversion of sulphur dioxide to sulphur trioxide.

Answer:

1. Two condition for the conversion of SO_2 to SO_3
2. The mixture of SO_2 gas and O_2 gas must be pure and dry and in the ratio of 2 : 1 by volume.
3. The mixture should be passed over platinised asbestos or vanadium pentaoxide maintained
   at 450 ° C.

Question 4.
Give one equation each to show the following properties of sulphuric acid:
(1) Dehydrating property.
(2) Acidic nature.
(3) As a non-volatile acid.

Answer:

1. Dehydrating property.
   $$HCOOH \xrightarrow{\text{Conc. } H_2SO_4} CO + H_2O$$
2. Acidic nature.
   $CuO + H_2S0_4 \rightarrow CuSO + H_2O$
3. As a non-volatile acid.
   $$NaCl + H_2SO_4\ (conc.) \xrightarrow[<200°C]{\text{heat}} NaHSO_4 + HCl$$

2015

Question 1.
Identify the acid in each case:

1. The acid which is used in the preparation of a nonvolatile acid.
2. The acid which produces sugar charcoal from sugar.
3. The acid on mixing with lead nitrate soln. produces a white ppt. which is insoluble even on heating.

Answer:

1. Nitric acid (cone.)
2. Cone, sulphuric acid
3. Dilute hydrochloric acid

Question 2.
Give equations for the action of sulphuric acid on —
(a) Potassium hydrogen carbonate.
(b) Sulphar

Answer:
(a) Action of sulphuric acid on potassium hydrogen carbonate
$2KHCO_3 + H_2SO_4 \rightarrow K_2SO_4 + 2H,O + 2CO_2 \uparrow$

(b) Action of sulphuric acid on sulphur
$S + 2H_2SO_4$ (cone.) $\rightarrow 3SO_2, + 2H_2O$

Question 3.
In the manufacture of sulphuric acid by the Contact process, give the equations for the conversion of sulphur trioxide to sulphuric acid.

Answer:
In the contact process for the manufacture of sulphuric acid, the equations for the conversion of sulphur trioxide to sulphuric acid are

$$SO_3 + H_2SO_4 \text{ (conc.)} \longrightarrow \underset{\text{(oleum or pyrosulphuric acid)}}{H_2S_2O_7}$$

$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

2016

Question 1.
Write balanced chemical equations for: Action of dilute Sulphuric acid on Sodium Sulphite.

Answer:
$Na_2SO_3 + H_2SO_4$(dil) $\rightarrow Na_2SO_4 + H_2O + SO_2\uparrow$

Question 2.
State your observations when:

1. Barium chloride soln. is mixed with sodium sulphate soln.
2. Concentrated sulphuric acid is added to sugar crystals.

Answer:
(1)

$$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 \downarrow + 2NaCl$$

(White precipitates)

When sodium sulphate is mixed with barium chloride. White coloured precipitates of Barium sulphate are formed.

(2)

$$C_{12}H_{22}O_{11}\,(s) \xrightarrow{Conc.H_2SO_4} 12C\,(s) + 11\,H_2O$$

(sugar charcoal
Black spongy mass)

When cone, sulphuric acid is added to sugar crystals black spongy mass (sugar charcoal) is formed.

Question 3.
A, B, C and D summarize the properties of sulphuric acid depending on whether it is dilute or concentrated.
A: Typical acid property
B: Non-volatile acid
C: Oxidizing agent
D: Dehydrating agent

Choose the property (A, B, C or D) depending on which is relevant to each of the following:

1. Preparation of hydrogen chloride gas.
2. Preparation of copper sulphate from copper oxide.
3. Action of cone, sulphuric acid on sulphur.

Answer:

1. Preparation of Hydrogen chloride gas.
   B: Non-volatile acid
2. Preparation of Copper sulphate from copper oxide.
   A: Typical acid property
3. Action of cone. Sulphuric acid on Sulphur.
   C: Oxidizing agent

2017

Question 1.
Write the balanced chemical equation for – Action of concentrated sulphuric acid on sulphur.

Answer:

$$S + 2H_2SO_4\,(conc.) \xrightarrow{heat} 2H_2O + 3SO_2$$

Question 2.
State one relevant observation for – Action of cone, sulphuric acid on hydrated copper sulphate.

Answer:
Blue coloured copper sulphate crystals crumble with a hissing sound and change to white powdery mass.

Question 3.
State – How will you distinguish between dilute hydrochloric acid and dilute sulphuric acid using lead nitrate solution.

Answer:
Hydrochloric acid forms a white precipitate with lead nitrate solution. This precipitate dissolves on warming the reaction mixture so as to form clear solution. Sulphuric acid forms a white precipitate with lead nitrate solution. This precipitate does not dissolve on warming the reaction mixture.

Question 4.
Write balanced chemical equations to show –

- The oxidizing action of cone, sulphuric acid on carbon.
- The behaviour of H_2SO_4 as an acid when it reacts with magnesium.
- The dehydrating property of cone, sulphuric acid with sugar.
- The conversion of SO_3 to sulphuric acid in the Contact process.

Answer:

1. $C + 2H_2SO_4$ (cone.) $\rightarrow CO_2 + 2SO_2 + 2H_2O$
2. $Mg + H_2SO_4$ (dil.) $\rightarrow MgSO_4 + H_2$ (g)
3. $C_{12}H_{22}O_{11} + 11\ H_2S0_4$(conc.) $\rightarrow 12C + 11H_2S0_4.H_2O + \Delta H$
4. **(a)** $SO_3 + H_2SO_4$ (cone.) $\rightarrow H_2S_2O_7$ (oleum)
   (b) $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ (cone.)

ADDITIONAL QUESTIONS

Question 1.
State why sulphuric acid was called – 'oil of vitriol'.
Answer:
Sulphuric acid was initially called 'oil of vitriol '.It was initially prepared by – distilling green vitriol [$FeSO_4.7H_2O$] and hence the name – 'oil of vitriol'.

$$2FeSO_4.7H_2O \xrightarrow{\text{heat}} Fe_2O_3 + SO_2 + H_2SO_4 + 13H_2O$$

Question 2.
State how you would convert
(1) sulphur
(2) chlorine
(3) sulphur dioxide – to sulphur acid.

Answer:

1. S + 6HNO. [cone.] → $6NO_2 + 2H_2O + H_2SO_4$
2. $Cl_2 + SO_2 + 2H_2O \rightarrow 2HCl + H_2SO_4$
3. $3SO_2 + 2HNO_3 + 2H_2O \rightarrow 3H_2SO_4 + 2NO$

Question 3.
State the purpose of the 'Contact process'.

Answer:
When sulphur is burnt in air, it bums with a pale blue flame forming sulphur dioxide and traces of sulphur trioxide.
$S + O_2 \rightarrow SO_2$ [$2S + 3O_2 \rightarrow 2SO_4$ (traces)]
Burning of sulphur or iron pyrites in oxygen is preferred to purified air since heat energy is wasted in heating the unreactive nitrogen component of the air.

Question 4.
In the Contact process

1. State how you would convert **(a)** sulphur **(b)** iron pyrites to sulphur dioxide in the first step of the Contact process.
2. State the conditions i.e. catalyst, promoter, temperature and pressure in the catalytic oxidation of sulphur dioxide to sulphur trioxide in the Contact tower. Give a balanced equation for the same.
3. State why the above catalytic oxidation {reaction supplies energy.
4. Give a reason why – vanadium pentoxide is preferred to platinum during the catalytic oxidation of sulphur dioxide.
5. Give a reason why the catalyst mass is heated electrically – only initially.
6. State why sulphur trioxide vapours are absorbed in concentrated sulphuric acid and not in water to obtain sulphuric acid.

Answer:

1. $S + O_2 \rightarrow 5\text{-}\ SO_2$
   $4FeS_2 + 11O_2 \rightarrow 5\text{-}\ 2Fe_2O_3 + 8SO_2$
2. Catalytic oxidation of sulphur dioxide to sulphur trioxide.

   $$2SO_2 + O_2 \underset{450\text{-}500^\circ C\ 1\text{-}2\ atmos}{\overset{V_2O_5}{\rightleftharpoons}} 2SO_3 + \Delta$$

   [Above equation for the catalysed reaction is exothermic- hence supplies energy.]
   Catalyst: Vanadium pentoxide [V_2O_5] or platinum [Pt],
   Temperature: 450-500°C Pressure : 1 to 2 atmospheres
   Conversion ratio: 98% of sulphur dioxide converted to sulphur trioxide.
3. The catalytic oxidation of SO_2 to SO_3 is an – exothermic reaction. Thus this reaction supplies energy in the form of heat.

   $$2SO_2 + O_2 \underset{450\text{-}500^\circ C\ 1\text{-}2\ atmos}{\overset{V_2O_5}{\rightleftharpoons}} 2SO_3 + 45\ K\ cals$$

4. **Vanadium pentoxide is preferred –** to platinized asbestos as a catalyst since it is comparatively – cheaper and less easily poisoned or susceptible to impurities.
5. The catalyst – mass is – only initially heated electrically, since the catalytic oxidation of sulphur dioxide is an exothermic reaction and the heat produced maintains the temperature at 450 – 500°C.
6. Even though sulphur trioxide is an acid anhydride of sulphuric acid – it is not directly absorbed in water to give sulphuric acid.
   The reaction is highly exothermic resulting in production of – a dense fog of sulphuric acid particles which do not condense easily.
   Hence sulphur trioxide vapours are – dissolved in cone, sulphuric acid to give oleum which on dilution with – the requisite amount of soft water in the dilution tank gives – sulphuric acid of the desired concentration [about 98%].

Question 5.
Give a reason why concentrated sulphuric acid is kept in air tight bottles.

Answer:
Concentrated sulphuric acid has a great affinity for water and as such it is a hygroscopic liquid. Being Hygroscopic, it absorbs moisture from the atmosphere and hence cone, sulphuric acid is kept in air tight bottles.

Question 6.
State the basic steps with reasons, involved in diluting a beaker of cone. H_2SO_4.

Answer:
For dilution of cone. H_2SO_4, the cone, acid is always added to water and water is never added to the cone, acid even though heat is evolved in both cases.

Reason: If water is added to cone. H_2SO_4 the heat produced is sufficient to spontaneously vaporise a part of the few drops of water added. This is because the amount of water is very small and bioling point of water is much lower than cone. H_2SO_4, which is in bulk. Due to this sudden vaporisation of water cone, acid tend to spurt out and cause serious injuries.
On the other hand, if cone. H_2SO_4 is added to water, the heat produced in this case can only raise the temperature of water slightly because water is an bulk. Thus, in this case spurting of the cone, acid is avoided.

Question 7.
Give reasons why dilute sulphuric acid:
(1) behaves as an acid when dilute.
(2) is dibasic in nature.

Answer:

1. Acidic properties of sulphuric acid are due to the presence of – hydronium ions [H_3O^+] formed when H_2SO_4 dissociates in aq. solution.

$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$$

$$H+ + H_2O \longrightarrow H_3O^+ \quad X_2$$

[H+ ions hydrated in aq. solns. to H_3O+ ions]

$$H_2SO_4 + 2H_2O \rightleftharpoons 2H_2O^+ + SO_4^{2-}$$

2. Sulphuric acid dissociates in – aq. solution giving $2H^+$ ions per molecule – of the acids .Hence its – basically is two.

$$H_2SO_4\ [aq.] \rightleftharpoons 2H^+ + SO_4^{2-}$$

$$[H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{2-}]$$

[Basicity is the number of H^+ ions formed by dissociation of one molecule of the acid in its aq. soln.]

Question 8.
Convert dil. H.SO, to –

1. Hydrogen
2. Carbon dioxide
3. Sulphur dioxide
4. Hydrogen sulphide
5. An acid salt
6. A normal salt.

Answer:

1. Dil H_2SO_4 to hydrogen by the action of any active metal (say zinc) on dil. H_2SO_4

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$$

Zinc — Dil. sulphuric acid — Zinc sulphate

2. Dil. H_2SO_4t0 carbon dioxide by the action of any carbonate or bicarbonate on dil. H_2SO_4

$$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$$

Calcium carbonate — Dilute sulphuric acid — Carbon dioxide

3. Dil. $H_2S0_4$to sulphur dioxide by the action of any sulphide on dil. H_2SO_4
$Na_2SO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + SO_2$
4. H_2SO_4 to hydrogen sulphide by the action of any sulphide on dil. H_2SO_4
$FeS + H_2SO_4$ (dil.) $\rightarrow FeSO_4 + H_2S\uparrow$
5. $H_2S0_4$to an acid by the action of insufficient strong base with excess of dil. H_2SO_4

$$NaOH + H_2SO_4 \longrightarrow NaHSO_4 + H_2O$$

(insufficient) Sodium bisulphate

6. $H_2SO_4$to a normal salt by the action of sufficient (or excess of) strong base (NaOH) with excess of dil. FI_2SO_4

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

(Excess) Sodium bisulphate

Question 9.
Give equations for formation of two different acids from cone. H_2SO_4. State the property of sulphuric acid involved in the above formation.

Answer:

(1) $NaCl + H_2SO_4$ (conc.) $\xrightarrow{< 200^\circ C} NaHSO_4 + HCl.$

(2) $NaNO_3 + H_2SO_4$ (conc.) $\xrightarrow{< 200^\circ C} NaHSO_4 + HNO_3.$

Property of Sulphuric acid involved in the formation of these acids: Cone. H_2SO_4 is a non-volatile acid.

Question 10.
Give equations for oxidation of cone. H_2SO_4 giving the oxidised products –

1. Carbon dioxide
2. Sulphur dioxide
3. Phosphoric acid
4. Copper (II) sulphate
5. Iodine
6. Sulphur respectively.

Answer:

(1) $C + 2H_2SO_4 \xrightarrow{\Delta} CO_2 + 2SO_2 + 2H_2O$

(2) $S + 2H_2SO_4 \xrightarrow{\Delta} 3SO_2 + 2H_2O,$

(3) $2P + 5H_2SO_4 \xrightarrow{\Delta} 2H_3PO_4 + 2H_2O + 5SO_2$

(4) $Cu + \underset{\text{(conc.)}}{2H_2SO_4} \longrightarrow CuSO_4 + SO_2 + 2H_2O$

(5) $2HI + H_2SO_4\,(conc.) \xrightarrow{\Delta} I_2 + 2H_2O + SO_2$

(6) $H_2S + H_2SO_4\,(conc.) \longrightarrow S + 2H_2O + SO_2$

Question 11.
Give a reason why concentrated and not dil H_2SO_4 – behave as an oxidising and dehydrating agent.

Answer:

1. Cone. H_2SO_4 be aves as an oxidising agent because cone.H_2SO_4 whes h. ated decomposes to give nascent oxygen which acts as a strong oxidising agent.

$$H_2SO_4\,(conc.) \xrightarrow{heat} H_2O + SO_2 + [O]$$

Nascent oxygen

On the other hand, dil H_2SO_4 on heating does not decompose to give nascent oxygen and as such cannot behave as an oxidising agent.

2. Cone. H_2SO_4 behaves as a dehydrating agent because cone. H_2SO_4 act as a great affinity for water and hydration of cone. H_2SO_4 is an exothermic reaction.On the other hand, dil H_2SO_4 has no affinity for water and hence cannot act as a hydrating agent.

Question 12.
Give the equation for the reaction cone, sulphuric acid with –

1. glucose
2. sucrose
3. cellulose
4. an organic acid containing one carbon atom and two hydrogen atoms
5. an organic acid containing two carbon and two hydrogen atoms
6. an alcohol
7. hydrated copper (II) sulphate.

Answer:

1. Reaction of cone. H_2SO_4 with glucose, $C_tH_{12}O_6$ –
Dehydration.

$$C_6H_{12}O_6 \xrightarrow{Conc.\ H_2SO_4} 6C + 6H_2O$$

2. Reaction of cone. H_2SO_4 with sucrose, $C_{12}H_{12}O_{12}$ –
Dehydration.

$$C_{12}H_{22}O_{11} \xrightarrow{Conc.\ H_2SO_4} 12C + 11H_2O$$

3. Reaction of cone. H_2SO_4 with cellulose, $(C_6H_{10}O_5)_n$ –
Dehydration.

$$(C_6H_{10}O_5)_n \xrightarrow{Conc.\ H_2SO_4} 5nC + 5nH_2O$$

4. Reaction of cone. H_2SO_4 with an organic acid containing one carbon atom and two hydrogen atoms, HCOOH (formic acid or methanoic acid) –

Dehydration.

$$HCOOH \xrightarrow{\text{Conc. } H_2SO_4} CO + H_2O$$

Formic acid

5. Reaction of cone. H_2SO_4 with an organic acid containing two carbon atom and two hydrogen atoms, $[COOH]_2$ (oxalic acid or erhanedi ic acid) – **Dehydration.**

$$\begin{matrix} COOH \\ | \\ COOH \end{matrix} \xrightarrow{\text{Conc. } H_2SO_4} H_2O + CO\uparrow + CO_2$$

Oxalic acid — Carbon monoxide — Carbon dioxide

6. Reaction of cone. H_2SO_4 with an alcohol (other than methanol) – say ethyl alcohol or ethanol, c_2H_5OH
Dehydration.

$$C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} C_2H_4 + H_2O$$

Ethyl alcohol — Ethene

7. Reaction of cone. H_2SO_4 with hydrated copper (II) sulphate, $CuS0_4.\ 5H_2O$ (blue vitriol) – **Dehydration.**

$$CuSO_4 . 5H_2O \xrightarrow{\text{Conc. } H_2SO_4} CuSO_4 + 5H_2O$$

Blue crystals — White powder

Question 13.
State the observation seen when cone. H_2SO_4 is added to –
(1) sucrose
(2) hydrated copper (II) sulphate.

Answer:

1. Cone. H_2SO_4 dehydrates sucrose to carbon, called sugar charcoal. This is m the form of a black spongy charged mass of carbon.

$$C_{12}H_{22}O_{11} \xrightarrow{\text{Conc. } H_2SO_4} 12C + 11H_2O$$

Sucrose — Sugar Charcoal

2. Cone. H_2S0_4 dehydrates blue crystals of copper (II) sulphate pentahydrate (blue vitriol) to copper sulphite, which is in the form of a white powder.

$$CuSO_4 . 5H_2O \xrightarrow{\text{Conc. } H_2SO_4} CuSO_4 + 5H_2O$$

Blue crystals — White powder

Question 14.
State how addition of –

1. copper
2. NaCl to hot cone. H_2SO_4 serves as a test for the latter.

Answer:

1. Copper turnings when heated with cone. H_2SO_4 gives a colourless suffocating gas with a smell of burning sulphur(SO_2). The gas turns orange coloured acidified potassium dichromate solution green. This can be used as a test for cone. H_2SO_4.

$$Cu + 2H_2SO_4 \xrightarrow{heat} CuSO_4 + SO_2\uparrow + 2H_2O$$

2. Common salt (NaCl) when heated with cone. H_2SO_4 gives a colourless gas pungent smell only which (HCl) gives white fumes with NH_3. This can be used as a test for cone. H_2SO_4.

$$NaCl + H_2SO_4 \xrightarrow[<200°C]{heat} NaHSO_4 + HCl\uparrow$$

Question 15.
Give two tests for dilute sulphuric acid with balanced equations. State why
(1) $BaCl_2$
(2) $Pb(NO_3)_2$ are used for the above tests.

Answer:

1. Barrium chloride solution on treating with dilute sulphuric acid forms white ppt. of barium sulphate, which is insoluble in all acids
   $BaCl_2 + H_2SO_4$ (dil) → $2HCl + BaS0_4 \downarrow$
2. Lead nitrate on treating with dilute sulphuric acid forms white ppt of lead sulphate, which is insoluble in all acids.
   $Pb(NO_3)_2 + H_2SO_4$ (dil) → $2HNO_3 + PbSO_4 \downarrow$

Question 16.
Give a test to distinguish dilute sulphuric acid from dilute HCl and dilute HNO_3.

Answer:
Test to distinguish dil H_2SO_4 from dil HCl and HNO_3-$BaCl_2$ soln. when added to dil. H_2S0_4 gives a white ppt. of $BaSO_4$, but with dil. HCl and dil. HNO_3, no white ppt. is produced – since $BaCl_2$ and $Ba(NO_3)_2$ are soluble in dil. H_2SO_4.

Question 17.
State three different chemical compounds other than acids manufactured industrially from sulphuric acid.

Answer:

1. Barium sulphate
2. Lead sulphate

3. Sodium sulphate

UNIT TEST PAPER 7D — H_2SO_4

Question 1.
Select the correct answer from the choice in brackets.

1. The oxidised product obtained when sulphur reacts with cone. H_2S0_4. ($H_2S/SO_2/H_2SO_3$).
   Ans. SO_2

1. The dehydrated product obtained when cane sugar reacts with cone. H_2S0_4. (CO / C / CO_2)
   Ans. C

1. The type of salt formed when excess of caustic soda reacts with sulphuric acid, (acid salt / normal salt)
   Ans. Normal salt

1. The reduced product obtained when hydrogen sulphide reacts with cone. H_2S0_4. (SO, / S / H.O)
   Ans. SO_2

1. The salt which reacts with dil. H_2SO_4 acid to give an insoluble ppt. (Cu $(NO_3)_2$ / Zn $(NO_s)_2$ / Pb $(NO_3)_2$
   Ans. $Pb(NO_3)_2$

Question 2

Iron pyrites $\xrightarrow{A}$ Colourless acidic gas $\xrightarrow{B}$ Sulphur trioxide $\xrightarrow{C}$ Oleum $\xrightarrow{D}$ Sulphuric acid.

1. Give a balanced equation for the conversion 'A'.
   Ans. $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$
2. The gaseous mixture of the product of conversion 'A' and air contains dust particles as an impurity. Name another impurity in the same mixture.
   Ans: Arsenious oxide (As_2O_3)
3. Is the conversion 'B' an exothermic or an endothermic reaction. Would lowering the temperature favour or retard the forward reaction.
   Ans. Conversion of SO_2 into SO_3 is an exothermic reaction. As such lowering of temperature will favour the forward reaction i.e. Formation of SO_3.
4. If the product of conversion 'B' is an acid anhydride of H_2S0_4, the anhydride of conversion 'A' is……..
   Ans. Acidic.
5. State why water is added for the conversion 'D' and not for the conversion 'C'

Ans. SO_3 is not directly dissolved in water to give H_2SO_4. This is because the dissolution of SO_3 in water is highly exothermic resulting in production of dense fog of sulphuric acid particles which do not condense easily.

Question 3.
Give balanced equations for the following reactions using sulphuric acid.

1. Formation of a black mark on a piece of wood on addition of cone. H_2SO_4 to it.
   Ans. $(C_6H_{10}O_5)_n + H_2S0_4$ (cone.) $\rightarrow 6(C)_n + 5(H_2O)_n$
2. Oxidation of a foul smelling acidic gas, heavier than air and fairly soluble in H_2O by cone. H_2SO_4.
   Ans. $H_2S + H,SO_4$ (cone.) $\rightarrow S + 2H_2O + SO_2$
3. Formation of an acid salt from sulphuric acid and **(a)** an alkali **(b)** a sodium salt.
   Ans.
   (a) Formation of an acid salt from sulphuric acid and an alkali (KOH)
   $KOH + H_2SO_4$ (dil.)$\rightarrow KHSO_4 + 2H_2O$
   (b) Formation of an acid salt from sulphuric acid and a sodium salt (NaCl)
   $$NaCl + H_2SO_4\,(conc.) \xrightarrow[<200°C]{\text{heat}} NaHSO_4 + HCl$$
4. Formation of a hydrocarbon from an organic compound
   Ans:
   $$C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} C_2H_4 + H_2O$$
   Ethyl alcohol — Ethylene
5. Formation of sulphur dioxide using a metal below hydrogen in the activity series.
   Ans: $Cu + 2H_2SO_4$ (cone.) $\rightarrow CuSO_4 + 2H_2O + SO_2$

Question 4.
Match the conversions in column 'X' using sulphuric acid, with the type of

chemical property of sulphuric acid A to E it represents in column 'Y'

'X'	'Y'
1. Nitre → Nitric acid	A : As an oxidising agent
2. Copper(II) oxide →Copper (II) sulphate	B : As a dibasic acid
3. Copper →Copper (II) sulphate	C : As an acid when dilute
4. Ethanol (ethyl alcohol] →Ethene	D : As a least or non-volatile acid
5. Sodium hydroxide→ Sodium bisulphate and sodium sulphate	E : As a dehydrating agent

Answer:

1. Nitre→Nitric acid acid	D : As a least or non-volatile
2. Copper (II) oxide→Copper (II) sulphate	C : As an acid when dilute.
3. Copper→Copper (II) sulphate	A : As an oxidising agent
4. Ethanol (ethyl alcohol] → Ethene	E : As a dehydrating agent
5. Sodium hydroxide→sodium bisulphate and sodium sulphate	B : As a dibasic acid

Question 5.
Select the correct substance from the substances A to J which react with the sulphuric acid to give the product 1 to 10. [State whether the acid used in each case is dilute or concentrated].

A : Iron
B : Sodium carbonate
C : Sodium chloride
D : Formic acid
E : Sodium nitrate
F : Sodium sulphite
G : Ethyl alcohol

H : Sodium sulphide
I : Sodium hydroxide (excess)
J : Hydrogen sulphide

1. Product – ulphur dioxide
2. Product- Sulphur
3. Product-Hydrogen
4. Product-Hydrochloric acid
5. Product-Sodium sulphate
6. Product-Carbon dioxide
7. Product-Carbon monoxide
8. Product-Nitric acid
9. Product—Hydrogen sulphide
10. Prorfwcf-Ethene

Answer:

1. F: Sodium sulphite
2. H: Sodium sulphide
3. A: Iron
4. C: Sodium chloride
5. I: Sodium hydroxide
6. E: Sodium Carbonate
7. D: Formic acid
8. E: Sodium nitrate
9. H: Sodium sulphide
10. G: Ithyl alcohol

Question 6.
Give reasons for the following:

1. Sulphuric acid forms two types of salts with an alkali.
   Ans. Sulphuric acid forms two types of . disc, viz., sulphates and bisulphates (or hydrogen sulphates) with alkales because it is a dibasic :acid, i.e. one molecule of H_2SO_4 on dissociation gives two H^+ions.

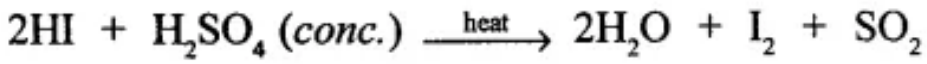
   $$NaOH + H_2SO_4 \longrightarrow NaHSO_4 + H_2O$$
   [insufficient] [acid salt]

   $$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$
   [excess] [normal salt]

2. Cone, sulphuric acid is used as a laLoraioiy reagent in the preparation of iodine from hydrogen iodide.
   Ans. Cone. H_2SO_4. oxidises HI to iodine.

   $$2HI + H_2SO_4\ (conc.) \xrightarrow{heat} 2H_2O + I_2 + SO_2$$

3. Barium chloride solution can be used to distinguish between dil. H_2SO_4 and dil HNO_3.
   Ans. $BaCl_2$ soln. when added to dil. H_2SO_4 gives a white ppt. of $BaSO_4$, but with dil. HNO_3, n: white ppt. is produced since $BaCl_2$ and $Ba(NO_3)$, are soluble in dil. H_2SO_4.
4. The gaseous product obtained differs when zinc reacts with dilute and with cone. H_2SO_4
   Ans. The metal reacts differently with dilute acid and concentrated acid. That is the character of metal. With dilute sulphuric acid, zinc gives hydrogen.
   $Zn + H_2SO_4$ (dil.) $\rightarrow ZnSO_4 + H_2$
   The same metals will react differently with concentrated sulphuric acid to give sulphur dioxide gas.



5. Ethanol can be converted to ethene using cone, sulphuric acid.
   Ans. Ethanol cart be converted into ethene by heating it with cone. H_2SO_4 because cone. H_2SO_4 is a strong dehydrating agent.