Questions are for both separate science and combined science students unless indicated in the question

1 Sodium (Na) and sodium chloride (NaCl) both have lattice structures.

Their melting points are shown in the table.

	Melting point in °C	Type of lattice structure
sodium	98	giant metallic
sodium chloride	801	

(a) Complete the table by stating the type of lattice structure in sodium chloride.

(1)

(b) Explain why sodium and sodium chloride have different melting points.

In your answer you should refer to

- the types of particle
- the types of forces between the particles in each substance **(separate only)**

(5)

(c) The equation shows the reaction of sodium with water.

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

A sample of sodium of mass 0.138 g reacts with excess water.

Calculate the volume of hydrogen, in cm^3, produced at room temperature and pressure (rtp).

[The volume of one mole of a gas at rtp is 24 000 cm^3] **(separate only)**

(3)

Volume of gas produced = ... cm^3

(d) Sodium chloride can be made by many different reactions.

A student prepared a sample of sodium chloride using the following method.

Step 1 She added an excess of a solid sodium compound, X, to dilute hydrochloric acid. The mixture fizzed as the solid reacted.

Step 2 She filtered the mixture produced to remove the excess solid X. The filtrate was a colourless liquid.

Step 3 She evaporated the colourless liquid. A white solid remained.

(i) Describe a chemical test that the student could do to show that the colourless liquid in Step 2 contained chloride ions, Cl^-.

(3)

Test .....

.....

.....

Result .....

(ii) The student concluded that solid X was sodium hydroxide.

State one reason why this conclusion was **not** correct.

Suggest a possible identity of solid X.

(2)

Reason .....

.....

Solid X could be .....

(e) Sodium chloride can also be made by reacting sodium with chlorine gas.

Draw a dot and cross diagram to show the arrangement of the electrons in each of the ions in sodium chloride. Show the charge on each ion.

Show only the outer electrons.

(3)

(f) Potassium bromide can be made by reacting potassium with bromine gas.

Explain why it is difficult to be sure whether the reaction between potassium and bromine gas would be more vigorous than the reaction between sodium and chlorine gas.

(2)

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(Total for Question 1 = 19 marks)

2 The diagram shows the elements in Period 3 of the Periodic Table.

Na	Mg	Al	Si	P	S	Cl	Ar

(a) (i) Identify an element in Period 3 that forms a basic oxide.

(1)

.....

(ii) Identify an element in Period 3 that forms an acidic oxide.

(1)

.....

(b) Magnesium and chlorine react together to form magnesium chloride, a compound with ionic bonding.

The equation for the reaction is

$$Mg + Cl_2 \rightarrow MgCl_2$$

(i) Complete the dot and cross diagram to show the arrangement of the outer electrons in the magnesium and chloride ions formed.

Show the charge on each ion.

(3)

(ii) State what is meant by the term **ionic bonding**.

(2)

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(iii) Explain why magnesium chloride has a high melting point.

(3)

(c) Aluminium is extracted from aluminium oxide using electrolysis.

Calculate the mass, in grams, of aluminium formed when a charge of 20 faradays is passed through aluminium oxide dissolved in molten cryolite. **(separate only)**

The ionic half-equation for the formation of aluminium is

$$Al^{3+} + 3e^- \rightarrow Al$$

(2)

mass of aluminium = ... g

(Total for Question 2 = 12 marks)