1 This question is about the halogens (Group 7).

(a) How do the boiling points of the halogens change down the group from fluorine to iodine?

_____

_____

(1)

(b) Sodium bromide is produced by reacting sodium with bromine.

Sodium bromide is an ionic compound.

(i) Write down the symbols of the **two** ions in sodium bromide.

_____

(1)

(ii) Chlorine reacts with sodium bromide solution to produce bromine and one other product.

Complete the word equation for the reaction.

chlorine + sodium bromide ⟶ bromine + _____

(1)

(iii) Why does chlorine displace bromine from sodium bromide?

_____

_____

(1)

(iv) Use the Chemistry Data Sheet to help you to answer this question.

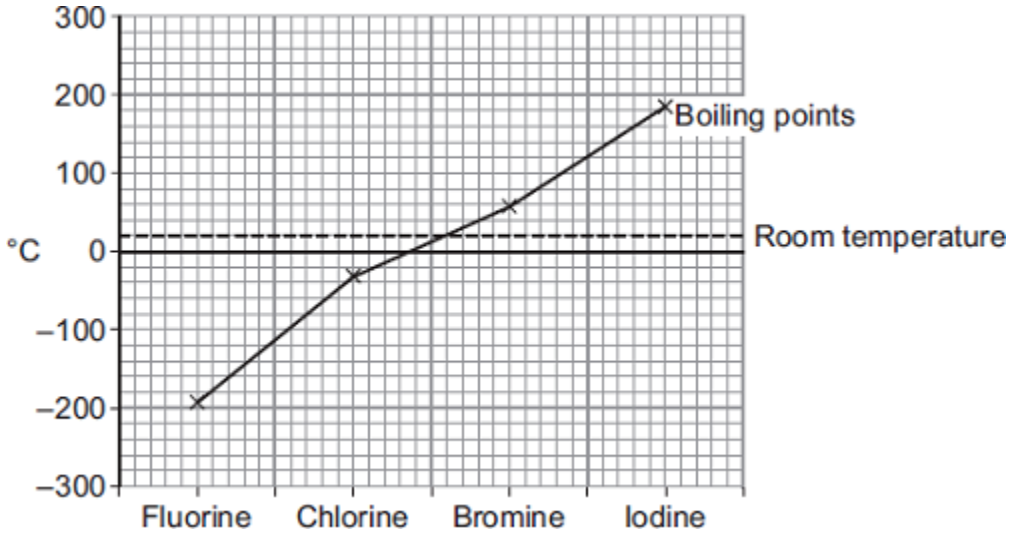
Suggest which halogen could react with sodium chloride solution to produce chlorine.

_____

(1)

(Total 5 marks)

2 The graph shows the boiling points of the halogens.



(a) Use the graph to help you answer these questions.

(i) Use the correct answer from the box to complete the sentence.

gas	liquid	solid

At room temperature chlorine is a _____ .

(1)

(ii) Describe the trend in boiling point from fluorine to iodine.

_____

_____

(1)

(b) Chlorine reacts with metals to produce metal chlorides.

(i) When a chlorine atom forms a chloride ion it gains one electron.

What is the charge on a chloride ion?

_____

(1)

(ii) Write a word equation for the reaction between sodium and chlorine.

_____

(1)

(c) In the UK water companies add chlorine to tap water.

Why is chlorine added to tap water?

_____

(1)

(d) Water companies add fluoride to tap water in some parts of the UK.

Fluoride is added to improve dental health.

Suggest **one** reason why some people are against adding fluoride to tap water.

_____

_____

_____

(1)

(Total 6 marks)

3 This question is about the halogens.

(a) Which group in the periodic table is known as the halogens?

Tick **one** box.

Group 1 ☐

Group 2 ☐

Group 7 ☐

Group 0 ☐

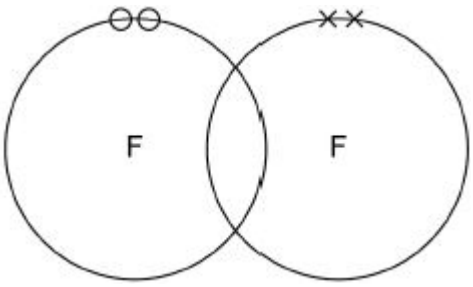
(1)

(b) A fluorine atom has 7 electrons in the outer shell.

The diagram below shows part of a dot and cross diagram to represent a molecule of fluorine (F_2).

Complete the dot and cross diagram.

You should show only the electrons in the outer shells.



(2)

(c) Chlorine reacts with potassium bromide solution.

Complete the word equation.

chlorine + potassium bromide ⟶ _____ + _____

(2)

(d) What type of reaction happens when chlorine reacts with potassium bromide solution?

Tick **one** box.

decomposition ☐

displacement ☐

neutralisation ☐

precipitation ☐

(1)

(e) Complete the sentence.

Choose the answer from the box.

an atom	**an electron**	**a neutron**	**a proton**

Chlorine is more reactive than bromine.

This is because chlorine gains _____ more easily.

(1)

(f) How does the size of a chlorine atom compare with the size of a bromine atom?

Complete the sentence.

Choose the answer from the box.

bigger than	**the same size as**	**smaller than**

A chlorine atom is _____ a bromine atom.

(1)

(g) Give a reason for your answer to part **(f)**

Reason _____

_____

(1)

(h) Fluorine reacts with chlorine to produce ClF_3

Balance the chemical equation for the reaction.

$$Cl_2 + \_\_\_\_\_F_2 \longrightarrow 2\ ClF_3$$

(1)

(i) Explain why fluorine is a gas at room temperature.

Use the following words in your answer:

energy **forces** **molecules** **weak**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

4 The Periodic Table contains groups of elements that have similar chemical properties.

(a) The halogens are in Group 7 of the Periodic Table.

(i) Complete the table. Iodine has been done for you.

Halogen	Colour of vapour
chlorine	
	red-brown
iodine	purple

(2)

(ii) Why do the halogens have similar chemical properties?

_____

_____

(1)

(b) The alkali metals are in Group 1 of the Periodic Table. State what is formed when any alkali metal reacts with water.

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

5 The halogens are in Group 7 of the periodic table.

(a) Why, in terms of electrons, are the halogens in Group 7?

_____

_____

(1)

(b) Sea water contains bromide ions (Br^-).
The bromide ions can be changed to bromine by bubbling chlorine gas into sea water.
Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.

$$2Br^-(aq) + Cl_2(g) \rightarrow Br_2(g) + 2Cl^-(aq)$$

Explain, in terms of electrons, why chlorine is more reactive than bromine.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 4 marks)

6 Read the information about the periodic table.

Portrait of Dimitri Mendeleev by Ilya Repin

When the Russian chemist Dimitri Mendeleev put forward his periodic table in 1869, the atomic structure of elements was unknown.

Mendeleev tried to arrange the elements in a meaningful way based on their chemical reactions. First he put the elements in order of their increasing atomic weight.
He then put elements with similar properties in the same column.

However, he left gaps, and sometimes did not follow the order of increasing atomic weight – for example, he placed iodine (atomic weight 127) after tellurium (atomic weight 128).

Within a few years there was sufficient evidence to prove that Mendeleev was correct.

Our modern periodic table has evolved from Mendeleev's table.

The modern periodic table on the Data Sheet may help you to answer these questions.

(a) (i) State why Mendeleev left gaps.

_____

_____

(1)

(ii) State why some elements were **not** placed in order of increasing atomic weight.

_____

_____

(1)

(b) (i) The periodic table is now based on atomic structure.

Explain how.

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) Suggest why it is impossible to have an undiscovered element that would fit between sodium and magnesium.

_____

_____

(1)

(c) Explain, in terms of electrons, why fluorine is the most reactive element in Group 7.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

1 (a) increase

1

(b) (i) Na^+ **and** Br^-

both required

1

(ii) sodium chloride

allow NaCl

*do **not** allow sodium chlorine*

1

(iii) chlorine is more reactive than bromine

allow converse argument

allow symbols Cl, Cl_2, Br and Br_2

allow chlorine / it is more reactive

*do **not** allow chloride **or** bromide*

1

(iv) fluorine

allow F / F_2.

*do **not** allow fluoride.*

1

[5]

2 (a) (i) gas

1

(ii) Increases

1

(b) (i) –1

allow Cl^-

allow –

allow negative

1

(ii) sodium + chlorine → sodium chloride

allow correct symbol equation

1

(c) reduce microbes

accept sterilise

accept prevent diseases

allow disinfect

allow kill bacteria / germs / microbes / micro-organisms

allow to make it safe to drink

ignore get rid of bacteria

1

(d) any **one** from:

- no freedom of choice

  allow unethical

- fluoride in toothpaste

- too much can cause fluorosis

  allow too much can cause damage to teeth

1

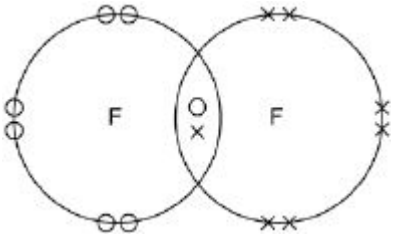
[6]

3

(a) group 7

1

(b)



*one shared pair anywhere in overlap between two circles **or** on intersection*

6 other electrons on each atom

*allow dots **or** crosses **or** mixture for all marks*

ignore any inner shell electrons

1
1

(c) bromine

1

potassium chloride

1

either order

allow correct chemical formulae

(d) displacement

1

(e) (an) electron

1

(f) smaller than

1

(g) (chlorine has) fewer levels / shells (of electrons)

allow converse for bromine

allow (chlorine has) fewer electrons

allow Cl has 3 levels / shells <u>and</u> Br has 4 levels / shells

ignore atomic number
***or** mass number*
***or** number of protons*

1

*mark independent of answer to part **(f)***

(h) 3

allow multiples

1

(i) there are <u>weak forces</u>

*do **not** accept weak bonds*

1

between <u>molecules</u>

1

*allow weak intermolecular forces for the first **2** marks*

which require little <u>energy</u> to overcome / break

allow does not need much <u>energy</u> to boil

1

[13]

4

(a) (i) green

*accept 'green-yellow' but **not** 'yellow' alone*

1

bromine or Br or Br_2

*do **not** accept bromide*

1

(ii) same number of electrons in outer energy level **or** *accept shell for energy level*

7 electrons in outer shell

accept need to gain 1 electron

1

(b) any **two** from:

- hydrogen **or** H_2

  *do **not** accept gas given off **or** fizzes*

- heat

  accept exothermic

  *do **not** accept flame*

- alkaline solution

  *accept (metal) hydroxide **or** NaOH **or** OH^-*

  *do **not** accept dissolves **or** forms a solution **or** floating*

  *accept balanced chemical equation for **2** marks*

2

[5]

5 (a) all have seven electrons in their outer shell / energy level

1

(b) *must be comparative in all points or converse*

chlorine atom is smaller than bromine atom

or

chlorine atom has fewer shells than bromine atom

1

outer shell / energy level of chlorine has stronger (electrostatic) attraction to the nucleus than bromine

or

outer shell of chlorine is less shielded from the nucleus than bromine

1

so chlorine more readily <u>gains</u> an extra electron

1

[4]

6 (a) (i) undiscovered elements owtte

1

(ii) they would be in the wrong group / have the wrong / different properties / don't fit the pattern owtte

allow atomic weights may have been wrong

1

(b) (i) any **three** from:

- elements arranged in proton / atomic number order
  ignore mass number / atomic weight / neutrons throughout
- group: elements in the same group / column have same number of outer electrons owtte
- group: number of shells increase down group
- period: elements in the same period / row have the same number of shells / energy levels
- period: number of protons / electrons increase across period
- atomic number: link of atomic number to number of protons
- atomic number gives number of electrons

3

(ii) it would mean splitting a proton / electron

or

implication of splitting proton / electron

1

(c) *must be a comparison*

(outer) electron closer (to nucleus)
accept fewer (electron) shells / energy levels
fluorine is the smaller/est

1

stronger/est attraction (to nucleus) owtte
*do **not** allow magnetic / intermolecular forces*

or

less screening (by inner electrons)

1

electron gained more easily
*need some indication of <u>outer</u> electron shell somewhere in explanation otherwise max of **2** marks*

1

[9]