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O-level

Nitrogen and its compounds

Source: Air

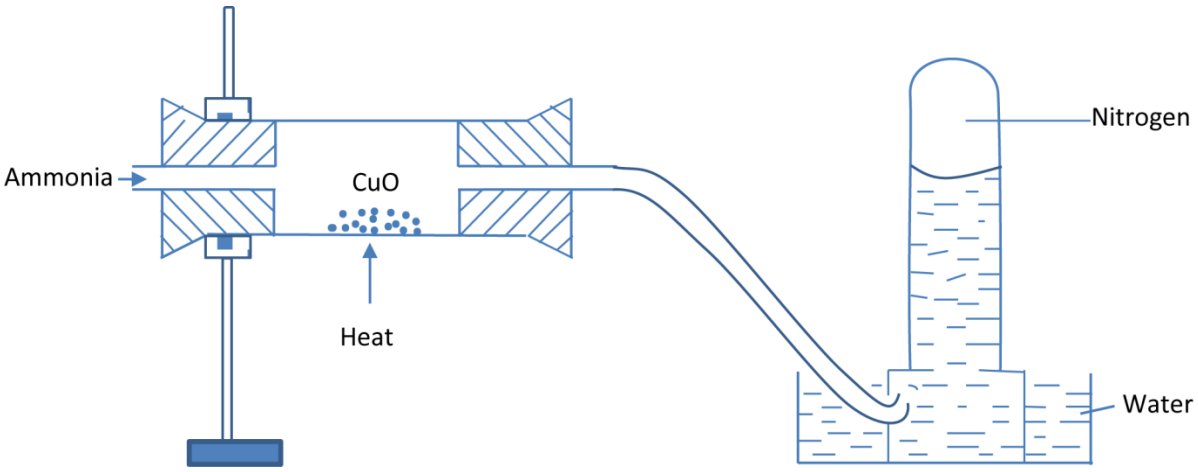
Industrial preparation of nitrogen

By distillation of air from which carbon dioxide and water vapor have been removed. Nitrogen distills of leaving oxygen as the residue. (oxygen has a higher boiling point than nitrogen)

Laboratory preparation

By oxidation of ammonia with copper oxide

Set up



Equation

$2NH_3(g) + 3CuO(s) \rightarrow N_2(g) + 3H_2O(l) + 3Cu(s)$

Physical properties on nitrogen

- It is colorless
- Odorless
- Non reactive

Chemical properties of nitrogen

Nitrogen does not react easily because the nitrogen atoms are bonded by strong triple covalent bonds

However, under drastic conditions it reacts to form compounds. For instance, nitrogen reacts with magnesium, zinc and lithium to form nitrides. This is because the formation of nitrides liberates a lot of heat that breaks the strong nitrogen-nitrogen triple bond

$3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$

$3Zn(s) + N_2(g) \rightarrow Zn_3N_2(s)$

$6Li(s) + N_2(g) \rightarrow 2Li_3N(s)$

The nitrides hydrolyze in water to give ammonia

$Mg_3N_2(s) + 6H_2O(l) \rightarrow 3Mg(OH)_2(s) + NH_3(g)$

Ammonia is an alkaline gas that turns litmus solution blue or damp red litmus paper blue.

Note that magnesium burns in air to produce magnesium oxide as well.

$Mg(s) + O_2(g) \rightarrow 2MgO(s)$

Magnesium oxide is a white solid that is insoluble in water.

Exercise 1

Magnesium burns in air to produce two solids A and B. A is insoluble in water while B reacts with water to form a gas that turns damp red litmus paper blue

(a) Identify Solids A and B.
(b) Write equations leading to the formation of A and B.
(c) Write and equation between B and water.

Uses of nitrogen

a. Raw material for synthesis of ammonia and nitric acid
b. Coolant

Compounds of nitrogen

Ammonia, NH_3

Industrial preparation

By reaction nitrogen and hydrogen

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + heat$

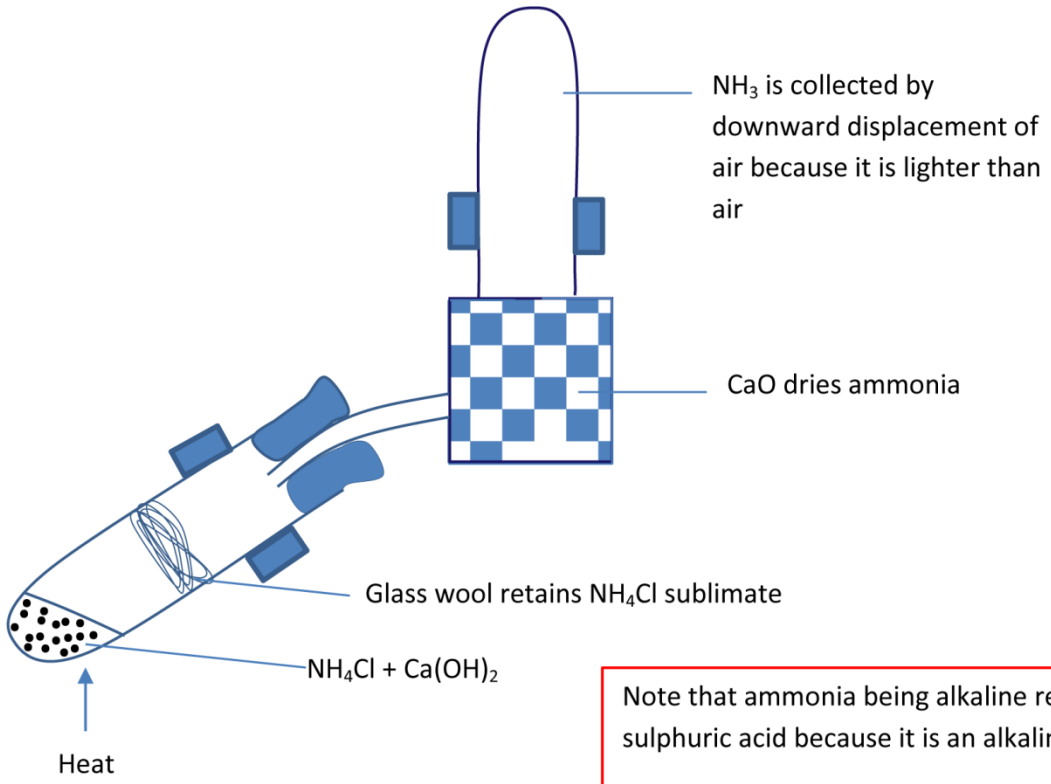
Conditions for production of ammonia.

1. Pressure:
   Production of ammonia is accompanied with a decrease in the number of moles of a gas and as such high yield of ammonia is favored by high pressure.
2. Temperature
   Production of ammonia produces heat; high yields are thus expected at low temperatures.

   However, at low temperature, the reaction is slow that a compromise temperature of 450^0-500^0C is used.
3. A catalyst is iron

Laboratory preparation of ammonia

By reacting calcium hydroxide ($Ca(OH)_2$) with ammonium chloride (NH_4Cl)



Note that ammonia being alkaline reacts with sulphuric acid because it is an alkaline gas.

Thus, concentrated sulphuric acid is not used to dry ammonia

Equation

$Ca(OH)_2$ (s) + $2NH_4Cl$ (s) → $CaCl_2$(aq) + $2H_2O$ (l) + $2NH_3$ (g)

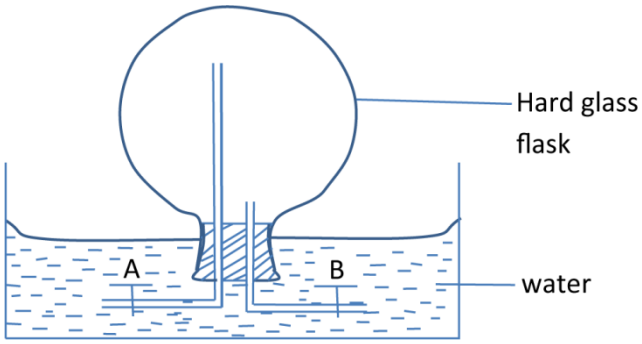
Reasons why ammonia is not dried suing fused calcium chloride or concentrated sulphuric acid.

In presence of water calcium chloride reacts with ammonia to form ammonium chloride
$2NH_3(g) + CaCl_2 (s) + H_2O(l) \rightarrow 2NH_4Cl(aq) + CaO(s)$
Ammonia reacts with sulphuric acid
$2NH_3(g) + H_2SO_4 (aq) \rightarrow (NH_4)_2SO_4 (aq)$

Properties of ammonia

(i) Has chocking smell
(ii) Turns red litmus paper from red to blue.
(iii) It is very soluble in water

This solubility is demonstrated by a fountain experiment.



(a) The hard glass flask is filled with ammonia and taps A and B are closed
(b) The flask is inverted in water as shown above.
(c) Tap B is open water dissolves ammonia to create a vacuum inside the flask
(d) Immediately tap A is open, water splashes into the flask like a fountain.

(iv) Ammonia as a reducing agent
It reduces black copper oxide to brown copper and orange lead II oxide to grey lead metal.

$3CuO(s) + 2NH_3 (g) \longrightarrow 3Cu (s) + 3H_2O (l)$

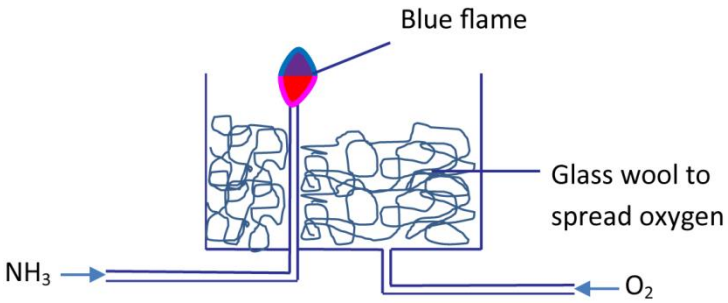
Black brown

$3PbO(s) + 2NH_3 (g) \longrightarrow 3Pb (s) + 3H_2O (l)$

Orange grey

(v) Oxidation of ammonia

Ammonia burns with a blue flame in oxygen.



Equation

$4NH_3\ (s) + 3O_2\ (s) \rightarrow 2N_2(g) + 6H_2O\ (l)$

In presence of excess O_2 and platinum or copper wire catalyst, ammonia is oxidized to nitrogen monoxide and the brown fumes on nitrogen dioxide.

$4NH_3\ (s) + 5O_2\ (s) \rightarrow 4NO(g) + 6H_2O\ (l)$

$2NO_2\ (s) + O_2\ (s) \rightarrow 2NO_2(g)$

(vi) Reaction of ammonia solution with common cations

- Form a white precipitate with lead (II) and aluminium salts that are insoluble in excess

  $NH_3\ (aq) + H_2O\ (l) \rightarrow NH_4^+(aq) + OH^-\ (aq)$

  Then

  $Pb^{2+}(aq) + 2OH^-(aq) \rightarrow Pb(OH)_2(s)$

  $Al^{3+}(aq) + 3OH^-(aq) \rightarrow Al(OH)_3(s)$
- Forms white precipitate with zinc II salts soluble in excess due to formation of a complex ion

  $Zn^{2+}(aq) + 2OH^-(aq) \rightarrow Zn(OH)_2\ (s)$

  Then

  $Zn(OH)_2\ (s) + 4NH_3\ (aq) \xrightarrow{\text{Excess}} Zn(NH_3)_4^{2+}(aq)$
- Forms blue precipitate with copper II salts soluble in excess to give a deep blue solution due to formation of a complex ion

  $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2\ (s)$

  Then

  $Cu(OH)_2\ (s) + 4NH_3\ (aq)\ (Excess) \rightarrow Cu(NH_3)_4^{2+}(aq)$

(vii) React of ammonia with chlorine

Ammonia is oxidized by chlorine to nitrogen

$2NH_3(g) + 3Cl_2(g) \rightarrow N_2(g) + 6HCl(g)$

Uses of ammonia

- Disinfectant
- For preparation of liquid soap
- Fertilizers

  Note that prolonged use of ammonia nitrate fertilizer may make the soil acidic because ammonium nitrate in soil reacts with water forming ammonium hydroxide and nitric acid plants absorb ammonium ions leaving nitric acid in solution.

  $NH_4NO_3(s) + H_2O(l) \rightarrow NH_4OH(aq) + HNO_3(aq)$

Ammonium salts

Common ammonium salt include ammonium chloride (NH_4Cl), ammonium sulphate ($(NH_4)_2SO_4$) ammonium carbonate ($(NH_4)_2CO_3$) and ammonium nitrate (NH_4NO_3)

a. Ammonium chloride, ammonium carbonate and ammonium sulphate decompose to give an alkaline gas ammonia (turns damp red litmus paper blue). Ammonium chloride sublimes the rest do not.

$NH_4Cl \xrightarrow{heat} NH_3(g) + HCl(g)$

$(NH_4)_2CO_3(s) \xrightarrow{heat} 2NH_3(g) + CO_2(g) + 2H_2O(l)$

$(NH_4)_2SO_4 \rightarrow (NH_4)HSO_4 + NH_3(g)$

Or

$(NH_4)_2SO_4 \rightarrow N_2(g) + 2SO_2(g) + 4H_2O(l)$

b. Ammonium salts react with sodium hydroxide to liberate ammonia

   $NH_4^+(aq) + OH^-(aq) \rightarrow NH_3(g) + H_2O(l)$

   Ammonia is an alkaline gas that turns damp red litmus paper blue.

Nitric acid

Industrial preparation

Ammonia is oxidized to nitrogen dioxide in the presence of platinum catalyst.

$4NH_3\ (s) + 7O_2\ (s) \rightarrow 4NO_2(g) + 6H_2O\ (l)$

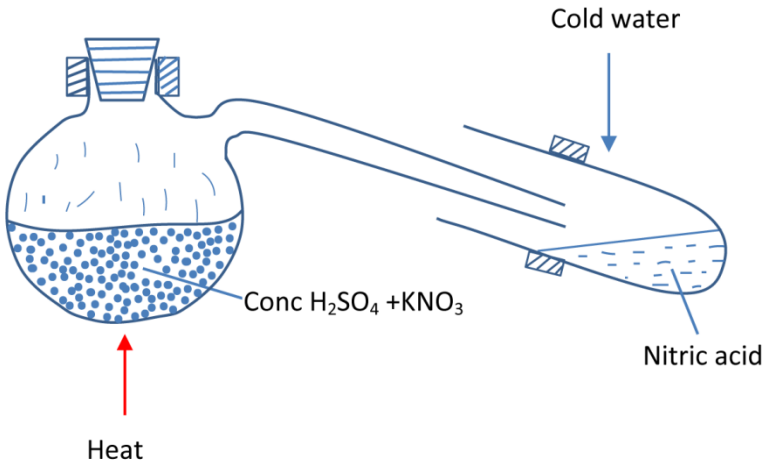
The nitrogen dioxide is dissolved in water in presence of oxygen to produce nitric acid

$4NO_2\ (g) + 2H_2O\ (l) + O_2\ (g) \rightarrow 4HNO_3\ (aq)$

Laboratory preparation

By heating potassium nitrate with concentrated sulphuric acid

$H_2SO_4\ (aq) + 2KNO_3\ (s) \rightarrow HNO_3(aq) + KHSO_4(aq)$



Properties of nitric acid

a. Turns blue litmus red
b. Liberate carbon dioxide from carbonates and hydrogen carbonates
   $HCO_3^- + H^+\ (aq) \rightarrow CO_2(g) + H_2O(l)$
   $CO_3^{2-} + 2H^+\ (aq) \rightarrow CO_2(g) + H_2O(l)$

c. It reacts with metals to produce hydrogen
   $Mg\ (s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$

d. It oxidizes non metals
   $S(s) + 6HNO_3(aq) \rightarrow H_2SO_4\ (aq) + 6NO_2(aq) + 2H_2O\ (l)$
   $C(s) + 4HNO_3(aq) \rightarrow CO_2\ (s) + 6NO_2(aq) + 2H_2O\ (l)$

e. It decomposes on heating to form nitrogen dioxide and oxygen
   $4HNO_3(l)\ \ (Heat) \rightarrow 4NO_2\ (g) + O_2\ (g) + 2H_2O(l)$
   Nitrogen dioxide is soluble in water where oxygen is insoluble in water. Therefore, when fuming nitric acid is heated, the gas collected over water is oxygen.
f. It oxidizes metals
   It oxidizes copper and lead to copper II nitrate and lead II nitrate respectively.

$3Cu(s) + 8HNO_3(aq) \rightarrow 3Cu(NO_3)_2(aq) + 2NO(g) + 4H_2O\ (l)$

Dilute

$3Pb(s) + 8HNO_3(aq)\ (dil) \rightarrow 3Pb(NO_3)_2(aq) + 2NO(g) + 4H_2O\ (l)$

$Cu(s) + 4HNO_3(aq)(conc.) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O\ (l)$

$Pb(s) + 4HNO_3(aq)\ (conc) \rightarrow Pb(NO_3)_2(aq) + 2NO_2(g) + 2H_2O\ (l)$

Nitrates

These are salt of nitric acid
Decomposition of nitrates

1. Nitrates of group 1 elements decompose on heating to give nitrites and oxygen
   $2NaNO_3\ (s) \rightarrow 2NaNO_2\ (s) + O_2\ (g)$

2. Nitrates of other elements decompose to liberate oxide, nitrogen dioxide and oxygen.

   $2Cu(NO_3)_2\ (s) \rightarrow 2CuO(s) + 2NO_2(g) + O_2\ (g)$

   $2Pb(NO_3)_2\ (s) \rightarrow 2PbO(s) + 2NO_2(g) + O_2\ (g)$

3. Silver nitrate decompose on heating to liberate silver metal, nitrogen dioxide and oxygen
   $2Ag(NO_3)_2\ (s) \rightarrow 2Ag\ (s) + 2NO_2(g) + O_2\ (g)$
4. Ammonium nitrate decompose on heating into dinitrogen oxide and water
   $NH_4NO_3 \rightarrow N_2O(g) + 2H_2O(l)$

Testing for nitrates

1. Nitrates are identified from the brown fumes when nitrates are heated strongly.
2. Brown ring test
   To 1 cm^3 of a nitrate solution, add freshly prepared iron II sulphate, followed sulphuric acid slowly over the wall of slanted test tube.
   Observation
   A brown ring forms at the junction of the two solution.
   Uses of nitric acid
   For fertilizers, dyes, explosives.

Exercise

For numbers 1 to 20 circle the correct alternative

1. Which of the following when heat does not produce oxygen?
   A. $Ca(NO_3)_2$
   B. $AgNO_3$
   C. KNO_3
   D. $NH4NO_3$

4. Which of the following nitrates will form nitrogen dioxide when strongly?
   A. Calcium nitrate
   B. Sodium nitrate
   C. Copper (II) nitrate
   D. Ammonium nitrate

2. Which of the following gases is evolved when copper is reacted with concentrated nitric acid?
   A. Nitrogen
   B. Nitrogen monoxide
   C. Nitrogen dioxide
   D. Dinitrogen oxide

3. Which one of the following catalyst is used during the manufacture of ammonia
   A. Platinum
   B. Manganese (IV) oxide
   C. Vanadium (V) oxide
   D. Finely divided iron

4. $560cm^3$ of an oxide of nitrogen N_yO_x, weigh 1.10g at s.t.p. What one of the following is the oxide of nitrogen? (N = 14, O = 16; 1 mole of a gas at s.t.p occupies 22.4 dm^3)
   A. NO
   B. NO_2
   C. N_2O
   D. N_2O_4

5. Which of the following gases is formed when ammonia is passed over heated copper (II) oxide?
   A. Nitrogen monoxide
   B. Nitrogen dioxide
   C. Dinitrogen oxide
   D. Nitrogen

6. Which one of the following equations shows the reaction in which nitric acid behaving as oxidizing agent?
   A. $Mg(s) + 6HNO_3(aq) \longrightarrow Mg(NO_3)_2(aq) + H_2\ (g)$
   B. $S(s) + 6HNO_3(aq) \longrightarrow H_2SO_4(aq) + 6NO_2(g) + 2H_2O\ (l)$
   C. $CuCO3(s) + 2HNO_3\ (aq) \longrightarrow Cu(NO3)2\ (aq) + H2O(l) + CO_2\ (g)$
   D. $ZnO\ (s) + 2HNO_3\ (s) \longrightarrow Zn(NO_3)_2\ (aq) + H_2O(l)$

7. Which of the following gases is produced when Lead (II) nitrate is heated strongly?
   A. Nitrogen
   B. Dinitrogen oxide
   C. Nitrogen monoxide
   D. Nitrogen dioxide
8. Which of the following equation shows the reaction which does not take place during the manufacture o nitric acid?
   A. $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$
   B. $2H_2O(l) + 4NO_2(g) + O_2(g) \longrightarrow 4HNO_3(aq)$
   C. $4NH_3(g) + O_2(g) \longrightarrow 2N_2(g) + 6H_2O(l)$
   D. $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$
9. Which one of the following pairs of ions consists of ions that react with aqueous ammonia to form precipitates which are solution in excess aqueous ammonia?
   A. Zn^{2+} and Al^{3+}
   B. Zn^{2+} and Fe^{2+}
   C. Cu^{2+} and Zn^{2+}
   D. Al^{3+} and Fe^{3+}
10. Which of the following nitrates when heated decomposes to give a reddish-brown gas?
   A. Sodium nitrate
   B. Silver nitrate
   C. Potassium nitrate
   D. Ammonium nitrate
11. The substance which is most suitable for drying ammonia is
   A. Concentrated sulphuric acid
   B. Calcium chloride
   C. Phosphorus (V) oxide
   D. Calcium oxide
12. The gas that turns brown when exposed to air from the following list is
   A. Sulphur dioxide
   B. Hydrogen chloride
   C. Hydrogen sulphide
   D. Nitrogen monoxide
13. The hydroxide that dissolves in excess aqueous ammonia but not in sodium hydroxide solution is
   A. Lead (II) hydroxide
   B. Zinc hydroxide
   C. Aluminium hydroxide
   D. Copper (II) hydroxide
14. Ammonia burns in oxygen to yield
   A. Nitrogen and water
   B. Nitric acid
   C. Nitrogen and hydrogen

D. Nitric acid, nitrogen and water.

15. Fuming nitric acid was heated and the gas evolved was collected over water. The gas was
    A. Nitrogen dioxide
    B. Oxygen
    C. Nitrogen monoxide
    D. Hydrogen
16. The process which does not require a catalyst is the manufacture of
    A. Nitric acid
    B. Ammonia
    C. Sodium hydroxide
    D. Sulphuric acid
17. When ammonium nitrate is heated it produces
    A. Nitrogen dioxide
    B. Ammonia
    C. Dinitrogen oxide
    D. Nitrogen monoxide
18. Dilute nitric acid reacts with copper to produce
    A. Copper nitrate, water and nitrogen dioxide
    B. Copper nitrate, water and nitrogen monoxide
    C. Copper nitrate, water and ammonia
    D. Copper nitrate, water and hydrogen
19. Copper (II) nitrate is strongly heated the gases evolved are
    A. Oxygen and nitrogen
    B. Oxygen and nitrogen dioxide
    C. Nitrogen and ammonia
    D. Ammonia and nitrogen dioxide
20. The catalyst used in the manufacture of nitric acid is
    A. Iron
    B. Platinum
    C. Iron (III) oxide
    D. Vanadium (V) oxide

Each of the questions 21 to 28 consist of an assertion (statement) on the left hand side and a reason on the right hand side.

Select

A. If both assertion and reason are true statements and the reason is a correct explanation of the assertion.
B. If both assertion and reason are true statements and the reason is **not** a correct explanation of the assertion
C. If the assertion is true but the reason is not correct statement.

D. If the assertion is not correct but the reason is a correct statement.

Instruction summarized

Assertion	
A. True	**True and a correct explanation**
B. True	**True but not a correct explanation**
C. True	**Incorrect**
D. Incorrect	**Correct**

21.	Nitrogen diffuses faster	Because	Nitrogen molecules are monatomic
22.	Ammonium nitrate (NH_4NO_3) is a better fertilizer than ammonium sulphate [$(NH_4)_2SO_4$]	Because	Ammonium nitrate contains a higher percentage of nitrogen than ammonium sulphate (H = 1, O = 16, S = 32)
23.	The reaction between ammonia and copper oxide is similar to that between hydrogen and lead (II) oxide	Because	Both copper and lead oxides are divalent oxides
24.	Copper (II) hydroxide dissolves in excess aqueous ammonia	Because	Copper (II) ions form a complex ion with ammonia.
25.	Zinc hydroxide is soluble in excess aqueous ammonia	Because	Zinc is amphoteric
26.	Ammonia reacts with copper (II) oxide to form nitrogen	Because	Copper (II) oxide is oxidized by ammonia
27.	Copper reacts with concentrated nitric acid to produce nitrogen dioxide	Because	Copper is above hydrogen in the electrochemical series
28.	Nitrogen is chemically inert	Because	Nitrogen is diatomic

In each of the questions 29 to 35 one or more of the answers given may be correct. Read each questions carefully and then indicate the correct answer according to the following

A. If 1, 2, 3, only are correct
B. If 1 and 3 only are correct
C. If 2 and 4 only are correct
D. If 4 only is correct

29. Which of the following substances is formed when ammonia is burnt in oxygen in the presence of platinum?
    1. NO
    2. N_2
    3. NO_2
    4. N_2O
30. Which of the following nitrate (s) when heated strongly will give off brown gas?
    1. Copper nitrate
    2. Potassium nitrate
    3. Lead nitrate
    4. Ammonium nitrate
31. Which of the following is/are formed when ammonia is passed over heated copper (II) oxide
    1. A brown solid
    2. A reddish brown gas
    3. Colorless liquid
    4. A black solid
32. Nitrogen can react with hydrogen to produce ammonia according to the following equation.

    $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$: $\Delta H = -92kJmol^{-1}$

    The condition(s) that would favor the formation of ammonia is/are
    1. Low pressure
    2. High pressure
    3. High temperature
    4. Low temperature
33. Which of the following nitrates will decompose on heating to form a nitrate?
    1. Calcium nitrate
    2. Potassium nitrate
    3. Magnesium nitrate
    4. Sodium nitrate
34. Nitric acid shows the following property of properties
    1. Turns litmus blue
    2. Forms salt with bases
    3. Is powerful reducing agent
    4. Produces carbon dioxide with carbonates
35. Ammonia may be dried using
    1. Concentrated sulphuric acid
    2. Calcium hydroxide
    3. Calcium chloride
    4. Calcium oxide

Section B

Answers must be put in the spaces provided

36. (a) when a nitrate of a metal Y was heated strongly, a brown fumes were observed together with a solid residue which was reddish brown when hot and yellow when cold.
    (i) Identify Y.
    (ii) Write equation for the reaction that took place.
    (b) The residue (a) was heated with dilute nitric acid. Write equation or the reaction that took place.
    (c) To the product in (b), dilute sodium hydroxide was added dropwise until there was no further change. State what was observed.
37. State what would be observed and write equations or the reaction that would take place if the following salts were heated
    (a) Calcium nitrate
    Observation
    Equation
    (b) KNO_3
    Observation
    Equation
38. (a)When a white solid T was heated with sodium hydroxide solution an alkaline gas X was formed
    (i) Identify the cation in T
    (ii) Write ionic equation for the reaction that took place.
    (b) Aqueous ammonia was added to aluminium sulphate solution
    (i) State what was observed
    (ii) Write an equation for the reaction that took place.
39. (a) Complete the following equations (your equations should be balanced)
    (i) $NaNO_3 \xrightarrow{heat}$
    (ii) $AgNO_3 \xrightarrow{heat}$
    (c) concentrated nitric acid was added to copper metal and the mixture heated
        (i) state what was observed
        (ii) write an equation for the reaction.
40. When aqueous ammonia was added dropwise to a solution containing zinc sulphate, a white precipitate, Q, was formed. Q dissolved in excess aqueous ammonia to form a colorless solution
    Write
    (i) An ionic equation for the reaction leading to the formation of Q
    (ii) The formula of the cation species present in the colorless solution.
41. (a) Write an equation for the reaction between oxygen and
    (i) Ammonia in the presence of heated platinum
    (ii) Nitrogen monoxide

(b) state how the product in (a)(ii) can be converted to nitric acid

(c) Write an equation and state the conditions for the reaction between nitric acid and

(i) Sulphur

(ii) lead (II) oxide

(d) In each case, state what is observed and write an equation for the reaction that took place when, sodium nitrate was heated strongly
   (i) Alone
   (ii) As a mixture with concentrated sulphuric acid

42. Although nitrogen is generally unreactive, it readily reacts with burning magnesium ribbon.
   (a) Give a reason why nitrogen is generally inert (01mark)
   (b) Burning magnesium reacts with nitrogen
      (i) Give a reason for the reaction (1mark)
      (ii) Write equation for the reaction (1 ½ marks)
   (c) Water was added to the product in (b). write an equation for the reaction (1 ½ marks)
43. (a) Write Equation for the reaction leading to the formation of ammonia on large scale (1 ½ mark)
   (b) State any two condition for the reaction (02 marks)
   (c) Write equation for reaction between ammonia and copper (II) oxide (1 ½ mark)
44. Lead (II) nitrate was heated until there was no further change
   (i) What was observed
   (ii) Write equation for the reaction that took place

Section C

45. (a) (i) Draw a labelled diagram of a setup of apparatus that can be used to prepared ammonia in the laboratory.
   (ii) Write equation for the formation o ammonia
   (d) Write a reaction between ammonia and
      (i) Hydrogen chloride
      (ii) Lead (II) nitrate
      (iii) Aqueous solution of lead (II) nitrate
   (e) State what is observed if ammonia was added to a solution o copper (II) chloride dropwise until
   (f) in excess.
   (g) On heating a mixture of ammonium sulphate and aqueous potassium hydroxide, ammonia gas was produced according to the following equation.
   $(NH_3)_2SO_4$ (s) + 2KOH(aq) $\longrightarrow$ K_2SO_4 (aq) + $2H_2O$(l) + $2NH_3$ (g)

X g of ammonium sulphate was heated with excess potassium hydroxide until there was no further change, 424.5cm3 of ammonia gas evolved at s.t.p.
Calculate the value of X.
(S = 32, H = 1, N=14, O =16; 1 mole of ammonia gas at s.t.p. occupies 22.4 dm3 at s.t…)

46. (a) Describe how nitric acid can be manufactured using hydrogen and nitrogen as raw materials. [Illustrate your answer with equations.].
    (b) Write equations to show the effect of heat on
        (i) NH_4NO_3
        (ii) $Zn(NO_3)_2$
    (c) Potassium nitrate was heated with concentrated sulphuric acid. Write equation or the reaction that took place
47. (a) With the help of equations, outline how a dry sample of ammonia can be prepared in the laboratory starting from ammonium chloride. Diagram not required.
    (b) Draw a labelled diagram of a setup of apparatus to show that ammonia is very soluble in water
    (c) Using equation where possible, explain why when dry ammonia is passed over strongly heated lead (II) oxide, a colorless liquid is formed and a grey solid residue is obtained.
    (d) Ammonium nitrate dissolve in water according to the following equation
    $NH_4NO_3(s) + H_2O(l) \longrightarrow NH_4OH\ (aq) + HNO_3\ (aq)$
    Explain using equations Why extensive use of ammonium nitrate as a fertilizer can make the soil become acidic (4 ½ mark)
48. (a) Describe how a dry sample of ammonia can be prepared in the laboratory. Diagram not required (06 marks)
    (b) Name a reagent that can be used to test for ammonia and state what would be observed if ammonia is tested with the reagent (02marks).

49. (a) Explain the following, illustrating your answer with equations where applicable.
    (b) When ammonia is added drop-wise until in excess to copper (II) sulphate solution, a blue precipitate is formed. The precipitate dissolves in excess ammonia solution to form a blue solution.
    (c)(i) Draw a labelled diagram of the set up of apparatus that can be used to show that ammonia can burn in oxygen (3marks)
    (ii) Write an equation for the combustion of ammonia in oxygen (1 ½ marks)
    (d) Dry ammonia was passed over heated copper (II) oxide.
        (i) state what was observed (1mark)
        (ii) Write an equation for the reaction (1 ½ marks)
50. (a) (i) Draw a labelled diagram to show how a dry sample of ammonia can be prepared from ammonium chloride in the laboratory.
        (ii) Write equation for the reaction leading to the formation of ammonia.

(b) Dry ammonia was passed over heated lead (II) oxide

(i) state what was observed

(ii) Write equation for the reaction that took place

(c) Describe how ammonia is converted to nitric acid. Use equation to illustrate your answer.

51. (a) (i) Name the raw materials for manufacture of ammonia.

(ii) Write equation leading to the formation of ammonia

(b) explain how formation of ammonia is affected by

(i) pressure

(ii) temperature

(c) state another factor that affects formation of ammonia

(d) Dry ammonia was passed over copper (II) oxide until there was no further change.

State what was observed and explain your answer.