CLASS 10TH CHEMISTRY WORKSHEET CHAPTER – STUDY OF COMPOUNDS - AMMONIA

Intext Questions

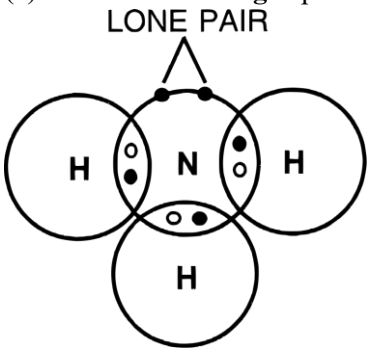
Question 1

(a) State the type of bonding present in ammonia, show by a diagram.

(b) What is the formula of liquid ammonia? Account for the basic nature of this compound.

Answer

(a) **Covalent bonding** is present in ammonia as shown below —



(b) The formula of liquid ammonia is NH_4OH.

The aqueous solution of ammonia [NH_4OH] is a weak base. It dissociates partially to give hydroxyl ions [OH^{1-}].

The basic nature of NH_4OH is due to the presence of hydroxyl ions [OH^{1-}].

$NH_3 + H_2O \longrightarrow NH_4OH$

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

Question 2

(a) Write a balanced chemical equation for the lab preparation of ammonia.

(b) How is ammonia dried and collected in the laboratory?

(c) Ammonia cannot be collected over water. Give reason.

Answer

(a) $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$ [g]

(b) In order to get dry ammonia, the gas is passed through a drying tower containing lumps of quicklime [CaO].

Ammonia gas is collected in inverted gas jars by the **downward displacement of air**.

(c) As ammonia gas is highly soluble in water, therefore, it is not collected over water.

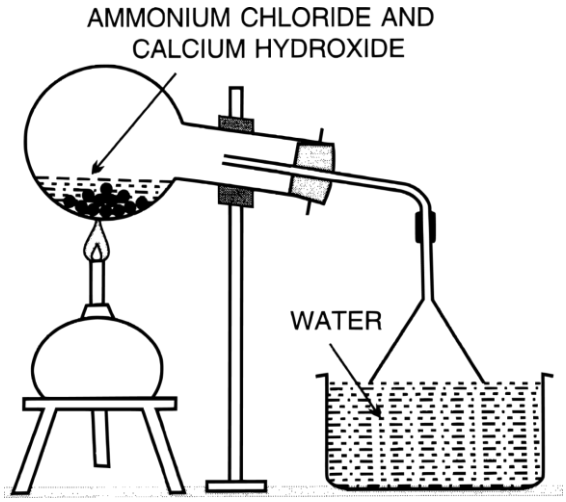
Question 3

(a) Explain with a diagram the preparation of aqueous ammonia.

(b) Why drying agents such as P_2O_5 and $CaCl_2$ are not used to dry NH_3 ?

Answer

(a) The diagram below shows the preparation of aqueous ammonia:



Procedure : Water is taken in a container and only a small portion of the mouth of the funnel is dipped in water. As ammonia dissolves in water at a higher rate than it's production in the flask, the pressure in the funnel above water level decreases for a moment and water rushes into the funnel.

As a result, the rim of the funnel loses it's contact with water. Since, ammonia produced pushes the water down, the funnel comes in contact with water again. In this way, ammonia dissolves in water without back suction of water.

(b) Ammonia being basic in nature reacts chemically with P_2O_5 and $CaCl_2$

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

$4NH_3 + CaCl_2 \longrightarrow CaCl_2.4NH_3$

Hence, P_2O_5 and $CaCl_2$ are not used to dry NH_3

Question 4

A substance 'A' was heated with slaked lime and a gas 'B' with a pungent smell was obtained. Name the substances A and B and give a balanced equation.

Answer

Substance A is **Ammonium chloride (NH_4Cl)** and gas B is **Ammonia**

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

Question 5

Ammonia is manufactured by Haber's process —

(a) Under what conditions do the reactants combine to form ammonia? Give a balanced equation for the reaction.

(b) In what ratio by volume, are the above gases used?

(c) State one possible source of each reactant used in Haber Process.

(d) State whether the formation of ammonia is promoted by the use of high pressure or low pressure?

(e) Mention two possible ways by which ammonia produced is removed from unchanged gases.

(f) What is the function of

(i) finely divided iron,

(ii) molybdenum in the above process?

(g) What is the percentage formation of ammonia?

(h) How can this percentage formation be increased?

Answer

(a) Nitrogen reacts with hydrogen under specific conditions liberating ammonia

$N_2 + 3H_2 \rightleftharpoons 2NH_3 + \Delta$

Conditions :

Temperature : 450-500°C [Optimum temperature]

Pressure : 200 to 900 atmospheres [Optimum pressure]

Catalyst : Finely divided iron [Fe]

Promotor : Molybdenum [Mo]

[Catalyst - iron [III] oxide [Fe_2O_3] may also be used containing promoters about 1% K_2O and 3% Al_2O_3]
(b) According to the above equation, nitrogen and hydrogen combines in 1:3 ratio by volume.
(c) Nitrogen is obtained by **fractional distillation of liquid air**. Hydrogen is obtained from the **water gas (Bosch process) or from natural gas.**
(d) The formation of ammonia is promoted by the use of **high pressure as it favours the forward direction.**
(e) Two possible ways by which ammonia produced is removed from unchanged gases are:

1. **By Liquefaction** — ammonia is liquefied easily as compared to nitrogen and hydrogen.
2. **By Absorbing in water** — because ammonia is highly soluble in water, as hydrogen and nitrogen are very slightly soluble.

(f) Function of finely divided iron and molybdenum are:

1. Finely divided iron **increases the rate of reaction.**
2. Molybdenum acts as a promoter to **increase the efficiency of the catalyst.**

(g) **15%**
(h) The **unchanged nitrogen and hydrogen are recirculated** through the plant to get more ammonia, by this way we can achieve 98% of ammonia.

Question 6a

Give reason —
Ammonium compounds does not occur in minerals.

Answer

Due to the high solubility of Ammonium compounds in water it does not occur in minerals.

Question 6b

Give reason —
Ammonium nitrate is not used in the preparation of ammonia.

Answer

As ammonium nitrate is explosive in nature and may itself decompose forming nitrous oxide and water vapour, hence it is not used in the preparation of ammonia.

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

Question 6c

Give reason —
Conc. H_2SO_4 is a good drying agent, yet it is not used to dry NH_3.

Answer

As sulphuric acid **reacts chemically with ammonia to form ammonium sulphate** hence, it is not used as a drying agent for drying ammonia.

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

Question 6d

Give reason —
In the lab. preparation of ammonia

1. calcium hydroxide is used in excess.
2. Flask is fitted in slanting position.

Answer

1. In the lab preparation of ammonia, ammonium chloride is used. Ammonium chloride is sublime, during the reaction, the heat will cause ammonium chloride to vapourise. To prevent this, calcium hydroxide is used in excess. It absorbs excess heat and prevents the loss of ammonium chloride as vapours.
2. The flask is fitted in slanting position so that the water formed in the reaction does not trickle back into the heated flask and thus break it.

Question 7

State the following conditions required in the Haber's process-
(a) Temperature

(b) Pressure
(c) Catalyst

Answer

Conditions :
(a) Temperature : 450-500°C [Optimum temperature]
(b) Pressure : 200 to 900 atmospheres [Optimum pressure]
(c) Catalyst : Finely divided iron [Fe]

Question 8

Choose the correct word or phrase from the brackets to complete the following sentences and write balanced equations for the same.
(a) Ammonium chloride is a soluble salt prepared by ..... [precipitation, neutralization].
(b) When ammonium chloride is heated, it undergoes ..... [thermal decomposition/dissociation].
(c) Heating ammonium chloride with sodium hydroxide produces ..... [ammonia, nitrogen].

Answer

(a) Ammonium chloride is a soluble salt prepared by ***neutralization***.
NH_3 (gas) + HCl (gas) ⟶ NH_4Cl (solid)
(b) When ammonium chloride is heated, it undergoes ***thermal dissociation***.
$NH_4Cl \rightleftharpoons NH_3 + HCl$
(c) Heating ammonium chloride with sodium hydroxide produces ***ammonia***.
$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$

Question 9

An element has 2 electrons in it's N shell. It reacts with a non-metal of atomic number 7. The compound formed reacts with warm water and produces a basic gas. Identify the elements and write the balanced chemical reactions.

Answer

An element has 2 electrons in it's N shell, hence, it has

1. 2 (electrons in K shell) +
2. 8 (electrons in L shell) +
3. 8 (electrons in M shell) +
4. 2 (electrons in N shell) = 20 electrons total i.e. **Calcium**

Non metal (atomic number 7) is **Nitrogen**
Calcium and Nitrogen react to form **calcium nitride.**
$3Ca + N_2 \longrightarrow Ca_3N_2$
Ca_3N_2 reacts with water to give **calcium hydroxide and ammonia.**
$Ca_3N_2 + 6H_2O \longrightarrow \mathbf{3Ca(OH)_2 + 2NH_3}$ [g]

Question 10

The following reactions are carried out
A: Nitrogen + metal ⟶ compound X.
B: X + water ⟶ ammonia + another compound.
C: Ammonia + metal oxide ⟶ metal + water + N_2
One metal that can be used for reaction A is magnesium.
(a) Write the formula of the compound X formed
(b) Write the correctly balanced equation for reaction B where X is the compound formed.
(c) What property of ammonia is demonstrated by reaction C ?

Answer

(a) When metal for A is magnesium, then, compound X is $\mathbf{Mg_3N_2}$
$N_2 + 3Mg \longrightarrow Mg_3N_2$
(b) Magnesium nitride
$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$ [g]

(c) **Ammonia is a reducing agent** and hence it reduces the less reactive metal oxide to the respective metal.

$2NH_3 + 3MgO \longrightarrow 3Mg + 3H_2O + N_2$

Question 11

Correct the following:

(a) A reddish-brown precipitate is obtained when ammonium hydroxide is added to ferrous sulphate.

(b) Liquid ammonia is a solution of NH_3.

(c) Finely divided platinum is used in Haber's Process.

(d) Conc. H_2SO_4 is a drying agent for NH_3.

(e) Ammonium salts, on heating, decompose to give ammonia.

Answer

(a) A ***dirty green*** precipitate is obtained when ammonium hydroxide is added to ferrous sulphate.

(b) ***Aqueous*** ammonia is a solution of NH_3 **in water**.

(c) Finely divided ***iron*** is used in Haber's Process.

(d) ***Quicklime***, is a drying agent for NH_3,

(e) Ammonium salts, on heating ***with caustic alkali***, decompose to give ammonia.

Question 12

Choose the correct from the following:

Ammonia can be obtained by adding water to

A : Ammonium chloride.

B : Ammonium nitrite.

C : Magnesium nitride.

D : Magnesium nitrate

Answer

Magnesium nitride

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

Exercise 9 — Multiple Choice Type

Question 1

The catalyst used in Haber's process is:

1. Molybdenum
2. Platinum
3. Nickel
4. Iron

Answer

Iron

Reason — The catalyst used in haber's process of manufacture of ammonia is Finely divided iron.

Question 2

Nitrogen gas can be obtained by heating :

1. Ammonium nitrate
2. Ammonium nitrite
3. Magnesium nitride
4. Ammonium chloride

Answer

Ammonium nitrite

Reason — When ammonium nitrate is heated it decomposes into nitrogen gas and water.

$NH_4NO_2 \xrightarrow{\Delta} 2H_2O + N_2$

Question 3

Ammonia can be obtained by adding water to:

1. NH_4Cl

2. Mg_3N_2
3. $Mg\ (NO_3)_2$
4. $(NH_4)_2\ SO_4$

Answer

Mg_3N_2

Reason — Ammonia can also be obtained by the action of warm water on nitride of metal like magnesium.

$Mg_2N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3 \uparrow$

Question 4

The gas collected by downward displacement of air is

1. HCl
2. NH_3
3. CO_2
4. H_2S

Answer

NH_3

Reason — Ammonia (NH_3) gas is collected in inverted gas jars by downward displacement of air because it is lighter than air.

Question 5

In the Haber's process, the ratio of reactants nitrogen and hydrogen is:

1. 2 : 3
2. 3 : 2
3. 1 : 3
4. 3 : 1

Answer

1 : 3

Reason — In the Haber's process, the ratio of reactants nitrogen and hydrogen is 1 : 3. One volume of nitrogen (from liquid air) and three volume of hydrogen (water gas from Bosch process).

Question 6

When ammonia reacts with an excess of chlorine, the main product formed is:

1. NH_4Cl
2. NCl_3
3. Cl_2
4. HCl

Answer

NCl_3

Reason — When ammonia reacts with an excess of chlorine, products formed are hydrogen chloride and yellow coloured highly explosive liquid nitrogen trichloride.

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

Question 7

Ammonia is used in:

1. Contact process
2. Haber's process
3. Ostwald process
4. Bayer's process

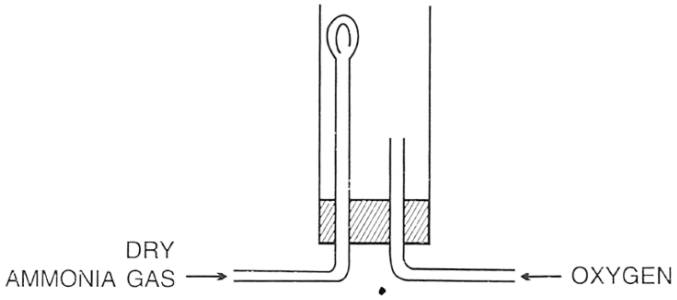
Answer

Ostwald process

Reason — Ammonia is used as a starting material for manufacturing nitric acid using ostwald process.

Question 8

In the following set up for burning ammonia in oxygen, ammonia tube is fitted higher and oxygen tube is kept lower because ?



P — Oxygen is lighter than ammonia.
Q — Ammonia is lighter than oxygen.
R — Ammonia and oxygen mixture is explosive and by keeping them in this position, limited oxygen will react with ammonia.
Which of the following is true ?

1. Only P
2. Only Q
3. Only R
4. Both P and Q

Answer
Only R
Reason — Ammonia burns in oxygen with greenish yellow fumes. This reaction is explosive and dangerous. Hence, by keeping ammonia tube higher than oxygen tube, limited oxygen will react with ammonia.

Question 9
Assertion (A): Ammonia does not conduct electricity in gaseous or liquid state.
Reason (R): Ions in ammonia gas or liquid ammonia are not free to move.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer
A is true but R is false.
Explanation — Pure ammonia (NH_3) in its gaseous or liquid form is covalent and does not contain free ions to conduct electricity. Hence, the assertion (A) is true.
Ammonia consist of molecule, it doesn't have free ions to conduct electricity. Hence, the reason (R) is false.

Question 10
Assertion (A): Ammonia is dried by passing through a drying tower containing CaO.
Reason (R): Ammonia being basic in nature reacts with other drying agents.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer
Both A and R are true and R is the correct explanation of A.
Explanation— Ammonia is dried by passing it through a drying tower containing lumps of quicklime (CaO). Hence, the assertion (A) is true.
Other drying agents like conc. sulphuric acid, phosphorous pentoxide and anhydrous calcium chloride are not used, as

ammonia is basic in nature, reacts with other drying agents. Hence, the reason (R) is true and it is the correct explanation of assertion (A).

Question 11

Assertion (A): Ammonia and its compounds do not occur in minerals.

Reason (R): Ammonia is not soluble in water.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation— Ammonia and ammonium compounds do not occur as minerals because they are highly soluble in water. Hence, the assertion (A) is true. Ammonia is highly soluble in water. Hence, the reason (R) is false.

Question 12

Assertion (A): In the preparation of ammonia, hydrogen is obtained by Bosch process.

Reason (R): Hydrogen and nitrogen are used in the ratio 1:3.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation — In the Haber's process of manufacturing ammonia, nitrogen and hydrogen are used as reactants. Where, hydrogen is obtained as water gas from Bosch process. Hence, the assertion (A) is true.

The ratio of reactants nitrogen and hydrogen in the Haber's process is 1 : 3. **One volume of nitrogen** (from liquid air) and **three volume of hydrogen** (water gas from Bosch process). Hence, reason (R) is false.

Question 13

Assertion (A): Haber's process is used to manufacture ammonia.

Reason (R): The catalyst used in this process is vanadium oxide or platinum.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation — Haber's process is used to manufacture ammonia. Hence, the assertion (A) is true.

The catalyst used in Haber's process is finely divided iron. Hence, the reason (R) is false.

Question 14

Assertion (A): Ammonia is recovered by liquification process in Haber's process.

Reason (R): Nitrogen and hydrogen liquify with difficulty as compared to ammonia.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true and R is the correct explanation of A.

Explanation — Ammonia obtained from Haber's process is separated from the unreacted nitrogen and hydrogen by liquification process. Hence, the assertion (A) is true.

Ammonia is recovered by liquification process because ammonia is liquified easily as compared to Nitrogen and Hydrogen. Hence, the reason (R) is true and it is the correct explanation of assertion (A).

Question 15

Assertion (A): Liquid ammonia is used as a refrigerant in ice plants.

Reason (R): CFC, the main refrigerant, causes global warming.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation — Liquid ammonia is used as a refrigerant in ice plants because anhydrous ammonia is a clear, colourless liquid under pressure. It evaporates rapidly and produces cooling effect. This makes ammonia a good refrigerant. Hence, the assertion (A) is true. CFC, the main refrigerant, decompose by ultraviolet rays to form free chlorine radicals. These free radicals contribute to global warming and ozone depletion. Hence, the reason (R) is true. Since, reason (R) doesn't explain why liquid ammonia is used as refrigerant in ice plants, it is not the correct explanation of assertion (A).

Exercise 9 — Very Short Answer Type

Question 1

Name:

(a) the gas which is prepared by Haber's process.

(b) two gases which give dense white fumes with ammonia.

(c) one salt of ammonia in each case which is used in:

(i) dry cell (ii) explosives (iii) medicine

(d) an acidic gas which reacts with a basic gas liberating a neutral gas,

(e) a metallic chloride soluble in ammonium hydroxide,

(f) the gas obtained when ammonia burns in an atmosphere of oxygen without any catalyst,

(g) a nitride of a divalent metal which reacts with warm water liberating ammonia,

(h) an amphoteric oxide reduced by the basic gas,

(i) a white salt produced by an acidic gas and a basic gas,

(j) The gas that burns in oxygen with a green flame.

(k) The gas produced when excess ammonia reacts with chlorine.

(l) The white crystalline solid that is soluble in water. It liberates a pungent smelling gas when heated with sodium hydroxide solution.

(m) An alkaline gas which produces dense white fumes when reacted with HCl gas.

Answer

(a) Ammonia

(b) Hydrogen chloride and chlorine gas

(c)

(i) dry cell — ammonium chloride

(ii) explosives — ammonium nitrate

(iii) medicine — ammonium carbonate

(d) Acidic gas — Cl_2 ; Basic gas — Ammonia; Neutral gas — N_2

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

(e) Silver chloride

(f) Nitrogen

(g) Magnesium nitride

(h) Lead oxide

(i) Ammonium chloride
(j) Ammonia (NH_3)
(k) Nitrogen

$8NH_3$ [excess] + $3Cl_2 \longrightarrow 6NH_4Cl + N_2$

(l) Ammonium salts like ammonium chloride, ammonium sulphate
(m) Ammonia gas

$NH_3 + HCl \longrightarrow NH_4Cl$

Question 2

Fill in the blank from the choices given in bracket :
(a) Ammonia gas is collected by ..... (upward displacement of air, downward displacement of water, downward displacement of air).
(b) Ammonia reacts with excess chorine to form ..... (nitrogen / nitrogen trichloride / ammonium chloride).

Answer

(a) Ammonia gas is collected by **downward displacement of air**.
(b) Ammonia reacts with excess chlorine to form ***nitrogen trichloride***

$NH_3 + 3Cl_2$ [excess] $\longrightarrow 3HCl + NCl_3$

Question 3

Complete the blanks (i) to (v) 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 (i) ..... gas. When the same gas is passed through water, it forms a soln. which will be (ii)..... in nature, and will contain the ions (iii) ..... and (iv) ..... . A (v) ..... coloured ppt. of iron [II] hydroxide is formed when the above solution is added to iron [II] sulphate solution.

Answer

(i) Ammonia
(ii) Alkaline
(iii) Ammonium
(iv) Hydroxyl
(v) Dirty green

Question 4

Name the gas evolved when the following mixtures are heated :
(a) Calcium hydroxide and Ammonium chloride.
(b) Sodium nitrite and Ammonium chloride.

Answer

(a) Ammonia gas

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

(b) Nitrogen gas

$NH_4Cl + NaNO_2 \longrightarrow NaCl + NH_4NO_2$

$NH_4NO_2 \longrightarrow 2H_2O + N_2$

Question 5

Name a compound prepared by ammonia and is used as :
(a) Explosive
(b) Fertilizers
(c) Medicine
(d) Laboratory reagent

Answer

(a) Ammonium nitrate
(b) Ammonium sulphate

(c) Ammonium carbonate
(d) Ammonia solution

Question 6

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

Answer

Ammonia
Reducing nature of ammonia:
$2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$ [g]

Exercise 9 — Short Answer Type

Question 1

Pick the odd member from the list giving reasons:
(a) Ammonia, sulphur dioxide, hydrogen chloride, carbon dioxide.
(b) Copper oxide, aluminium oxide, sodium oxide, magnesium oxide.

Answer

(a) **Ammonia is basic in nature** and rest are acidic.
(b) **Copper oxide is less reactive and can be reduced by C, CO or hydrogen** whereas aluminium oxide, sodium oxide, magnesium oxide are reduced by electrolysis.

Question 2

A gas 'P' gives dense white fumes with chlorine. It's aqueous solution gives a blue colour with copper (II) hydroxide. Give the name and formula of the gas P.

Answer

Gas 'P' is **Ammonia** and its formula is **NH_3**.
With chlorine, ammonia gas gives dense white fumes of NH_4Cl.
$8NH_3$ [excess] + $3Cl_2 \longrightarrow 6NH_4Cl + N_2$
Reaction of copper (II) hydroxide with aqueous solution of Ammonia (NH_4OH) is given below:
$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$

Question 3

Copy and complete the following equations.
(a) $AlN + H_2O \longrightarrow$
(b) $2NH_3 + 3PbO \longrightarrow$
(c) $NH_3 + 3Cl_2 \longrightarrow$
(d) $NH_3 + CO_2 \longrightarrow$
(i) Which property of ammonia is illustrated by equation (c)?
(ii) What important fertiliser is prepared from equation (d)? State the conditions.

Answer

(a) $AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3\uparrow$
(b) $2NH_3 + 3PbO \longrightarrow 3Pb + 3H_2O + N_2$ [g]
(c) $NH_3 + 3Cl_2$ [excess] $\longrightarrow 3HCl + NCl_3$
(d) $2NH_3 + CO_2 \longrightarrow NH_2CONH_2 + H_2O$
(i) Ammonia acts as a **reducing agent** as it loses hydrogen in equation (c).
(ii) **Urea** is prepared from equation (d). Ammonia reacts with carbon dioxide at 150°C and 150 atm, pressure to give urea.

Question 4

(a) What do you observe when ammonium hydroxide is added to the aqueous solution of :
(i) $FeSO_4$
(ii) Iron (III) chloride.
(iii) Lead nitrate

(iv) Zinc nitrate
(b) Write balanced equation for Q.4(a).

Answer

(i) Dirty green ppt. of ferrous hydroxide is formed which is insoluble in excess of NH_4OH.
(ii) Reddish brown ppt. of ferric hydroxide is formed which is insoluble in excess of NH_4OH.
(iii) White ppt. of lead hydroxide is formed which is insoluble in excess of NH_4OH.
(iv) White gelatinous ppt. of Zinc hydroxide is formed which is soluble in excess of NH_4OH.
(b) The balanced chemical equations are given as :

(i) $FeSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Fe(OH)_2 \downarrow$
(ii) $FeCl_3 + 3NH_4OH \longrightarrow 3NH_4Cl + Fe(OH)_3 \downarrow$
(iii) $Pb(NO_3)_2 + 2NH_4OH \longrightarrow 2NH_4NO_3 + Pb(OH)_2 \downarrow$
(iv) $Zn(NO_3)_2 + 2NH_4OH \longrightarrow 2NH_4NO_3 + Zn(OH)_2 \downarrow$

Question 5

When ammonium hydroxide is added to solution B, a pale blue precipitate is formed. This pale blue precipitate dissolves in excess ammonium hydroxide giving an inky blue solution. What is the cation (positive ion) present in solution B? What is the probable colour of solution B.

Answer

Solution B is **Copper Sulphate** and cation present is **(Cu^{2+})**. The colour of solution B is Blue.
Ammonium hydroxide gives a blue precipitate when it combines with a solution of copper salt, due to the formation of $Cu(OH)_2$

$CuSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Cu(OH)_2 \downarrow$

The pale blue precipitate of copper hydroxide dissolves in excess of ammonium hydroxide forming tetraamine copper [II] sulphate, an azure blue soluble complex salt.

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

Question 6

Write the equation for the action of heat on:
(a) Ammonium chloride
(b) Ammonium nitrate
State whether each reaction is an example of thermal decomposition or thermal dissociation.

Answer

(a) $NH_4Cl \rightleftharpoons NH_3 + HCl$
This reaction is an example of **thermal dissociation**.
(b) $NH_4NO_3 \rightleftharpoons N_2O + 2H_2O$
This reaction is an example of **thermal dissociation.**

Question 7

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

Answer

Hydrogen chloride gas (HCl) and Ammonia (NH_3) are the two gases which can be used to study the fountain experiment.
The common property demonstrated by the fountain experiment is the **solubility of gases** in water.

Question 8

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

Hydroxyl ion [OH^{-1}] and ammonium ions [NH_4^+] are formed.

$NH_3 + H_2O \longrightarrow NH_4OH$

$NH_4OH \rightleftharpoons NH_4^+ + OH^{-1}$

The alkaline NH_4OH, due to the presence of hydroxyl ions [OH^-] turns red litmus blue and phenolphthalein soln. pink

Question 9

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

Answer

Conditions for catalytic oxidation of ammonia to nitric oxide are :

1. Temperature : 800°C
2. Catalyst : Platinum (Pt)

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

Question 10

Give reasons for the following —

(a) Liquid ammonia is used as a refrigerant in ice plants.

(b) Aqueous solution of ammonia is used for removing grease stains from woollen clothes.

(c) Aqueous solution of ammonia gives a pungent smell.

(d) Aqueous solution of ammonia conducts electricity.

Answer

(a) Liquid ammonia is a clear, colourless liquid under pressure. It evaporates rapidly and produces cooling effect. Moreover, Ammonia is environmentally compatible, has superior thermodynamic properties and its leaks are easily detectable due to its recognizable odour. All these reasons make liquid ammonia a good refrigerant.

(b) As aqueous solution of ammonia emulsifies or dissolves fats, grease etc., hence it is used for removing grease stains from woollen clothes.

(c) Pungent smell of aqueous solution of ammonia is due to the presence of ammonia, which has strong, pungent choking smell.

(d) In aqueous solution, the ammonia molecule combines with a hydrogen atom H^+ by sharing the lone pair of electrons of nitrogen atom to form ammonium ion (NH_4^+). Thus, in water, ammonium hydroxide (NH_4OH) dissociates into NH_4^+ (ammonium ion) and OH^- (hydroxide ion) as follows:

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

Due to this ionisation, aqueous solution of ammonia (NH_4OH) conducts electricity.

Question 11

Write balanced chemical equation for the following:

(a) Ammonium hydroxide is added to ferrous sulphate solution.

(b) Magnesium nitride is treated with warm water.

(c) Ammonium chloride is heated with sodium hydroxide.

(d) Chlorine reacts with excess of ammonia.

(e) Ammonia and Oxygen in the presence of a catalyst.

(f) Reduction of hot copper (II) oxide to copper using Ammonia gas.

(g) To illustrate the reducing nature of ammonia.

(h) Lab. preparation of ammonia using an ammonium salt.

(i) Reaction of ammonia with excess of chlorine.

(j) Reaction of ammonia with sulphuric acid.

(k) When excess of ammonia is treated with chlorine.

Answer

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

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

(c) $NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$

(d) $8NH_3$ [excess] $+ 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

(e) $4NH_3 + 5O_2 \xrightarrow[800°C]{Pt.} 6H_2O + 4NO\uparrow + \Delta$

(f) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$ [g]
(g) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$ [g]
(h) $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3\uparrow$
(i) $NH_3 + 3Cl_2$ [excess] $\longrightarrow 3HCl + NCl_3$
(j) $2NH_3 + H_2SO_4$ (dil.) $\longrightarrow (NH_4)_2SO_4$
(k) $8NH_3$ [excess] $+ 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

Question 12

Write a balanced equation for a reaction in which ammonia is oxidized by :
(a) a metal oxide
(b) a gas which is not oxygen.

Answer

(a) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2\uparrow$
(b) $NH_3 + 3Cl_2 \longrightarrow 3HCl + NCl_3\uparrow$

Question 13

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

Answer

Ammonia gas is a strong reducing agent. Below equation shows reduction of Black Copper [II] oxide to brown Copper by Ammonia.
$2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$ [g]

Question 14

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 15

Distinguish between the following (using ammonia solution) :
(a) Calcium chloride and zinc chloride.
(b) Ferric salt and ferrous salt
(c) Zinc nitrate and lead nitrate

Answer

(a) When we add ammonium hydroxide solution to both the given salt solutions, Zinc Chloride reacts to form a gelatinous white precipitate of Zinc Hydroxide (ZnOH), whereas, no such observations i.e no precipitate will form in case of Calcium Chloride solution because ammonium hydroxide is a weak base and it cannot react with calcium salts to precipitate the hydroxide of calcium.
$ZnCl_2 + 2NH_4OH \longrightarrow Zn(OH)_2 + 2NH_4Cl$
(b) On reaction with ammonium hydroxide, Iron [II] sulphate (ferrous salt) forms a dirty green ppt whereas iron [III] sulphate (ferric salt) forms a reddish brown ppt. Hence, the two can be distinguished easily.
$FeSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Fe(OH)_2\downarrow$
$Fe_2(SO_4)_3 + 6NH_4OH \longrightarrow 3(NH_4)_2SO_4 + 2Fe(OH)_3\downarrow$
(c) When zinc nitrate is treated with ammonium hydroxide, white gelatinous ppt. of Zinc hydroxide is formed which is soluble in excess of NH_4OH.
$Zn(NO_3)_2 + 2NH_4OH \longrightarrow 2NH_4NO_3 + Zn(OH)_2\downarrow$
Whereas, when lead nitrate is treated with ammonium hydroxide, white ppt. of lead hydroxide is formed which is insoluble in excess of NH_4OH
$Pb(NO_3)_2 + 2NH_4OH \longrightarrow 2NH_4NO_3 + Pb(OH)_2\downarrow$

Question 16

Give balanced equations for the following conversions :
(a) Ammonia to nitrogen using an acidic gas.
(b) Ammonia to brown gas.

(c) Ammonia to nitrogen trichloride
(d) Ammonia solution to an amphoteric hydroxide
(e) A nitride of a trivalent metal to ammonia
(f) Lead oxide to lead

Answer

(a) Ammonia to nitrogen using an acidic gas :

$8NH_3$ [excess] + $3Cl_2 \longrightarrow 6NH_4Cl + N_2$

(b) Ammonia to brown gas:

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

$2NO + O_2 \longrightarrow 2NO_2$ [brown gas]

(c) Ammonia to nitrogen trichloride

$NH_3 + 3Cl_2$ [excess] $\longrightarrow 3HCl + NCl_3$

(d) Ammonia solution to an amphoteric hydroxide :

$AlCl_3 + 3NH_4OH \longrightarrow 3NH_4Cl + Al(OH)_3$

(e) A nitride of a trivalent metal to ammonia:

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

(f) Lead oxide to lead

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

Question 17

State two relevant observations for : ammonium hydroxide soln. is added to zinc nitrate soln. slowly and then in excess.

Answer

White gelatinous precipitate of zinc hydroxide is formed which dissolves in excess of NH_4OH solution.

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

Question 18

Copy and complete the following table relating to important industrial process

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

Answer

Name of the process	Temperature	Catalyst	Equation for the catalyzed reaction
Haber's process	450 to 500°C	Finely divided iron (Fe)	$N_2 + 3H_2 \rightleftharpoons 2NH_3 + \Delta$

Question 19

Distinguish between the following pairs of compounds using the test given in bracket :

(a) Iron [II] sulphate and iron [III] sulphate [using ammonium hydroxide]

(b) A lead salt and a zinc salt [using excess ammonium hydroxide]

Answer

(a) On reaction with ammonium hydroxide, Iron [II] sulphate forms a dirty green ppt whereas iron [III] sulphate forms a reddish brown ppt. Hence, the two can be distinguished easily.

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

$Fe_2(SO_4)_3 + 6NH_4OH \longrightarrow 3(NH_4)_2SO_4 + 2Fe(OH)_3 \downarrow$

(b) A lead salt gives a chalky white ppt. on reaction with ammonium hydroxide that is insoluble in excess of ammonium hydroxide.

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

On the other hand, zinc salt forms a white gelatinous ppt. which dissolves when excess of ammonium hydroxide is added. Hence, the two can be distinguished.

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

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

Question 20

State relevant observation for the following:

(a) Ammonia gas is passed over heated copper (II) oxide.

(b) In the absence of catalyst, ammonia is burnt in an atmosphere of oxygen.

(c) Ammonium hydroxide is first added in a small quantity and then in excess to a solution of copper sulphate.

(d) Water is added to the product formed, when Al is burnt in a jar of nitrogen gas.

(e) Excess of chlorine gas is reacted with ammonia gas.

(f) Calcium hydroxide is heated with ammonium chloride crystals.

Answer

(a) Black copper [II] oxide is reduced to brown copper.

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

(b) **Green or greenish yellow flame** is seen when ammonia gas is burnt in an atmosphere of oxygen. The reaction of combustion of Ammonia is:

$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$

(c) Ammonium hydroxide if first added in small quantity and then in excess to a solution of copper sulphate, a pale blue ppt. of copper hydroxide is formed which dissolves in excess of ammonium hydroxide forming a soluble complex salt.

$CuSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Cu(OH)_2 \downarrow$

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

(d) When Al metal is burnt in a jar of nitrogen gas, its nitride i.e., AlN is formed. When warm water is added to AlN, it undergoes hydrolysis and is decomposed by warm water to give pungent smelling ammonia gas. The corresponding insoluble metal hydroxide (i.e., $Al(OH)_3$) is precipitated out. The reactions are shown below:

$2Al + N_2 \longrightarrow 2AlN$

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

(e) Colourless ammonia gas reacts with greenish yellow excess chlorine giving a yellow explosive liquid (Nitrogen trichloride).

$NH_3 + 3Cl_2$ [excess] $\longrightarrow 3HCl + NCl_3$

(f) Pungent smelling gas (ammonia) is given out.

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

Exercise 9 — Long Answer Type

Question 1

(a) Is ammonia more dense or less dense than air?

(b) What property of ammonia is demonstrated by the Fountain Experiment?

(c) Write the balanced equation for the reaction between ammonia and sulphuric acid.

Answer

(a) Ammonia is **less dense** than air because vapour density of **ammonia is 8.5** and that of **air is 14.4**.

(b) Fountain Experiment demonstrates the **high solubility of ammonia gas in water.**

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

Question 2

Ammonia solution in water gives a blue precipitate when it combines with a solution of copper salt. The blue precipitate further dissolves in excess of ammonia solution to give an azure blue solution. Explain with equation.

Answer

Ammonia solution in water gives a blue precipitate when it combines with a solution of copper salt, due to the formation of $Cu(OH)_2$

$CuSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Cu(OH)_2 \downarrow$

The pale blue precipitate of copper hydroxide dissolves in excess of ammonium hydroxide forming tetraamine copper [II] sulphate, an azure blue soluble complex salt.

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

Question 3

Give chemical equation(s) to prove that NH_3 contains nitrogen and hydrogen?

Answer

Ammonia dissociates into nitrogen and hydrogen at high temperature or by electric sparks

$2NH_3 \rightleftharpoons N_2 + 3H_2$

Question 4

When an ammonium salt is warmed with sodium hydroxide solution, a gas is evolved. State three ways in which you could identify this gas.

Answer

When an ammonium salt is warmed with sodium hydroxide solution, **ammonia gas** is evolved.

$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$

Three ways in which ammonia gas can be identified is:

1. It has a sharp characteristic odour.
2. It turns:
   i. moist red litmus blue,
   ii. moist turmeric paper brown,
   iii. phenolphthalein solution pink.
3. It gives dense white fumes with conc. hydrochloric acid.
   $NH_3 + HCl \longrightarrow NH_4Cl$

Question 5

A gas 'A' reacts with another gas 'B' in the presence of a catalyst to give a colourless gas 'C'. The gas 'C' when comes in contact with air produces a brown gas 'D'. The solution of 'A' in water turns red litmus blue. Explain the observations.

Answer

As the 'A' turns red litmus blue it is a base. Now the gas 'A' combines with 'B' in presence of Catalyst to give colourless gas Nitrogen monoxide. It reacts with oxygen to give brown gas which is Nitrogen dioxide. The gases are given as :

$A = NH_3$

$B = O_2$

$C = NO$

$D = NO_2$

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

$2NO + O_2 \longrightarrow 2NO_2$ [brown gas]

Question 6

(a) Name the common refrigerant. How does it deplete ozone layer?

(b) What is the alternative of chlorofluorocarbon carbon?

(c) State the advantages and disadvantages of using ammonia as refrigerant?

Answer

(a) The main refrigerants used are **Freon chlorofluorocarbons (CFC)**. They deplete ozone layer and contribute to global warming. The chlorofluorocarbons are decomposed by ultraviolet rays to highly reactive chlorine which is produced in the atomic form.

$$CF_2Cl_2 \xrightarrow{\text{Ultraviolet}} CF_2Cl + Cl[\text{free radical}]$$

The free radical [Cl] reacts with ozone and chlorine monoxide is formed.

$Cl + O_3$ [ozone] $\longrightarrow ClO + O_2$

This causes depletion of ozone. Chlorine monoxide further reacts with atomic oxygen and produces more free radicals.

$ClO + O \longrightarrow Cl + O_2$

Again this free radical [Cl] destroys ozone, and the process continues thereby giving rise to ozone depletion.

(b) Liquid ammonia

(c) Advantages of ammonia as refrigerant:

1. Ammonia is environmentally compatible. It does not deplete ozone layer and does not contribute towards global warming.
2. It has superior thermodynamic qualities as result ammonia refrigeration systems use less electricity.
3. Ammonia has a recognizable odour and so leaks are not likely to escape. It being lighter than air goes up in the atmosphere not affecting the life too much on earth.

Disadvantages of ammonia as a refrigerant are as follows:

1. It is not compatible with copper, so it cannot be used in any system with copper pipes.
2. It is poisonous in high concentration.

Question 7

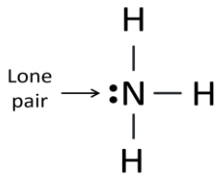
(a) Which feature of ammonia molecule leads to the formation of the ammonium ion when ammonia dissolves in water?

(b) Name the other ion formed when ammonia dissolves in water.

(c) Give one test that can be used to detect the presence of the ion produced in (b).

Answer

(a) Ammonia molecule has a **lone pair of electrons** on it's nitrogen atom.



Due to this lone pair of electrons, in aqueous solutions it forms ammonium ion.

$NH_3 + H_2O \longrightarrow NH_4OH$

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

(b) Hydroxyl ion [OH^-].

(c) The **red litmus paper turns blue** due to the presence of hydroxyl ion in the solution.

Question 8

(a) Of the two gases, ammonia and hydrogen chloride, which is more dense? Name the method of collection of this gas.

(b) Give one example of a reaction between the above two gases which produces a solid compound.

Answer

(a) HCl gas is denser as it's vapour density = 18.25, and that of ammonia is 8.5. HCl gas is collected by the **upward displacement of air.**

(b) $NH_3 + HCl \longrightarrow NH_4Cl$

Question 9

Study the flow chart given and give balanced equations to represent the reactions A, B and C.

$$Mg_3N_2 \xrightarrow{A} NH_3 \underset{C}{\overset{B}{\rightleftarrows}} NH_4Cl$$

Answer

A : $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$ [g]

B:

$$NH3[aq.] + HCl[vapour] \longrightarrow NH4Cl[dense\ white\ fumes]$$

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

Question 10

With respect to the manufacture of ammonia, answer the following:

(a) Name the process involved.

(b) State the ratio of the reactants taken.

(c) State the catalyst used.

(d) Give the equation for the manufacture of the gas - ammonia.

Answer

(a) Haber's Process

(b) Nitrogen (N_2) and hydrogen (H_2) in the ratio 1:3 by volume

(c) Finely divided iron (Fe)

(d) $N_2 + 3H_2 \rightleftharpoons 2NH_3 + \Delta$

Question 11

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

(a) Explain why ammonium nitrate is not used in the preparation of ammonia.

(b) Name the compound normally used as a drying agent during the process.

(c) How is ammonia gas collected? Explain why it is not collected over water.

Answer

(a) As **ammonium nitrate is explosive in nature and may itself decompose forming nitrous oxide and water vapour**, hence it is not used in the preparation of ammonia.

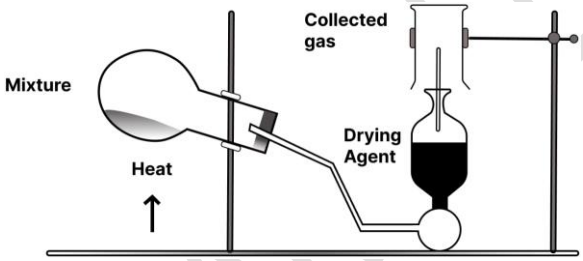
$$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$$

(b) **Quick lime [CaO]** is used as a drying agent during the process.

(c) **Downward displacement of air** is the method used for the collection of the ammonia gas. As ammonia gas is highly soluble in water, therefore, it is not collected over water.

Question 12

The diagram below shows set up for the lab. preparation of a pungent alkaline gas.



(a) Name the gas collected in the jar.

(b) Give a balanced equation for the above preparation

(c) State how the above gas is collected?

(d) Name the drying agent used.

(e) State how you will find out that the jar is full of the pungent gas?

Answer

(a) **Ammonia (NH_3) gas** is collected.

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

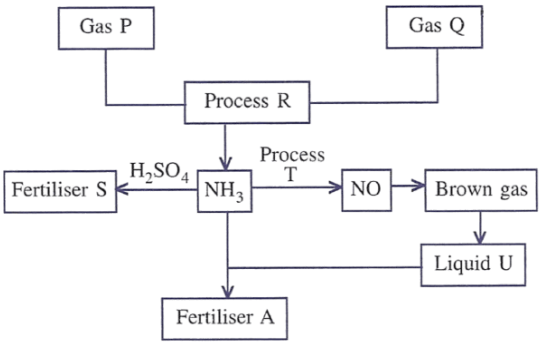
(c) **Downward displacement of air** is the method used to collect the gas.

(d) **Quicklime (CaO)** is the drying agent.

(e) A glass rod dipped in conc. HCl acid is brought near the mouth of the jar. If the jar is full-dense white fumes of ammonium chloride are formed.

Question 13

Answer the following questions with respect to the given figure.



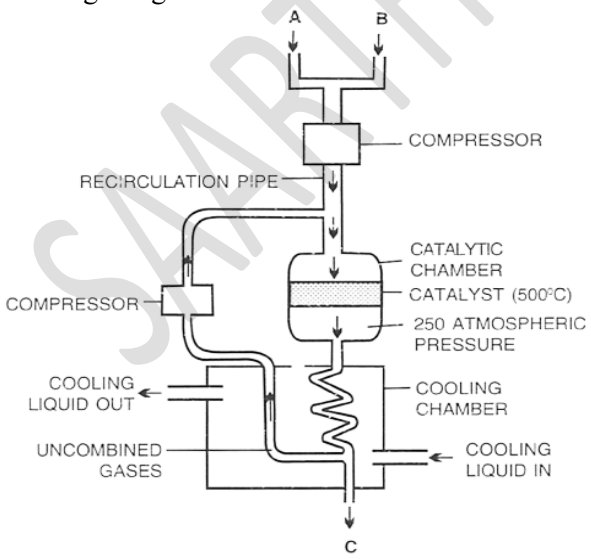
(a) Identify gas P and gas Q.
(b) Give a balanced equation to convert ammonia into gas P by a method other than decomposition. State the property of ammonia used in carrying out the conversion.
(c) Name fertiliser S and give a balanced equation for its preparation.
(d) Name process T and state the conditions that enable conversion of ammonia to nitric oxide.
(e) Give a balanced equation for the conversion of brown gas to liquid U.
(f) Name fertiliser A.
(g) Name process R.

Answer

(a) Gas P — Nitrogen [N_2] and Gas Q — Hydrogen [H_2]
(b) $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$ (g)
Ammonia acts as a reducing agent reducing copper oxide to copper and itself is oxidised to nitrogen gas.
(c) Fertiliser S is **Ammonium sulphate**
$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2 SO_4$
(d) Process T is **Ostwald's process** Conditions that enable conversion of ammonia to nitric oxide are 800°C temperature and platinum as catalyst.
(e) $4NO_2$ (g) + H_2O (l) + O_2 (g) $\longrightarrow 4HNO_3$ (aq.)
(f) Fertiliser A is **Ammonium nitrate**.
(g) Process R is the Haber's process.

Question 14

The diagram given below describes the manufacturing process of a gas.



(a) Name the process.
(b) Identify A, B and C.

(c) State the ratio of A and B
(d) Write the equation involved with their respective conditions.
(e) How is the product separated from unreacted reactants ?

Answer

(a) Haber's process
(b)
A — Nitrogen
B — Hydrogen
C — Liquid ammonia
(c) Ratio of A and B is 1:3
(d)

Reaction:

$N_2 + 3H_2 \rightleftharpoons 2NH_3 + heat$

Favorable Conditions:

Temperature	450-500°C
Pressure	Above 200 atm
Catalyst	Finely divided iron
Promoter	Traces of molybdenum or Al_2O_3

(e) Product is separated from unreacted reactants by Liquification. Ammonia is liquified easily as compared to nitrogen and hydrogen.