Question Bank
Nitric Acid and Nitrates

1. In laboratory preparation of nitric acid from potassium nitrate or sodium nitrate state with reasons :
(a) the acid used **(b)** the type of apparatus used
(c) temperature preferred **[6]**

Ans. (a) Concentrate sulphuric acid is used as it is the least volatile acid and does not distill over with nitric acid vapours.
(b) The apparatus is all glass as nitric acid vapours are highly corrosive in nature and react with rubber or cork stoppers.
(c) Temperature is kept below 200°C. It is because at higher temperature sodium sulphate is formed which fuses with glass appartus and renders it useless. Furthermore, the nitric acid vapours decompose to form nitrogen dioxide gas.

2. State the colour of :
(i) Pure nitric acid.
(ii) Nitric acid obtained during laboratory preparation.
(iii) Nitric acid obtained in laboratory is treated with water or air is blown through it.

Ans. (i) Pure nitric acid is **colourless.**
(ii) Nitric acid obtained in laboratory is pale yellow in colour.
(iii) The pale yellow colour of nitric acid disappears and hence it becomes colourless.

3. Which reaction of ammonia forms first step for the manufacture of nitric acid by Ostwald's process? Give chemical equation. [2]

Ans. The catalytic oxidation of ammonia forms the first step in the manufacture of nitric acid.

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

4. State how does the following affect each related step in Ostwald's Process?

(a) A higher ratio of air in reactants.

(b) Exothermicity of catalytic reaction.

(c) Use of low temperature in the oxidation of nitric oxide.

Ans. (a) 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.

(b) The exothermicity of catalytic reaction helps in stopping external heating, thereby saving on energy.

(c) Low temperature (less than 50°C) helps in rapid conversion of nitric oxide to nitrogen dioxide.

5. Explain the following :

(a) Why does nitric acid stains skin or organic matter yellow?

(b) Why dilute nitric acid cannot be concentrated beyond 68% by boiling? **[4]**

Ans. (a) It is because nitric acid combines with proteins present in the skin or organic matter to form xanthroprotic acid, which is yellow in colour.

(b) 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.

6. How is (a) nitric oxide gas (b) nitrogen dioxide gas is prepared from nitric acid. Support your answer by chemical equation. **[4]**

Ans. (a) When copper metal is treated with cold and dilute nitric acid, it forms nitric oxide gas.

$$3Cu + 8HNO_3 \text{ (dil.)} \longrightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO \text{ (g)}$$

(b) When copper metal is treated with cold and concentrated nitric acid, it forms nitrogen dioxide gas.

$$Cu + 4HNO_3 \text{ (conc.)} \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2 \text{ (g)}$$

7. How can you obtain sulphuric acid from nitric acid by using a non-metal? **[2]**

Ans. When sulphur is boiled with conc. nitric acid, it forms sulphuric acid.

$S + 6HNO_3$ (conc.) $\xrightarrow{heat}$ $H_2SO_4 + 6NO_2 + 2H_2O$

8. How can you obtain carbon dioxide from nitric acid by using a non-metal? **[2]**

Ans. When charcoal powder is boiled with conc. nitric acid, it oxidises it to carbon dioxide.

$C + 4HNO_3$ (conc.) $\xrightarrow{heat}$ $CO_2 + 4NO_2 + 2H_2O$

9. How can you obtain phosphoric acid from nitric acid using an non-metal? **[2]**

Ans. When phosphorus is warmed with conc. nitric acid, it oxidises it to phosphoric acid.

$P + 5HNO_3$ (conc.) $\xrightarrow{warm}$ $H_3PO_4 + 5NO_2 + H_2O$

10. How can you obtain hydrogen from nitric acid using a metal? [2]

Ans. When magnesium is treated with cold and very dilute nitric acid, it reacts to form magnesium nitrate and hydrogen.

$Mg + 2HNO_3$ (V. dil.) $\longrightarrow$ $Mg(NO_3)_2 + H_2$

11. How can you obtain nascent chlorine from nitric acid?

Ans. When one part of conc. nitric acid is mixed with three parts of conc. HCl, it forms a mixture, aqua regia which gives nascent chlorine.

HNO_3 (conc.) + 3HCl (conc.) $\longrightarrow$ $NOCl + 2H_2O + 2[Cl]$

12. What is aqua regia? How does it disolves gold? **[2]**

Ans. A mixture of three parts of conc. HCl and one part of conc. nitric acid is called aqua regia. It supplies nascent chlorine, which dissolves gold.

$3HCl$ (conc.) + HNO_3 (conc.) $\longrightarrow$ $NOCl + 2H_2O + 2[Cl]$

$Au + 3[Cl] \longrightarrow AuCl_3$

13. State how addition of nitric acid to acidified ferrous sulphate serves as a test for nitric acid.

Ans. 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.) $\longrightarrow$ $3Fe_2(SO_4)_3 + 4H_2O + 2NO$

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.

$FeSO_4 + NO \longrightarrow FeSO_4 . NO$

14. **(a)** Name two naturally occuring nitrates.

(b) Give equations for three different methods of preparing nitrates. [4]

Ans. (a) Sodium nitrate and potassium nitrate.

(b) (i) $CaO + 2HNO_3$ (dil.) $\longrightarrow$ $Ca(NO_3)_2 + H_2O$

(ii) $Ca(OH)_2 + 2HNO_3$ (dil. $\longrightarrow$ $Ca(NO_3)_2 + 2H_2O$

(iii) $CaCO_3 + 2HNO_3$ (dil.) $\longrightarrow$ $Ca(NO_3)_2 + 2H_2O + CO_2$

15. Write fully balanced chemical equations for action of heat on :

(a) Two different nitrates which evolve only one gas.

(b) Two different nitrates which leave a coloured residue.

(c) a nitrate which leaves behind no residue. [5]

Ans. (a) (i) $2NaNO_3 \xrightarrow{heat} 2NaNO_2 + O_2$ (g)

(ii) $2KNO_3 \xrightarrow{heat} 2KNO_2 + O_2$ (g)

(b) (i) $2Pb(NO_3)_2 \xrightarrow{heat} 2PbO + 4NO_2$ (g) + O_2(g)
yellow

(ii) $Cu(NO_3)_2 \xrightarrow{heat} 2CuO + 4NO_2$(g) + O_2(g)
black

(c) $NH_4NO_3 \xrightarrow{heat} N_2 + O_2$

16. Select the letters E, F, G, H, and I, which forms gaseous products of reactions 1 to 5.

E. Nitrous oxide, **F.** Hydrogen, **G.** Oxygen,
H. Nitrogen dioxide, **I.** Nitric oxide.

(i) Reaction of manganese with cold and dilute HNO_3

(ii) Reaction of zinc with dilute nitric acid.

(iii) Reaction of sulphur with conc. nitric acid.
(iv) Heating of ammonium nitrate.
(v) Heating of potassium nitrate.

Ans. (i) F. (Hydrogen) **(ii)** I. (Nitric Oxide)
(iii) H. (Nitrogen dioxide)
(iv) E. (Nitrous oxide)
(v) G. (Oxygen)

17. Give balanced equations for the following conversions

(a) Copper $\xrightarrow{P}$ copper nitrate $\xrightarrow{Q}$ copper oxide $\xrightarrow{R}$ copper

(b) Sulphur $\xrightarrow{A}$ sulphuric acid $\xrightarrow{B}$ sulphur dioxide.

Ans. (a) P : $Cu + 4HNO_3$ (conc.) $\longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

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

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

(b) A : $S + 6\ HNO_3$ (conc.) $\xrightarrow{heat} H_2SO_4 + 6NO_2 + 2H_2O$

B : $Cu + 2H_2SO_4$ (conc.) $\xrightarrow{heat} CuSO_4 + 2H_2O + SO_2$

18. Match the observations given from 1 to 5 with respective reactions from A to E.

(i) Reddish brown fumes evolved and reaction mixture is brown	*(A) Heating of KNO_3 +Cu + H_2SO_4 (conc.)*
(ii) Reddish brown fumes evolved and reaction mixture is blue	*(B) Heating of conc. HNO_3*
(iii) A brown solution is obtained	*(C) Heating of zinc nitrate*
(iv) Reddish brown fumes evolved and residue is white solid	*(D) Heating of Lead nitrate*
(v) Reddish brown fumes evolved and residue is yellow solid.	*(E) Reaction with acidified $FeSO_4$+HNO_3*

Ans. (i) B, **(ii)** A, **(iii)** E, **(iv)** C, **(v)** D

19. Select the correct word from the list in brackets to complete each sentence :

(i) The nitrate which on heating melts and liberates only one neutral gas is _____ [$Pb(NO_3)_2$ /$Ca(NO_3)_2$ /$NaNO_3$].

(ii) The reaction of _____ [$CaCO_3$ /CaS/CaO] with dilute nitric acid is an example of neutrilisation reaction.

(iii) Lead nitrate is a/an _____ [normal/acid] salt of nitric acid.

(iv) The mineral acid obtained from conc. nitric acid on reaction with a non-metal is _____ [HCl/H_2SO_4 /H_2CO_3].

(v) The oxidised product obtained on reaction with H_2S gas and dil. HNO_3 is _____ [SO_2 /S/H_2SO_4].

Ans. (i) $NaNO_3$, (ii) CaO, (iii) normal, (iv) H_2SO_4, (v) S

20. (a) What is aqua fortis? Describe a laboratory method of its preparation. [2]

(b) Why should the apparatus used to prepare above compound be all of glass? [1]

(c) Why should the temperature of reaction mixture not be above 200 °C? [1]

Ans. (a) Concentrated nitric acid is called aqua fortis.
It is prepared by heating potassium nitrate crystals with conc. sulphuric acid, when the nitric acid vapour distil over.

$$2KNO_3 + H_2SO_4 \text{ (conc.)} \longrightarrow K_2SO_4 + 2HNO_3$$

(b) The nitric acid is highly corrosive in nature. It attacks stoppers of cork or rubber. Thus, apparatus in which it is kept should be made all of glass.

(c) At a higher temperature (i) nitric acid decomposes to form nitrogen dioxide.
(ii) Instead of $KHSO_4$, K_2SO_4 is formed, which fuses in glass.

21. The two constituents of water gas can be separated by passing the mixture with extra steam over a heated iron catalyst. One of the gases is oxidised and then is dissolved out under pressure in water (or more easily in aqueous KOH). What is the name of the gas X left after this process have been carried out?
The gas X can be mixed with one of the gases present in air and then used in the preparation of yet another very important industrial gas.
(i) Name the gas present in air. (ii) Name the important industrial gas. (iii) What happens when this gas is passed over heated cupric oxide? Write an equation. [5]

Ans. X is hydrogen gas.

(i) Nitrogen is the gas present in air.

(ii) Important industrial gas is ammonia.

(iii) Ammonia reduces copper oxide to copper.

$$3CuO + 2NH_3 \xrightarrow{\Delta} 3Cu + 3H_2O + N_2$$

22. **(a)** Explain what you would observe and write the equation for what happens when lead nitrate is heated strongly. [3]

(b) **(i)** Fill in the blank spaces in the following statements :
Most of the nitric acid today is manufactured by Ostwald's process. In this process, a mixture of pure dry ammonia and air in the ratio of ..... by volume is first compressed and then passed over ..... at about ..... °C. This results in the oxidation of ammonia into ..... which combines with ..... of the air to give ..... This is an acidic gas from which nitric acid can be obtained by simply dissolving in ..... [4]

(ii) Give all the equations involved in the above process. [3]

Ans. **(a)** On heating, lead nitrate decomposes with a decrepitating noise and leaves behind a residue, which is reddish brown when hot and yellow when cold. It partially fuses in glass. It gives off reddish brown nitrogen dioxide gas along with oxygen.

$$2Pb(NO_3)_2 \xrightarrow{\text{heat}} 2PbO + 4NO_2 + O_2\ (g)$$

(b) (i) Most of the nitric acid today is manufactured by Ostwald's process. In this process, a mixture of pure dry ammonia and air in the ratio of **1 : 10** by volume is first compressed and then passed over **Platinum** at about **900 °C.** This results in the oxidation of ammonia into **nitric oxide** which combines with **oxygen** of the air to give **nitrogen dioxide.** This is an acidic gas from which nitric acid can be obtained by simply dissolving in **water.**

(ii) $4NH_3 + 5O_2 \xrightarrow{Pt\ -\ 900\ ^\circ C} 4NO + 6H_2O$

$4NO + 2O_2 \longrightarrow 4NO_2$

$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$

23. Give equations to obtain each of the following, mentioning the necessary experimental conditions.

(i) To obtain nitric oxide from nitric acid.

(ii) To obtain chlorine from concentrated hydrochloric acid.

(iii) To obtain lead from lead monoxide. [3]

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

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

(iii) $PbO + C \xrightarrow{heat} Pb + CO$

24. How can you obtain nitrous oxide from sodium nitrate? [2]

Ans. When sodium nitrate is mixed with ammonium chloride and gently heated, the following reaction takes place with the liberation of nitrous oxide.

$$NH_4Cl + NaNO_3 \xrightarrow{\Delta} NaCl + N_2O + 2H_2O$$

25. (a) 1. "To test the nitrate radical, only freshly prepared ferrous sulphate solution is used." Explain. [2]

2. Why is freshly prepared concentrated nitric acid yellow in colour? [1]

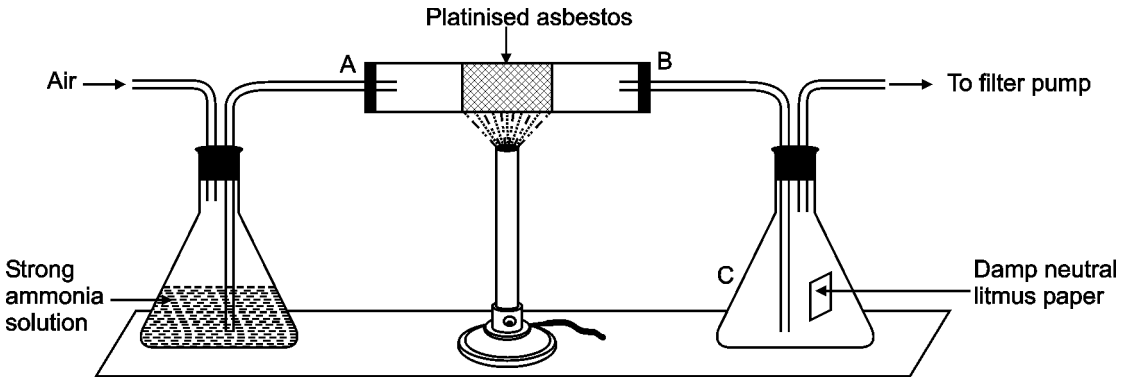
3. Write equations for the following and state which one of these reactions is a decomposition.

(i) One reaction of nitric acid with copper chips.

(ii) The action of heat on lead nitrate.

(iii) Reaction when ammonia is passed over heated cupric oxide. [3]

(b) When the air is drawn through the apparatus shown in the diagram, the following observations are made :



(i) The damp neutral litmus paper in the flask turns blue.
(ii) The platinised asbestos glows and continues to glow when the burner is removed.
(iii) A colourless liquid condenses at B.
(iv) Brown fumes appear in the flask and the litmus now turns pink. [1]

1. What is the purpose of platinised asbestos ?
2. Describe in words or in equations the chemical changes that are occurring in the apparatus, explaining the observations in (i), (ii), (iii) and (iv). Give reasons for your answers. [6]

(c) Give two uses of nitric acid. [2]

(d) Write down the equations for the following reactions :

(i) When ammonium chloride is warmed with sodium hydroxide solution.
(ii) When ammonium chloride is warmed with concentrated sulphuric acid. [2]

Ans. (a) **1.** It is because if ferrous sulphate is kept for a long time, it is oxidised to ferric sulphate due to self-oxidation. Thus, it cannot be used for testing nitrate radical.

2. It is because it contains some amount of nitrogen dioxide dissolved in it. It is nitrogen dioxide, which gives it a yellow tint.

3. (i) $Cu + 4HNO_3$ (conc.) $\longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

(ii) $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$
(It is a decomposition reaction.)

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

(b) **1.** It acts as a catalyst for the oxidation of ammonia.

2. **(i)** It is because ammonia is not completely oxidised initially. Thus, it turns litmus paper blue.

(ii) It is because reaction is exothermic in nature.

(iii) The colourless liquid formed during the oxidation of ammonia is water.

(iv) Brown fumes are formed, as nitric oxide is oxidised to nitrogen dioxide.

$$4NH_3 + 5O_2 \xrightarrow[900°]{Pt} 4NO + 6H_2O$$

$$4NO + 2O_2 \longrightarrow 4NO_2$$

(c) Uses of nitric acid :

1. It is used for etching designs in metals.
2. It is used as a rocket fuel.

(d) (i) $NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$ (g)

(ii) $2NH_4Cl + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2HCl$

26. **(a)** During a rain storm, the rainwater contains traces of nitric acid. Explain. [3]

(b) Lead nitrate is heated. Write a balanced equation. [1]

(c) Explain briefly or give balanced equations to show how would you obtain :

(i) Copper oxide from copper nitrate,

(ii) Ammonia from ammonium chloride. [2]

(d) **(i)** Give two large-scale uses of nitric acid.

(ii) A sample contains nitric oxide. The nitric oxide can be removed by passing the mixture through solution "S". Name the solution "S".

(iii) Nitrogen can be obtained in its pure state by heating a mixture of ammonium chloride and substance X. Name the substance X. [3]

(e) Nitrogen dioxide is called mixed anhydride. Explain. [1]

Ans. **(a)** $N_2 + O_2 \xrightarrow{\text{lightning}} 2NO$

$2NO + O_2 \longrightarrow 2NO_2$

$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$

As nitrogen and oxygen ultimately change to nitric acid during lightning, therefore, rain-water contains traces of nitric acid.

(b) $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

(c) (i) Heat copper nitrate strongly, till it gives off no more brown fumes. The residue left is copper oxide.

$2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2$ (g)

(ii) Heat ammonium chloride with calcium hydroxide.

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

(d) **(a)** It is used in making silver nitrate, which is required in the photographic industry.

(b) It is used in the manufacture of fertilisers.

(ii) The solution S is freshly prepared ferrous sulphate.

(iii) X is sodium nitrite.

(e) It is because nitrogen dioxide on dissolving in water forms two acids, i.e., nitric acid and nitrous acid.

27. **(a)** Name the gas evolved and write chemical equation when ammonium nitrate is heated.

(b) Name : (1) A metal which reacts with very dilute nitric acid to liberate hydrogen.

(2) A substance, which on heating decomposes, but does not leave any residue behind. [2]

(c) What is the product of oxidation of ammonia in Ostwald's process? [1]

Ans. (a) Gas evolved is nitrogen (I) oxide.

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

(b) (1) Magnesium. (2) Ammonium nitrate.

(c) Nitrogen (II) oxide (nitric oxide) and steam.

28. (a) Name :

(i) A gas which dissolves in water to give an alkaline solution.

(ii) A metal which reacts with very dilute nitric acid to liberate hydrogen.

(iii) A salt which is insoluble in cold water, but is soluble in hot water. [3]

(b) State the products of the following reactions :

(i) When ammonium nitrate is heated.

(ii) When a mixture of ammonium chloride and calcium hydroxide is heated. [2]

(c) What is the importance of nitrogen gas in air? [1]

(d) Write "word equations" or correctly balanced molecular equations for each of the following :

(i) Sodium nitrate is heated strongly.

(ii) Ammonium hydroxide is added to aqueous solution of iron (III) chloride.

(iii) A mixture of common salt (sodium chloride) and manganese dioxide is warmed with conc. sulphuric acid.

(iv) Magnesium nitride is treated with water.

(e) Give chemical names for :

(i) Aqua fortis **(ii)** Sal ammoniac. [2]

Ans. (a) (i) Ammonia **(ii)** Magnesium

(iii) Lead chloride.

(b) (i) Nitrous oxide (laughing gas) and steam.

(ii) Calcium chloride, water and ammonia gas.

(c) Nitrogen reduces the activity of oxygen present in air. Thus, the combustion of food materials in our body takes place at a controlled rate.

(d) **(i)** $2NaNO_3 \xrightarrow{heat} 2NaNO_2 + O_2$ (g)

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

(iii) $2NaCl + MnO_2 + 3H_2SO_4$ (conc.) $\xrightarrow{heat} 2NaHSO_4 + MnSO_4 + 2H_2O + Cl_2$ (g)

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

(e) **(i)** Aqua fortis is a conc. nitric acid.

(ii) Sal ammoniac is ammonium chloride.

29. **(a)** **(i)** Name a drying agent for ammonia.

(ii) Name a nitrate of metal which on heating does not give nitrogen dioxide. [2]

(b) Name all the products formed when :

(i) Ammonium nitrate is heated. **(ii)** Ammonia is passed over heated copper oxide. [2]

(c) Name all the products formed when ammonium chloride is mixed with sodium nitrite and the mixture is heated. [2]

(d) Calculate the percentage of nitrogen in ammonium nitrate (NH_4NO_3). [At. wt. of H = 1; N = 14; O = 16] [2]

(e) Write a balanced equation for the preparation of nitric acid from potassium nitrate. [2]

(f) Under what conditions do nitrogen and hydrogen combine to form ammonia? State one large-scale use of ammonia. [3]

(g) Write balanced word equations or balanced equations for the following :

(i) Action of concentrated nitric acid on copper.

(ii) Action of heat on sodium nitrate.

(iii) Water is added to aluminium nitride. [3]

Ans. (a) **(i)** Quicklime. **(ii)** Sodium nitrate.

(b) **(i)** Nitrous oxide gas (laughing gas) and steam.

(ii) Copper metal, nitrogen gas and steam.

(c) Sodium chloride, steam and nitrogen gas.

(d) Molecular wt. of NH_4NO_3 = 80 amu.

Molecular wt. of N_2 in NH_4NO_2 = 28 amu.

$\therefore$ % age of nitrogen in $NH_4NO_3 = \frac{28}{80} \times 100 = 35\%$.

(e) $KNO_3 + H_2SO_4$ (conc.) $\xrightarrow{\text{below } 200^oC}$ $KHSO_4 + HNO_3$

(f) **(i)** The ratio of volumes of nitrogen and hydrogen should be 1 : 3.

(ii) The mixture should be compressed between 200 Atms – 900 Atms.

(iii) The mixture should be passed over heated iron, containing molybdenum as promoter at 450 °C.

Ammonia is chiefly used in the manufacture of fertilisers.

(g) **(i)** $Cu + 4HNO_3$ (conc.) $\longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

(ii) $2NaNO_3 \xrightarrow{\text{heat}} 2NaNO_2 + O_2$

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

30. (a) Give reasons for the following :

(i) In the laboratory preparation of nitric acid, the mixture of concentrated sulphuric acid and sodium nitrate should not be heated very strongly above 200 °C. [1]

(ii) Though ammonium nitrite readily gives nitrogen on heating, a mixture of ammonium chloride and sodium nitrite in water is heated to prepare nitrogen in the laboratory. [1]

(iii) Reagent bottles containing sodium hydroxide solutions should have rubber stoppers and not glass stoppers. [1]

(iv) Ammonia cannot be collected over water.

(b) Complete and balance the following equations :

(i) $Cu + HNO_3 \longrightarrow$ ..... + NO_2

(ii) $NH_4NO_3 \longrightarrow$..... + ... [2]

(c) Give a chemical name or the formula of a substance formed as a brown ring in the test for nitrates. [2]

(d) Explain by giving a reason that commercial concentrated nitric acid is yellow in colour. But when it is diluted with water, it turns colourless. [2]

(e) State the conditions for the oxidation of ammonia to nitrogen monoxide (nitric oxide) in the manufacture of nitric acid by Ostwald's process. Also write the balanced equation of reaction which takes place. [2]

(f) Like oxygen, nitrous oxide (N_2O) also supports combustion. A glowing splint introduced in the jar of nitrous oxide is rekindled. Give one chemical test to distinguish oxygen from nitrous oxide. [1]

(g) Give (i) one chemical test for nitric acid (ii) two large-scale uses of ammonia. [2]

Ans. **(a)** **(i)** Refer to answer No. 53 – Section B.

(ii) It is because ammonium nitrite is highly unstable and cannot be stored for a long time. Furthermore, it decomposes explosively.

(iii) It is because sodium hydroxide, if kept for long time in glass, has a tendency to fuse in glass. Thus, stoppers get stuck in the neck.

(iv) It is because ammonia is highly soluble in water.

(b) **(i)** $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

(ii) $NH_4NO_3 \xrightarrow{\text{heat}} N_2O + 2H_2O$

(c) Chemical name : Nitrosoferrous sulphate.
Formula : $FeSO_4$. NO

(d) It is because it contains dissolved nitrogen dioxide. On diluting, nitrogen dioxide dissolves in water to form nitric acid.

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

(e) **Conditions :** (i) Ammonia and oxygen should be present in the ratio of 1 : 2 by volume.
(ii) Platinum should be used as catalyst.
(iii) Temp. should be maintained at 900 °C.
Equation :

$$4NH_3 + 5O_2 \xrightarrow{Pt - 900^oC} 4NO + 6H_2O$$

(f) Carbon (red hot) burns in oxygen to form carbon dioxide gas only, but in N_2O, it forms carbon dioxide gas and nitrogen.

(g) (i) All nitrates on heating with conc. sulphuric acid and small amount of copper turnings liberate reddish-brown gas — nitrogen dioxide.
(ii) (a) It is used in the manufacture of fertilisers such as urea, ammonium sulphate, etc.
(b) It is used in the manufacture of nitric acid.

31. **(a)** State what will you observe when :
(i) lead nitrate crystals are heated in a dry test tube.
(ii) ammonium hydroxide solution is added to copper sulphate solution, first a little and then in excess. [2]

(b) Name the products formed when :
(i) a mixture of carbon and conc. nitric acid is heated.
(ii) dilute nitric acid is added to copper. [2]

(c) Nitrogen prepared from atmosphere is more dense than nitrogen prepared by chemical reactions. Explain. [1]

Ans. **(a)** (i) Refer to answer No. 55 — Section B.
(ii) Initially, it forms a bluish white ppt. of copper hydroxide. On adding excess of ammonium hydroxide, the ppt. dissolves and it forms deep blue coloration.

(b) (i) Carbon dioxide gas, nitrogen dioxide gas and water.
(ii) Copper nitrate, nitric oxide gas and water.

(c) The nitrogen obtained from the air contains 1% of inert gases, which tends to increase its density.

32. (a) Copy and complete the following table : [2]

Process	***Name of Product***	***Name of Catalyst***	***Approx. Temperature***	***Approximate Pressure***
Haber's Process				

(b) Write the balanced equation for the preparation of ammonia from ammonium chloride. [1]

(c) Explain, why ammonia gas is evolved, when water is added to the product formed, when magnesium is burnt in air. [2]

(d) Name the gas evolved when the following mixtures are heated:

(i) Ammonium chloride and calcium hydroxide.

(ii) Ammonium chloride and sodium nitrate. [2]

(e) **(i)** Sodium hydroxide solution is added to solution A, a white ppt. is formed, which is insoluble in excess of sodium hydroxide. What metal ion is present in A? [1]

(ii) Ammonium hydroxide solution is added to solution B, when a pale blue ppt. is formed. This pale blue ppt. dissolves in excess of ammonium hydroxide to give inky blue colouration. Name the cation present in B. Name the probable colour of solution B. [2]

(iii) When an ammonium salt is warmed with sodium hydroxide solution, ammonia gas is evolved. State three ways in which you can identify the gas. [3]

Ans. (a)

Process	***Name of Product***	***Name of Catalyst***	***Approx. Temperature***	***Approximate Pressure***
Haber's Process	*Ammonia gas*	*Iron*	*450 °C*	*200 atms – 900 atms.*

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

(c) Magnesium reacts with nitrogen to form magnesium nitride. The magnesium nitride reacts with water to liberate ammonia gas.

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

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

(d) **(i)** Ammonia gas. **(ii)** Nitrous oxide (laughing gas).

(e) **(i)** Calcium ion is present in A. (ii)Copper ion is present in B. The colour of solution is deep blue.

(iii) 1. It has a characteristic burning smell which brings tears to eyes.

2. It turns red litmus paper blue, turmeric paper brown and phenolphthalein solution pink.

3. It forms dense white fumes with hydrochloric acid gas.

33. **(a)** Describe all that you would observe when copper nitrate is heated. [1]

(b) The following statement is correct only under certain conditions. Rewrite the statement, stating experimental conditions. "Copper and nitric acid react together producing nitrogen dioxide." [1]

(c) Name the product, catalyst and approximate temperature in Ostwald's process. How is the temperature maintained in Ostwald's process? [2]

(d) During a thunderstorm, the rainwater contains nitric acid. The nitric acid formed as a result of three chemical reactions. Describe (or write balanced chemical equations for) these three reactions. [2]

Ans. **(a)** Greenish-blue coloured copper nitrate on heating decomposes to give a reddish-brown gas nitrogen dioxide along with oxygen. It leaves behind a black residue of copper oxide.

(b) Copper and concentrated nitric acid react together at the room temperature, producing nitrogen dioxide gas.

(c) Product : Nitric oxide and steam.
Catalyst : Platinum at 900 °C.
Temperature is maintained by itself as the reaction is exothermic.

(d) Refer to answer. No. 59 (a) – Section B.

34. (a) Copy and complete the following equations :

(i) $Mg_3N_2 + 6H_2O \longrightarrow$

(ii) $2NH_3 + 3CuO \longrightarrow$

(iii) $8NH_3 + 3Cl_2 \longrightarrow$

(iv) $4NH_3 + 5O_2 \longrightarrow$ [4]

(b) **(i)** How would you obtain the compound magnesium nitride? [1]

(ii) What property is illustrated by reaction (a) (ii) above? [1]

(iii) What important industrial process starts with reaction (a)

(iv) above ? Name the catalyst used. [2]

(c) During laboratory preparation how is ammonia dried and collected? [2]

Ans. (a) **(i)** $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$

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

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

(iv) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

(b) **(i)** By burning magnesium ribbon in the atmosphere of nitrogen.
$3Mg + N_2 \longrightarrow Mg_3N_2$

(ii) Nitrogen is an oxidising agent.

(iii) Ostwald's reaction for the manufacture of nitric acid. The catalyst used is platinum.

(c) Ammonia is dried by passing it through quicklime.
Ammonia is collected by the downward displacement of air.