1 The table shows some properties of six compounds.

compound	melting point / °C	boiling point / °C	solubility in water	electrical conductivity of solution
copper sulfate	200	decomposes	soluble	high
hexane	–95	69	insoluble	does not dissolve
hydrogen chloride	–112	–85	soluble	high
octane	–57	126	insoluble	does not dissolve
silicon(IV) oxide	1610	2230	insoluble	does not dissolve
sodium chloride	801	1413	soluble	high

(a) Which of the following lists of compounds from the table contains only ionic compounds?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** copper sulfate, octane and sodium chloride

☒ **B** silicon(IV) oxide and sodium chloride

☒ **C** copper sulfate and sodium chloride

☒ **D** copper sulfate and silicon(IV) oxide

(b) Two of the compounds in the table produce a colour in a flame test.

Give the name of **one** of these compounds and the colour it produces in the flame test.

(2)

compound .....

colour .....

(c) Hexane is a covalent compound containing simple molecules.
It has a low boiling point.

(i) Explain why it has a low boiling point.

(2)

.....

.....

.....

.....

(ii) Hexane and water are immiscible.

Describe how separate samples of hexane and water can be obtained from a mixture of hexane and water.

(2)

.....

.....

.....

.....

(d) Draw a dot and cross diagram of a molecule of hydrogen chloride.

Show outer electrons only.

(2)

(Total for Question 1 = 9 marks)

2 (a) The table shows some information about the atoms and the ions of chlorine and sodium.

Complete the table.

(3)

	symbol of		number of electrons in	
	atom	**ion**	**atom**	**ion**
chlorine	Cl	Cl^-	17	
sodium	Na			10

(b) When silver nitrate solution, $AgNO_3$, is added to sodium chloride solution a white precipitate is formed.

(i) Write the balanced equation for this reaction.

(2)

.....

(ii) Silver nitrate solution can be added to a solution to test for the presence of chloride ions.
In this test, dilute nitric acid is added to the solution, followed by the silver nitrate solution.
A white precipitate shows the presence of chloride ions.

Why must the dilute nitric acid be added to make this a reliable test?

Put a cross (☒) in the box next to your answer.

(1)

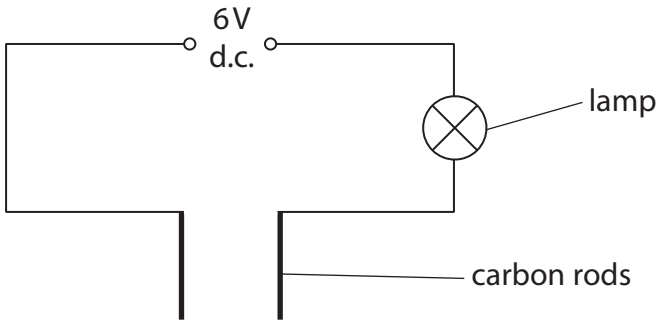
☒ **A** to dilute the solution of chloride ions

☒ **B** because the precipitate only forms if dilute nitric acid is added

☒ **C** to stop the white precipitate changing colour

☒ **D** to remove other ions that would also form a white precipitate

*(c) This circuit was used to test the ability of water, solid sodium chloride and sodium chloride solution to conduct electricity.



The results were

substance	conducts electricity
water	no
solid sodium chloride	no
sodium chloride solution	yes

Explain these results by referring to the structures of the substances.

(6)

(Total for Question 2 = 12 marks)

3 (a) Sodium chloride is a metal chloride which is soluble in cold water.

(i) Give the name of a metal chloride which is insoluble in cold water.

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** copper chloride

☒ **B** lead chloride

☒ **C** magnesium chloride

☒ **D** potassium chloride

(ii) Sodium chloride has a melting point of 801 °C.

Explain why the melting point of sodium chloride is high.

(2)

.....

.....

.....

(iii) Describe how you would test for the presence of chloride ions in a solution of sodium chloride.

(3)

.....

.....

.....

.....

.....

.....

*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

(6)

(Total for Question 3 = 12 marks)

4 (a) Substance **X** is an ammonium salt.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A test was carried out to find which anion is present in substance **X**.
Dilute hydrochloric acid was added to a sample of substance **X**.
There was effervescence and the gas given off turned limewater milky.

The anion present in substance **X** is

(1)

☒ **A** carbonate ion, CO_3^{2-}

☒ **B** chloride ion, Cl^-

☒ **C** nitrate ion, NO_3^-

☒ **D** sulfate ion, SO_4^{2-}

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

.....

.....

.....

.....

.....

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

.....

*(c) A technician found some colourless crystals of a substance left, unlabelled, in a beaker in a laboratory.

She knew the substance was one of potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

Explain how, using chemical tests, the technician could find out if the substance left in the beaker was potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

You may include equations in your answer.

(6)

(Total for Question 4 = 12 marks)