1 This question is about halogens and halides.

(a) At room temperature bromine is

(1)

- ☒ **A** a brown gas
- ☒ **B** a red-brown liquid
- ☒ **C** a colourless liquid
- ☒ **D** a grey solid

(b) Sodium reacts with bromine to form sodium bromide.

Balance the equation for this reaction.

(1)

..... Na + ... Br_2 → ..... NaBr

(c) A student carries out some experiments to investigate displacement reactions.

She adds some halogen solutions to halide solutions and observes whether a reaction occurs.

The table shows her results.

	Halogen solution added		
Halide solution	**bromine**	**chlorine**	**iodine**
lithium chloride	no reaction	(not done)	no reaction
sodium bromide	(not done)	reaction occurs	no reaction
potassium iodide	reaction occurs	reaction occurs	(not done)

(i) The table shows that she did not do three experiments.

Suggest why she did not do these experiments.

(1)

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(ii) The table shows that there was no reaction in three experiments.

Why was there no reaction in these experiments?

(1)

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.....

(iii) The student writes this word equation for one of the experiments in which a reaction occurs.

bromine + potassium iodide → potassium bromine + iodine

The name of one of the substances is incorrect.

Write the correct name of this substance.

(1)

.....

(iv) A reaction occurs when the student adds chlorine solution to potassium iodide solution.

Complete the chemical equation for this reaction.

(2)

Cl_2 + ...KI → ..... + ...

(v) All displacement reactions are examples of redox reactions.

State the meaning of the term **redox**.

(1)

.....

.....

(vi) The ionic equation for another reaction is

$$Br_2 + 2I^- \rightarrow 2Br^- + I_2$$

Explain which species is oxidised in this reaction.

(2)

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(Total for Question 1= 10 marks)

2 Bromine and iodine are halogens.

(a) Complete the table by giving the colour and physical state of each of these halogens at room temperature.

(2)

Halogen	Colour	Physical state
bromine	red-brown	
iodine		solid

(b) Bromine reacts with phosphorus to form the covalent compound phosphorus tribromide.

Draw a dot and cross diagram to show the outer electrons in a molecule of phosphorus tribromide.

(2)

Br P Br

Br

(c) Phosphorus tribromide reacts with water to form a mixture of two acids, HBr and H_3PO_3

Write a chemical equation for this reaction.

(2)

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(Total for Question 2 = 6 marks)

3 A student is supplied with aqueous solutions of these substances.

- bromine
- chlorine
- iodine
- potassium bromide
- potassium chloride
- potassium iodide

Describe two experiments the student could perform, using some of the solutions, to show the order of reactivity of bromine, chlorine and iodine.

Your answer should include the observations that the student would expect to make, and a chemical equation for one of the reactions.

(5)

(Total for Question 3 = 5 marks)

4 Bromine, chlorine, fluorine and iodine are elements in Group 7 of the Periodic Table.

(a) Which two of these elements have the darkest colours?

(1)

..... and .....

(b) The equation for the reaction between hydrogen and chlorine is

$$H_2 + Cl_2 \rightarrow 2HCl$$

Different names are used for the product, depending on its state symbol.

(i) What are the names used for HCl(g) and HCl(aq)?

(2)

HCl(g) .....

HCl(aq) .....

(ii) The presence of HCl(g) can be confirmed by adding ammonia (NH_3) gas.

State the observation in the reaction between HCl(g) and ammonia gas and write a chemical equation for the reaction.

(2)

observation .....

.....

chemical equation .....

(iii) The presence of chloride ions in HCl(aq) can be shown by mixing it with silver nitrate solution and dilute nitric acid.

State the result of this test and complete the chemical equation for the reaction by adding the state symbols.

(3)

result .....

.....

$$AgNO_3(\ldots\ldots) + HCl(aq) \rightarrow AgCl(\ldots\ldots) + HNO_3(\ldots\ldots)$$

(c) Solution X is made by dissolving HCl(g) in water.

Solution Y is made by dissolving HCl(g) in methylbenzene.

A student added magnesium ribbon and blue litmus paper to separate samples of each solution.

The table shows her results.

Test	Solution X	Solution Y
magnesium ribbon added	bubbles	no change
blue litmus paper added	goes red	stays blue

(i) What substance is responsible for the bubbles?

(1)

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(ii) State one change to the magnesium ribbon that could be seen after adding it to solution X.

(1)

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.....

(iii) What does the colour change of the litmus paper show about solution X?

(1)

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(iv) Why does the litmus paper stay blue in solution Y?

(1)

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(Total for Question 4 = 12 marks)

5 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

(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]

(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 5 = 19 marks)