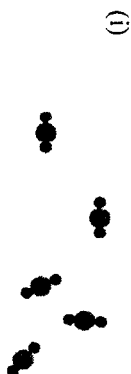


Section A (Answer ALL questions.)

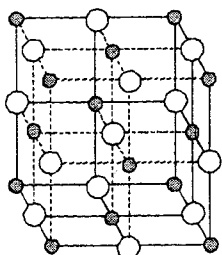
1. Consider the substances listed below:

carbon dioxide	hydrogen chloride	neon
nitrogen	silicon dioxide	sodium chloride

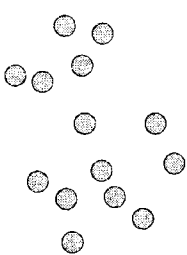
(a) Diagrams (i), (ii) and (iii) below show the arrangements of particles, which can be atoms, ions or molecules, in some substances. For each diagram, choose ONE substance from the above list, which has the arrangement of particles as shown under room temperature and pressure.



(ii)



(iii)



(b) From the above list, identify ONE substance which gives an acidic solution when dissolved in water. Write the chemical equation for the reaction involved.

(5 marks)

2. X, Y and Z are three different metals. The table below lists the results of three experiments carried out using the metals or their oxides.

Experiment	X	Y	Z
Adding metal to cold water	formation of a colourless gas	no observable change	no observable change
Adding metal to copper(II) sulphate solution	formation of a colourless gas and a reddish brown solid	formation of a reddish brown solid	no observable change
Heating metal oxide with carbon powder	no observable change	formation of a solid with metallic lustre	formation of a solid with metallic lustre

(a) What is the colourless gas formed when X is added to cold water? Suggest a test for the gas.

(b) Name the type of reaction that occurs when the oxide of Y is heated with carbon powder.

(c) Arrange the three metals in order of increasing reactivity. Explain your answer.

(d) Why is a colourless gas formed when X is added to copper(II) sulphate solution?

(7 marks)

3. (a) The atomic numbers of sulphur and chlorine are 16 and 17 respectively. Draw the electronic diagrams of the following atoms:
- (i) sulphur atom
 - (ii) chlorine atom
- (b) Chlorine reacts with sulphur to form a compound with relative molecular mass of 135.2. The compound contains 52.5 % of chlorine by mass.
- (i) Deduce the molecular formula of the compound.
 - (ii) Draw the electronic diagram of the compound, showing electrons in the *outermost shells* only.
- (Relative atomic masses: S = 32.1, Cl = 35.5)
- (6 marks)

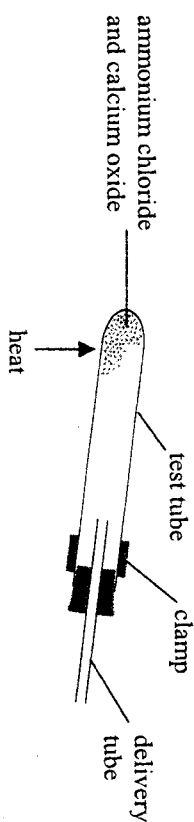
For questions 4 and 5, candidates are required to give paragraph-length answers. For each of these two questions, 3 marks will be awarded for effective communication of knowledge in Chemistry.

4. Discuss the similarities and differences in chemical properties of concentrated sulphuric acid and dilute sulphuric acid. Illustrate your answer using appropriate examples.
- (9 marks)
5. Plastic wastes cause environmental problems in modern cities. Suggest possible ways of treating plastic wastes, and discuss their advantages and disadvantages.
- (9 marks)

End of Section A

Section B (Answer any THREE questions.)

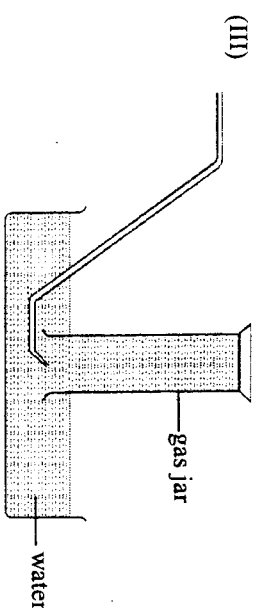
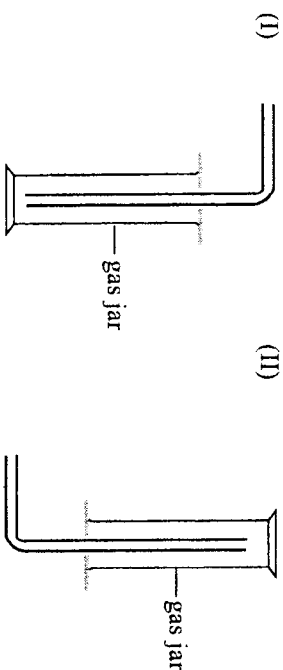
6. (a) Ammonia gas can be prepared by heating a mixture of ammonium chloride and calcium oxide in the set-up shown below:



- (i) The reaction of ammonium chloride with calcium oxide also gives calcium chloride as a product. Write the chemical equation for the reaction of ammonium chloride with calcium oxide.

- (ii) Why is it necessary to clamp the test tube with its mouth pointing downwards as shown?

- (iii) Decide which of the following set-ups, (I), (II) or (III), should be connected to the delivery tube to collect the ammonia gas produced. Explain your answer.



6. (a)

- (iv) Calculate the theoretical volume of ammonia gas, measured at room temperature and pressure, which can be obtained from the reaction of 1.0 g of ammonium chloride with excess calcium oxide.

(Relative atomic masses: H = 1.0, N = 14.0, Cl = 35.5; molar volume of gas at room temperature and pressure = 24 dm³) (9 marks)

Ammonia is manufactured by the Haber process. In the process, a mixture of nitrogen and hydrogen is passed over heated iron in the reaction chamber. The reaction of nitrogen with hydrogen can be represented by the following equation:



- (i) What does the sign ' \rightleftharpoons ' in the equation stand for?

- (ii) What is the function of iron in the reaction chamber?

- (iii) As air contains about 78% of nitrogen by volume, can air be used instead of nitrogen in the reaction chamber? Explain.

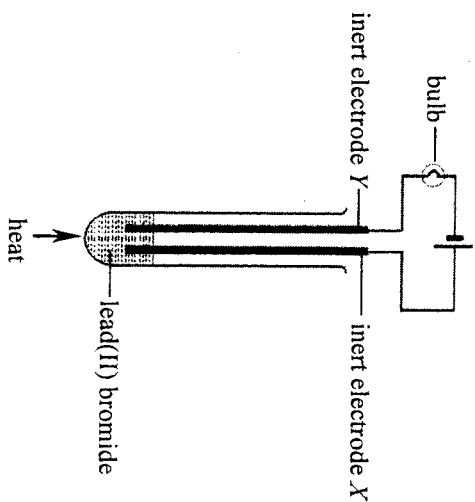
- (iv) In the process, only about 15% of the nitrogen is converted to ammonia. Suggest how the gaseous mixture that emerges from the reaction chamber can be treated so as to reduce the wastage of raw materials. (6 marks)

- (c) Ammonia reacts with copper(II) oxide upon heating. The products are nitrogen, copper and water.

- (i) State whether or not the reaction is a redox. Explain your answer in terms of oxidation number change.

- (ii) Write the chemical equation for the reaction of ammonia with copper(II) oxide. (3 marks)

7. (a) The set-up shown below is used to investigate the electrical conductivity of lead(II) bromide.



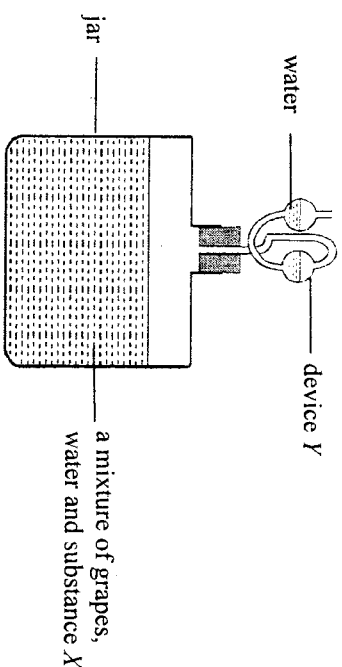
When the lead(II) bromide becomes molten, the bulb lights up.

- What would be observed at electrode X? Write the half equation for the reaction involved.
- State ONE potential hazard when carrying out the experiment.
- State what will happen to the bulb when heating is stopped and the molten lead(II) bromide is allowed to cool down gradually to room temperature. Explain your answer. (6 marks)

7. (b) Cracking is an important process in petrochemical industry.

- What is the meaning of the term 'cracking'?
 - Account for the importance of cracking in petrochemical industry.
 - Octane (C_8H_{18}) is used in an experiment to study cracking in a school laboratory. Cracking of octane gives a mixture of products, some of which are gases.
Draw a labelled diagram for the set-up used in the experiment, including the collection of the gaseous products.
 - One of the reactions involved in the cracking of octane gives two hydrocarbons, each containing the same number of carbon atoms.
 - Write the chemical equation for this reaction.
 - Suggest a chemical test to distinguish the two hydrocarbons from each other. (9 marks)
- Explain why filtration can be used to remove mud particles from muddy water, but cannot be used to remove sodium chloride from sea water. (3 marks)

8. (a) A mixture of grapes, water and substance X is used to produce wine in the set-up shown below:



- (i) The wine contains ethanol.
- (1) State ONE substance in grapes that can be converted to ethanol. Write the chemical equation for the reaction involved.
 - (2) Suggest what X may be. State its function in the production of ethanol.
- (ii) State TWO functions of device Y .
- (1) Explain why the concentration of ethanol in the wine cannot exceed a certain level (about 18% by volume).
 - (2) Suggest a means to increase the concentration of ethanol in the wine to a level higher than 18% by volume.
- (iv) Explain why a glass of wine turns sour upon standing in air. (9 marks)

8. (b)

An experiment was carried out to determine the concentration of a nickel(II) sulphate solution. The experiment consisted of the following three stages:

Stage 1: 25.0 cm³ of 0.503 M sodium hydroxide solution was added to 25.0 cm³ of the nickel(II) sulphate solution to precipitate out nickel(II) hydroxide.

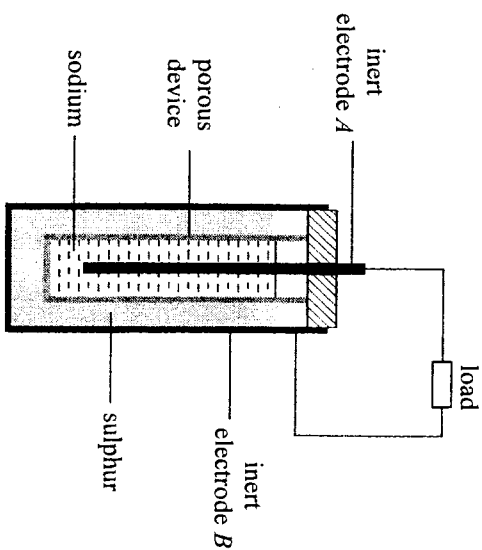
Stage 2: The mixture obtained in *Stage 1* was filtered and the residue was washed thoroughly with distilled water.

Stage 3: The excess alkali in the filtrate was titrated against 0.251 M hydrochloric acid with methyl orange as indicator. 18.5 cm³ of the acid was required to reach the end-point.

- (i) Write the ionic equation for the reaction in *Stage 1*.
- (ii) State the colour change at the end-point of the titration in *Stage 3*.
- (iii)
 - (1) Based on the titration result in *Stage 3*, calculate the number of moles of hydroxide ions present in the filtrate.
 - (2) Calculate the number of moles of sodium hydroxide that was added in *Stage 1*.
 - (3) Using your results in (1) and (2) above, calculate the molarity of the nickel(II) sulphate solution.
 - (iv) Why was it necessary to wash the residue thoroughly in *Stage 2* ? (9 marks)

9. (a)

The diagram below shows a sodium-sulphur cell connected to an external circuit. This cell operates at a high temperature of about 370°C , which is above the melting points of sodium and sulphur.

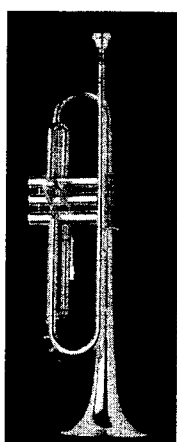


- (i) State and explain the direction of electron flow in the external circuit when the cell is discharged. Write half equations for the reactions at electrodes A and B.
- (ii) Suggest TWO functions of the porous device.
- (iii) Suggest why it is necessary for the cell to operate at a high temperature.
- (iv) Sodium-sulphur cells are rechargeable and are used in power stations to reduce the wastage of electricity generated. Suggest why these cells can be used to reduce the wastage of electricity.

(8 marks)

9. (b)

Brass is an alloy consisting mainly of copper and metal X. It is used to make musical instruments such as trumpet.



trumpet

- (i) What is X?
 - (ii) Suggest ONE reason for using brass instead of copper in making trumpets.
 - (iii) In an experiment, a piece of brass is added to a test tube containing 2M nitric acid.
- State TWO observations in the experiment and write the relevant chemical equation(s).

(6 marks)

(This question is continued on the next page.)

9. (c)

Organic wastes can be used as an alternative energy source. Under suitable conditions, the wastes can be digested by bacteria to give a gaseous mixture containing a high proportion of methane. Methane can be used as a fuel.

- (i) Suggest ONE organic waste that can be used for this purpose.
 - (ii) Write the chemical equation for the complete combustion of methane.
 - (iii) Suggest ONE advantage of using organic wastes as an alternative energy source.
 - (iv) Suggest ONE reason why organic wastes are *not* yet widely used as an energy source.
- (4 marks)

END OF PAPER