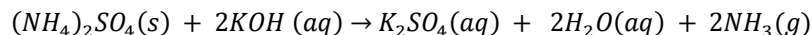


ORDINARY LEVEL CHEMISTRY PROBLEMS

PART 8: NITROGEN AND ITS COMPOUNDS

- (1) Ammonia reacts with oxygen in the presence of hot platinum to produce a colourless gas X which eventually gives brown fumes,
- (a) Identify X
 - (b) Write equation to show the formation of
 - (i) X
 - (ii) The brown fumes
 - (c) State the
 - (i) Role of platinum
 - (ii) Industrial application of the reaction in (b)
- (2) (a) (i) Name two substances from which nitric acid can be prepared in the laboratory
- (ii) Write an equation for the reaction between the substances you have named
- (b) Write equation(s) for the reaction(s) between nitric acid and copper
- (3) (a) (i) Write an equation for the reaction between oxygen and
- (ii) Ammonia in the presence of heated platinum
- (iii) Nitrogen monoxide
- (b) State how the product in (a) (ii) can be converted to nitric acid
- (c) Write equation and state the conditions for the reaction between nitric acid and
- (i) Sulphur
- (ii) Lead(II) oxide
- (d) In each case, state what would be observed and write the equation for the reaction that takes place when sodium nitrate was heated strongly
- (i) Alone
- (ii) As a mixture with concentrated sulphuric acid
- (4) (a) Nitrogen can react with hydrogen in the presence of a catalyst which is finely divided to form ammonia in the Haber process
- (i) State the source of nitrogen
- (ii) Name the catalyst used in the react
- (iii) Explain why the catalyst is finely divided
- (iv) Write equation for the reaction leading to the formation of ammonia
- (v) State two factors that can affect the yield of ammonia in the Haber process
- (b) Write equation for the reaction to show that ammonia can
- (i) Act as a reducing agent
- (ii) Burn in oxygen
- (c) Ammonia obtained by Haber process can be converted to nitrogen(II) oxide
- (i) Write equation for the reaction leading to the formation of nitrogen(II) oxide
- (ii) State the conditions for the reaction
- (d) Write equation to show how nitrogen(II) oxide can be converted to nitric acid.

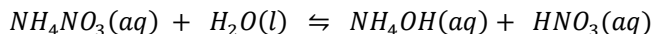
- (e) When aqueous ammonia was added dropwise until in excess to a solution of copper(II) nitrate, a blue precipitate P which dissolved in excess ammonia to give a deep blue solution was formed
- Identify P
 - Write the formula and name of the cation in the blue solution
- (1) (a) Write equation to show how ammonia can be prepared from calcium hydroxide
- Name one substance that can be used to dry ammonia
- (b) Ammonia was passed over heated copper(II) oxide
- State what was observed
 - Write equation for the reaction
- (6) When aqueous ammonia was added dropwise until in excess to a solution containing a cation X, a white precipitate was formed which dissolved in excess to give a colourless solution.
- Identify X
 - Write the formula of the cation in the colourless solution
 - Write an ionic equation for the reaction leading to the formation of the white precipitate
 - Name one other metal ion that when treated with aqueous ammonia would form a precipitate soluble in excess ammonia
 - State what would be observed in the above mentioned reaction.
- (7) (a) (i) Draw a labeled diagram of the setup of apparatus that can be used to prepare a dry sample of ammonia in the laboratory
- Write equation for the formation of ammonia
- (b) Write equation for the reaction between ammonia and
- Hydrogen chloride
 - Lead(II) oxide
- (c) State what would be observed if ammonia solution was added to a solution of copper(II) chloride dropwise until in excess
- (d) On heating a mixture of ammonium sulphate and aqueous potassium hydroxide, ammonia gas was produced according to the following equation



Calculate the mass of ammonium sulphate required to produce 424.4cm³ of ammonia gas at s.t.p.

- (8) (a) Describe how nitric acid can be manufactured using hydrogen and nitrogen as a raw material
- (b) Write equation to show the effect of heat on
- Ammonium nitrate
 - Zinc nitrate
- (c) Potassium nitrate was heated with concentrated sulphuric acid. Write equation for the reaction that took place

- (9) (a) When dilute nitric acid was reacted with copper, a colourless gas G which turned brown when exposed to air was evolved.
- Name gas G
 - Write the equation for the reaction leading to the formation of
 - Gas G
 - The brown gas
- (b) Write an equation for the reaction that would take place if the brown gas was dissolved in water.
- (c) State what would be observed if concentrated nitric acid was heated with iron(II) sulphate
- (10) (a) Write equation for the reaction to show the effect of heat on the following
- Sodium nitrate
 - Silver nitrate
- (b) Concentrated nitric acid was added to copper metal and the mixture heated.
- State what was observed
 - Write equation for the reaction
- (11) (a) Magnesium was heated in nitrogen. Write equation for the reaction that took place
- (b) Few drops of water were added to the product in (a)
- State what was observed
 - Write equation for the reaction
- (c) A piece of litmus paper was held over the reaction tube in (b).
- State what was observed
 - Explain your answer in (c) (i)
- (12) (a) (i) State the conditions under which sulphuric acid can react with sodium nitrate to form nitric acid
- (ii) Write equation for the reaction in (a)(i)
- (b) Sulphur was warmed with concentrated nitric acid
- State what was observed
 - Write equation for the reaction
- (c) Barium nitrate solution was added to the resulting mixture in (b).
- State what was observed
 - Write equation for the reaction
- (13) (a) With the help of equations, outline how a dry sample of ammonia can be prepared in the laboratory starting from ammonium chloride.
- (b) Draw a labeled diagram of the setup of apparatus to show that ammonia is very soluble in water
- (c) Using equations, explain why when dry ammonia is passed over heated lead(II) oxide, a colourless liquid and a grey solid is obtained.
- (d) Ammonium nitrate dissolves in water according to the equation

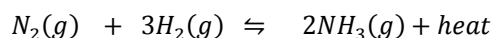


Explain using equations why extensive use of ammonium nitrate fertilizer can make the soil become acidic.

- (14) Although nitrogen is generally unreactive, it readily reacts with burning magnesium ribbon
- (a) State why nitrogen is generally inert
 - (b) Burning magnesium reacts with nitrogen
 - (i) Give a reason for the reaction
 - (ii) Write equation for the reaction
 - (c) Water was added to the product in (b) and a colourless gas T was evolved.
 - (i) Name T
 - (ii) write equation for the reaction leading to the formation of T
 - (iii) Name a laboratory reagent that can be used to dry T
 - (iv) Describe how T can be identified in the laboratory. Write equation to illustrate your answer.
- (15)
- (a) Describe how a dry sample of ammonia can be prepared.
 - (b) Name a reagent that can be used to test for ammonia. State what is observed and write the equation for the reaction when the reagent is used
 - (c)
 - (i) Draw a diagram of apparatus that can be used to show that ammonia can burn in oxygen
 - (ii) Write equation for the reaction
 - (d) Dry ammonia was passed over heated copper(II) oxide
 - (i) State what was observed
 - (ii) Write equation for the reaction
- (16)
- (a) Write equation for the reaction leading to the formation of ammonia on a large scale
 - (b) What name is given to the process of industrial manufacture for the industrial manufacture of ammonia
 - (c) State two conditions for the reaction
 - (d) Ammonia can react with lead(II) oxide
 - (i) State the conditions for the reaction
 - (ii) What would be observed
 - (iii) Write equation for the reaction
 - (iv) What property of ammonia is shown in the reaction
- (17)
- (a)
 - (i) Draw a labeled diagram to show that ammonia can burn in air
 - (ii) Write equation for the reaction
 - (b) Describe an experiment to demonstrate the high solubility of ammonia in water
 - (c) How is ammonia converted to nitric acid
 - (d) Give any other two industrial use of ammonia apart from manufacture of nitric acid and fertilizers
- (18)
- (a)
 - (i) Name the raw materials used for the manufacture of ammonia
 - (ii) Write equation for the reaction leading to the formation of ammonia
 - (b) Explain how the formation of ammonia is affected by
 - (i) Pressure

- (ii) Temperature
- (c) State another factor that affects the formation of ammonia
- (d) Dry ammonia gas was passed over heated copper(II) oxide
 - (i) State what was observed
 - (ii) Write equation for the reaction
 - (iii) Explain your observation in (i) above

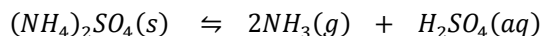
(19) Nitrogen reacts with hydrogen to produce ammonia according to the equation



The table below shows the percentage yield of ammonia at various temperatures and pressure.

Temperature (°C)	Pressure (atmospheres)		
	10	200	1000
250	30%	75%	95%
500	1%	18%	60%
1000	0%	0.1%	1%

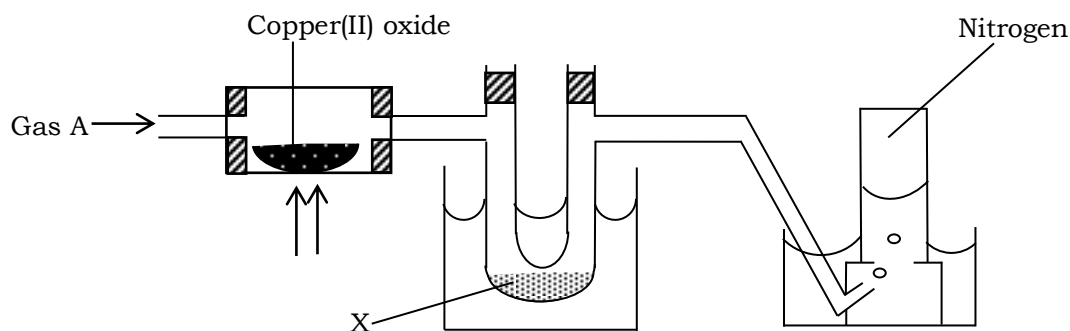
- (a) State how the percentage yield of ammonia varies with
 - (i) Pressure at constant temperature
 - (ii) Temperature at constant pressure
 - (b) State the temperature and pressure which give the maximum yield of ammonia
 - (c) Give two uses of ammonia
- (20)
- (a)
 - (i) Draw a well labeled diagram of the setup of apparatus that can be used to prepare ammonia on the laboratory
 - (ii) Write equation for the reaction
 - (b) Aqueous ammonia was added dropwise to until in excess to a solution of copper(II) nitrate
 - (i) State what was observed
 - (ii) Explain your observation including equations.
 - (c) Explain what happens when heated platinum foil is introduced into a gas jar containing a mixture of ammonia and nitrogen
 - (d) Ammonium sulphate when heated decomposes according to the equation



Calculate the volume of ammonia at room temperature produced when 1.32g of ammonium sulphate is strongly heated.

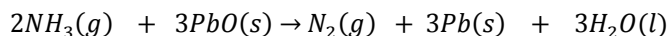
- (21) Nitrogen forms a series of oxides
- (a) Write the formula of the oxides of nitrogen and the class of oxides to which each one belongs
 - (b) Write equations for the reactions to show how each oxide can be obtained
 - (c) One of the oxides of nitrogen turns brown when exposed to air
 - (i) Name the oxide

- (ii) Explain why the named oxide turns brown. Include an equation in your answer.
- (d) One of the oxides of nitrogen reacts with water
- (i) Name the products of the reaction of the oxide with water
- (ii) Write equation for the reaction that takes place
- (e) State what is observed and write equation for the reaction when the following are heated to a constant mass
- (i) Lead(II) nitrate
- (ii) Zinc nitrate
- (iii) Aluminium nitrate
- (iv) Copper(II) nitrate
- (21) The diagram below shows the apparatus which can be used to prepare nitrogen in the laboratory



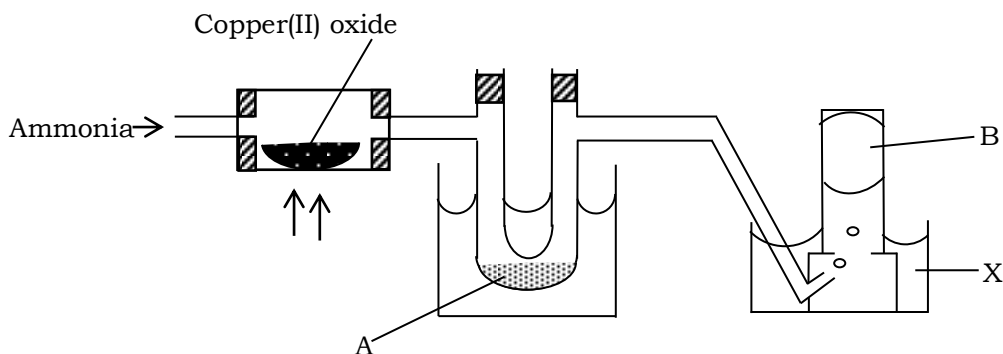
- (a) Name gas A
- (b) (i) State what would be observed
- (ii) Write equation for the reaction
- (c) Name
- (i) Substance X
- (ii) One reagent that can be used to identify X and state the observation
- (22) (a) Name the process by which ammonia is obtained on a large scale
- (b) One of the main uses of ammonia is the manufacture of fertilizers including ammonium sulphate $((NH_4)_2SO_4)$ and urea $(CO(NH_2)_2)$. Calculate the percentage of nitrogen in
- (i) Ammonium sulphate
- (ii) Urea
- (c) which one the above fertilizers is a better fertilizer
- (d) Aqueous ammonia was added to a solution of calcium hydrogen carbonate.
- (i) State what was observed
- (ii) Write equation for the reaction
- (iii) State the application of the reaction
- (23) (a) Draw a well labeled diagram for the preparation of ammonia
- (b) Describe an experiment that can be carried out to show that ammonia is an alkaline gas

- (c) A copper foil was strongly heated and held over a concentrated solution of ammonia in a beaker
- State what was observed
 - Explain your observation including equations
- (d) Ammonia reacts with lead(II) oxide according to the equation



Calculate the volume of ammonia at room temperature that would be required to completely react with 2.5g of lead(II) oxide

- (24) (a) When a mixture of hydrogen and nitrogen were passed over finely divided iron, gas **R** was produced.
- Name **R**
 - Write equation leading to the formation of **R**
- (b). State what is observed and write equation for the reaction when
- A gas jar of R is inverted over a gas jar of hydrogen chloride
 - R is passed over heated lead(II) oxide
- (25) (a) Describe the industrial preparation of nitric acid from ammonia
- (b) Explain what happens when concentrated nitric acid is added to copper
- (c) Write equations to show the effect of heat on the following
- Potassium nitrate
 - Magnesium nitrate
 - Silver nitrate
 - Ammonium nitrate
 - Ammonium nitrite
 - Ammonium carbonate
 - Ammonium sulphate
 - Ammonium chloride
- (25) Substances A and B are obtained from a reaction between ammonia gas and copper(II) oxide



- Name substances A, B and X
- Write equations for the reaction that takes place in the combustion tube
- State why it is not possible to collect the excess ammonia in the gas jar
- Name one other oxide that can be used instead of copper

26. In the preparation of ammonia in the laboratory, a mixture of ammonium chloride and calcium hydroxide is heated. The gas evolved is passed through a tower packed with calcium oxide before it is collected by upward delivery.
- (a). (i). Write an equation for the reaction that leads to the formation of ammonia
 - (ii). State why ammonia is passed into the tower packed with calcium oxide
 - (iii). Give a reason why ammonia is collected by upward delivery method
 - (b). (i). Name one reagent that can be used to identify ammonia
 - (ii). State what would be observed if ammonia is treated with the reagent you have named
 - (c). Name the catalyst that is used in the oxidation of ammonia during the manufacture of nitric acid
27. (a). State why ammonia is **not** dried using
- (i). Anhydrous calcium chloride
 - (ii). Concentrated sulphuric acid
- (b). Name the substance normally used in the laboratory for drying ammonia
- (c). Write equation for the reaction that can take place when copper(II) oxide is treated with ammonia.