Section A

Answer **all** the questions in the spaces provided.

1 The structures of some substances containing chlorine are shown in Fig. 1.1.

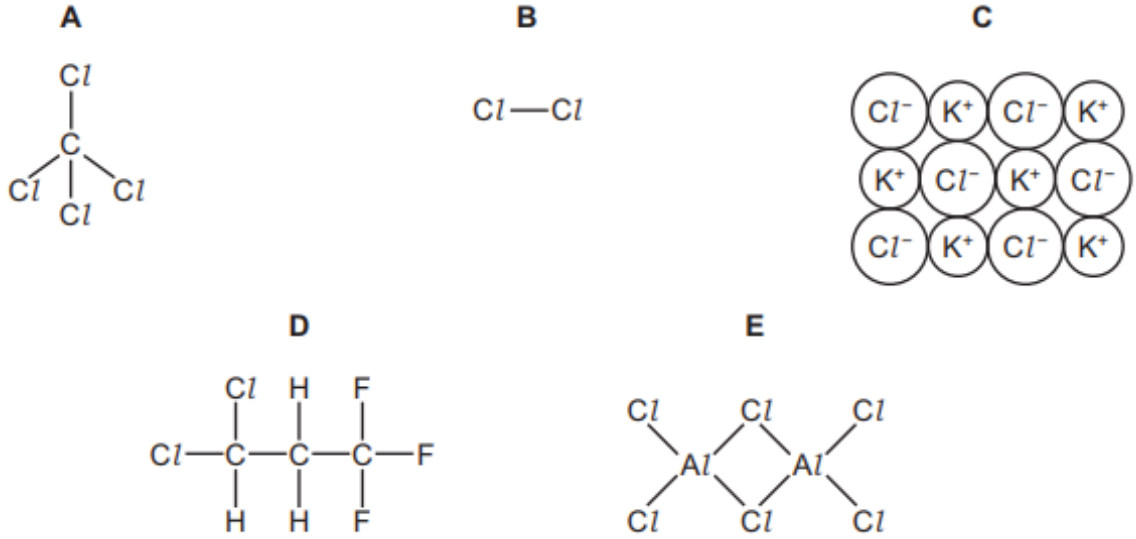

Fig. 1.1

Answer the following questions about these substances. Each of these letters A to E can be used once, more than once or not at all.

(a) Which substance conducts electricity in molten or aqueous state only?

…… [1]

(b) Which substance is a diatomic molecule?

…… [1]

(c) Which substance is an element?

Explain your answer.

……

…… [2]

(d) Which substance is the product of substitution of methane?

…… [1]

[Turn over]

2 Table 2.1 gives the composition of three particles.

Table 2.1

particle	number of protons	number of electrons	number of neutrons
A	15	15	16
B	15	18	16
C	15	15	17

(a) What is the evidence in Table 2.1 for each of the following?

(i) Particle A is an atom.

……..

…….. [1]

(ii) A, B and C are all particles of the same element.

……..

…….. [1]

(iii) Particles A and C are isotopes of the same element.

……..

……..

…….. [2]

(b) **(i)** What is the electronic structure of particle C?

…….. [1]

(ii) Is element C a metal or a non-metal? Give a reason for your choice.

……..

…….. [1]

[Turn over]

3 Coal-burning power stations generate a large amount of heat from the combustion of coal to convert steam which in turn drives turbine generators to produce electricity. Flue gas that is produced contains sulfur dioxide and oxides of nitrogen. These two gases cause acid rain.

(a) Oxides of nitrogen generally consist of a mixture of nitrogen monoxide and nitrogen dioxide. In flue gas, nitrogen monoxide is the main component in the oxides of nitrogen produced.

Explain how nitrogen monoxide causes acid rain even though it is a neutral oxide.

……

……

…… [2]

(b) Acid rain impacts farming greatly as it often causes the soil to be overly acidic and results in leaching of nutrients. In order to alleviate the effects of acid rain, a farmer has been advised to treat the soil to reduce the acidity.

Table 3.1 gives the solubility of some calcium compounds.

Table 3.1

	calcium hydroxide	calcium oxide	calcium carbonate
solubility in water (g per 100 ml of water)	0.173	immediately reacts with water on contact to form an alkaline solution	6.17×10^{-4}

Using the information in Table 3.1, suggest why calcium carbonate is less effective at reducing acidity than calcium hydroxide and calcium oxide.

……..

……..

…….. [2]

(c) Another source of oxides of nitrogen is from car engines.

Explain how the oxides of nitrogen are formed in car engines.

……..

……..

…….. [2]

[Turn over]

(d) Besides acid rain, name two other harmful effects of oxides of nitrogen and sulfur dioxide.

……..

…….. [2]

4 Soluble salts can be made by using a base and an acid.

(a) Complete this method of preparing dry crystals of the soluble salt cobalt(II) chloride from the insoluble base cobalt(II) carbonate.

step 1
Add an excess of cobalt(II) carbonate to hot dilute hydrochloric acid.

step 2

……

step 3

……

step 4

……

step 5

…… [3]

(b) 5.95 g of solid cobalt(II) carbonate is added to 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3.

(i) Write a balanced chemical equation, including state symbols, for the above reaction.

…… [2]

(ii) Show that the cobalt(II) carbonate is added in excess.

[3]

5 The reactivity of different metal oxides was compared by heating them with metals in a crucible. This is shown in Fig. 5.1.

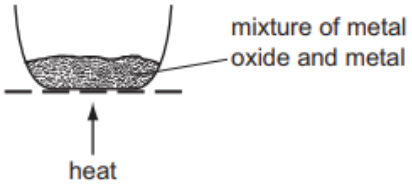

Fig. 5.1

The results are shown in Table 5.2.

Table 5.2

mixture	observations
iron(III) oxide + metal X	reacts
lead(II) oxide + iron	reacts
magnesium oxide + metal X	no reaction

(a) Use the results in Table 5.2 to suggest the order of reactivity of the metals iron, lead, magnesium and X, starting with the most reactive metal.

……... [1]

(b) Predict whether iron will react with zinc oxide.

Explain your answer.

……... [1]

(c) Write down two observations when lead(II) oxide reacts with iron.

……...

……... [2]

(d) In the mixture, iron(III) oxide reacts with metal X.

Which element is reduced in the reaction? Use ideas about oxidation state to explain your answer.

……...

……... [2]

[Turn over]

6 Fig. 6.1 shows how the ions present in solution A are separated.

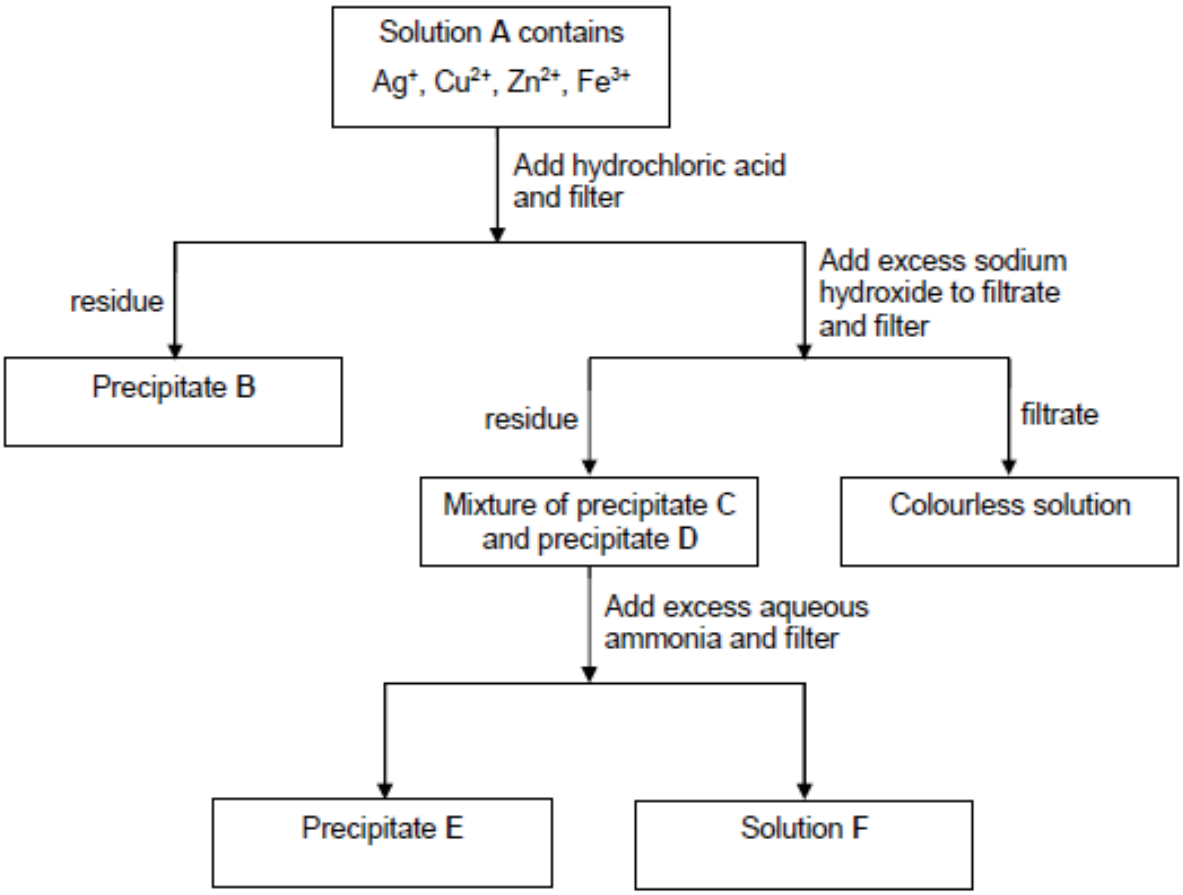

Fig. 6.1

(a) **(i)** It is known that solution A contains one anion. Suggest the identity of this anion. Give a reason for your answer.

……

……

…… [2]

(ii) Describe a test to confirm the anion named in **(a)(i).**

……

…… [1]

(b) Suggest the identity of substances B and C.

B ……..

C …….. [2]

[Turn over]

(c) Describe the movement and arrangement of particles in precipitate E which has been dried.

……

……

…… [2]

7 Fig. 7.1 shows a molecule of cyclohexane, C_6H_{12}, which is a cycloalkane and a saturated hydrocarbon. Cycloalkanes react in a similar way to alkanes.

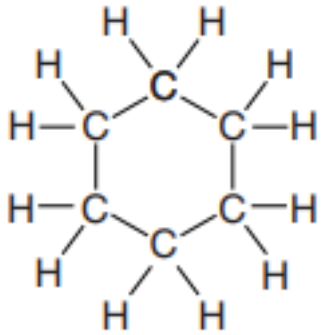

Fig. 7.1

(a) **(i)** Define the term saturated.

…… [1]

(ii) Define the term hydrocarbon.

……

…… [1]

(b) Construct the equation for the complete combustion of cyclohexane.

…… [1]

(c) Cyclohexane reacts with chlorine in the presence of ultraviolet light. This is a substitution reaction. Write the molecular formulae of two products of this reaction.

…… [2]

[Turn over]