

1 The table gives information about the first four elements in Group 7 of the Periodic Table.

Element	Atomic number	Electronic configuration	Physical state at 20 °C	Colour at 20 °C
fluorine	9	2.7	gas	pale yellow
chlorine	17	2.8.7	gas	pale green
bromine	35	2.8.18.7	liquid	red-brown
iodine	53	2.8.18.18.7	solid	dark grey

(a) Astatine (At) has an atomic number of 85 and is the fifth element in Group 7.

It is possible to make predictions about astatine by comparison with the other elements in Group 7.

(i) How many electrons does an atom of astatine have in its outer shell?

(1)

(ii) What physical state and colour would you expect for astatine at 20 °C?

(2)

Physical state.....

Colour.....

(iii) Predict the formula of the compound formed between astatine and hydrogen.

Suggest a name for this compound.

(2)

Formula.....

Name.....

(iv) Suggest how the reactivity of astatine compares to that of iodine.

Explain your answer.

(2)

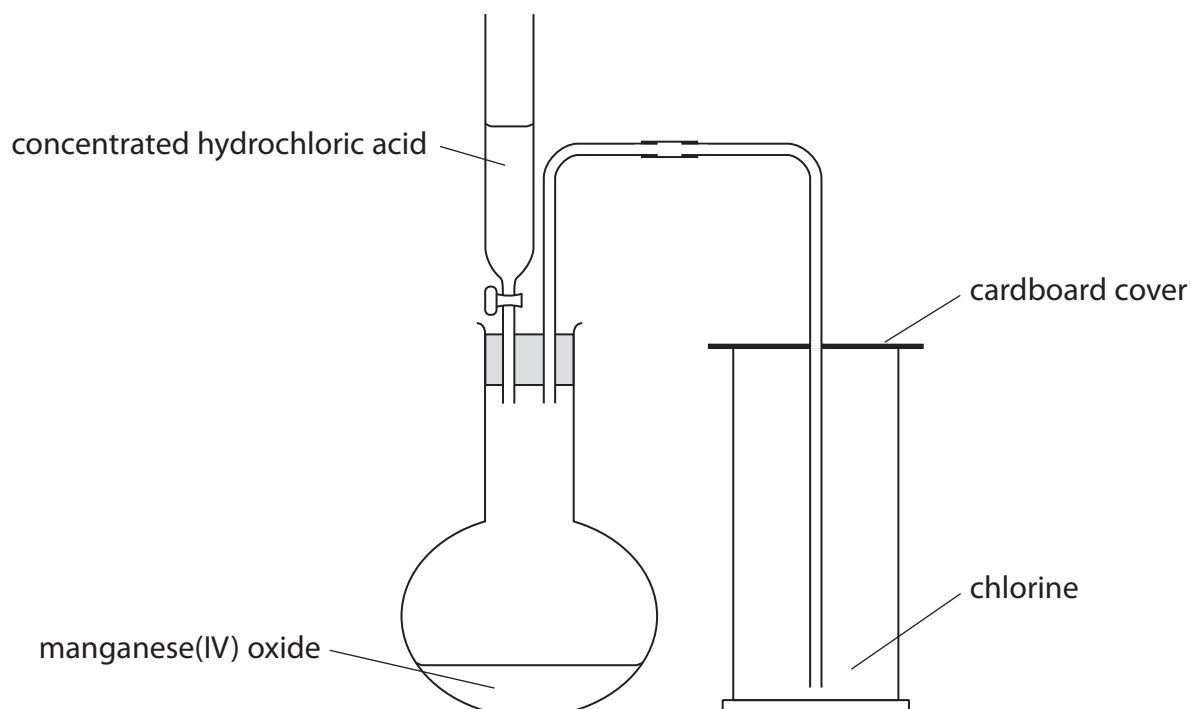
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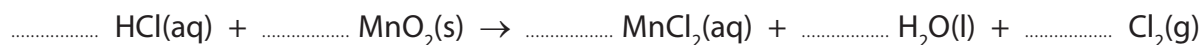
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- (b) Chlorine gas can be prepared by heating a mixture of concentrated hydrochloric acid and manganese(IV) oxide using this apparatus.



- (i) Balance the equation for the reaction.

(1)



- (ii) State what you would observe when a piece of damp litmus paper is placed into the gas jar containing chlorine.

(1)

.....

.....

(c) Chlorine can be used to obtain bromine (Br_2) from sea water.

Sea water contains bromide ions, Br^-

The pH of sea water is usually within the range of 7.5 to 8.4

The stages in the extraction of bromine from sea water are

Stage 1 The pH of the sea water is lowered to about 3.5

Stage 2 An excess of chlorine is bubbled through the sea water

Stage 3 The bromine (Br_2) is removed from the mixture and reacted with sulfur dioxide (SO_2) and water. This reaction converts the bromine to hydrogen bromide (HBr) and sulfuric acid (H_2SO_4)

Stage 4 The hydrogen bromide is reacted with chlorine to form bromine (Br_2)

(i) Suggest a substance that could be added to lower the pH of sea water in Stage 1. (1)

.....
(ii) Why is an excess of chlorine added in Stage 2? (1)

.....
(iii) Write a chemical equation for the reaction in Stage 3. (2)

.....
(iv) Write a chemical equation for the reaction in Stage 4. (1)

.....
(d) State the colour change observed when bromine is added to an aqueous solution of potassium iodide. (2)

Colour of potassium iodide solution at start.....

Colour of final reaction mixture.....

(Total for Question 1 = 16 marks)

1 This question is about halogens and halides.

(a) At room temperature bromine is

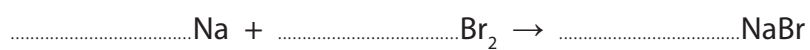
(1)

- ☐ **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)



(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.

Halide solution	Halogen solution added		
	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.

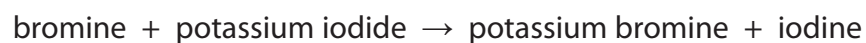
(1)

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

Why was there no reaction in these experiments?

(1)

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



The name of one of the substances is incorrect.

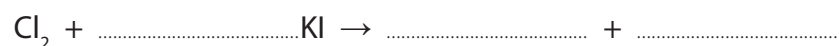
Write the correct name of this substance.

(1)

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

Complete the chemical equation for this reaction.

(2)

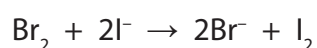


- (v) All displacement reactions are examples of redox reactions.

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

(1)

- (vi) The ionic equation for another reaction is



Explain which species is oxidised in this reaction.

(2)

(Total for Question 1= 10 marks)