

Q1.

This question is about the periodic table.

The figure below shows an early version of the periodic table published by a scientist.

- (a) The scientist left gaps in the periodic table in the figure above.

Each gap is represented by a question mark (?).

Give **one** reason why the scientist left gaps in this periodic table.

(1)

- (b) Which scientist published the periodic table in above figure?

Tick (✓) **one** box.

Bohr	
Chadwick	
Mendeleev	

(1)

- (c) The modern periodic table is different from the periodic table in above figure.

One extra group of elements has been added.

What is the name of the extra group of elements in the modern periodic table?

Tick (✓) **one** box.

Alkali metals	
Halogens	
Noble gases	

(1)

- (d) Why do the elements in Group 1 of the modern periodic table have similar chemical properties?

Tick (✓) **one** box.

The elements all form negative ions.	
The elements all have one electron in the outer shell.	
The elements all have the same number of shells.	

(1)

(e) **Table 1** shows the melting points of the first five elements going down Group 1.

Table 1	
Element	Melting point in °C
Lithium	181
Sodium	98
Potassium	X
Rubidium	39
Caesium	29

Predict value **X**.

X = _____ °C

(1)

(f) Give **one** observation you would see when a small piece of potassium is added to water.

(1)

(g) **Table 2** shows information about the first five elements going down Group 7.

Table 2	
Element	State at 150 °C
Fluorine	gas
Chlorine	_____
Bromine	gas
Iodine	liquid
Astatine	solid

Complete **Table 2**.

(2)

(h) The elements in Group 7 consist of molecules.

What is the formula of a molecule of bromine?

Tick (✓) **one** box.

Br	<input type="checkbox"/>
Br ₂	<input type="checkbox"/>

Br ²	
2Br	

(1)
(Total 9 marks)

Q2.

The halogens are elements in Group 7.

- (a) Bromine is in Group 7.

Give the number of electrons in the outer shell of a bromine atom.

_____ (1)

- (b) Bromine reacts with hydrogen. The gas hydrogen bromide is produced.

What is the structure of hydrogen bromide?

Tick **one** box.

Giant covalent	
Ionic lattice	
Metallic structure	
Small molecule	

(1)

- (c) What is the formula for fluorine gas?

Tick **one** box.

F	
F ₂	
F ²	
2F	

(1)

A student mixes solutions of halogens with solutions of their salts.

The table below shows the student's observations.

	Potassium chloride (colourless)	Potassium bromide (colourless)	Potassium iodide (colourless)
Chlorine (colourless)		Solution turns orange	Solution turns brown

Bromine (orange)	No change		Solution turns brown
Iodine (brown)	No change	No change	

(d) Explain how the reactivity of the halogens changes going down Group 7.

Use the results in the table above.

(3)

A company uses chlorine to produce titanium chloride from titanium dioxide.

(e) What is the relative formula mass (M_r) of titanium dioxide, TiO_2 ?

Relative atomic masses (A_r): O = 16 Ti = 48

Tick **one** box.

64	<input type="checkbox"/>
80	<input type="checkbox"/>
128	<input type="checkbox"/>
768	<input type="checkbox"/>

(1)

(f) The company calculates that 500 g of titanium dioxide should produce 1.2 kg of titanium chloride.

However, the company finds that 500 g of titanium dioxide only produces 900 g of titanium chloride.

Calculate the percentage yield.

Percentage yield = _____ %

(2)

(Total 9 marks)

Q3.

Group 7 is an important family of elements in the periodic table.

- (a) (i) What name is given to the Group 7 elements?

Draw a ring around your answer.

Halogens

Noble gases

Transition elements

(1)

- (ii) The grid shows some statements about Group 7 elements.

Tick () the **two** correct statements.

Statement	()
They are metals	
They consist of molecules	
They have coloured vapours	
They have high melting points	

(2)

- (b) The table gives information about some of the Group 7 elements.

Name of element	Melting point in °C	Boiling point in °C	Electronic structure
Fluorine	-220	-188	2, 7
Chlorine	-101	-35	2, 8, 7
Bromine	-7	58	2, 8, 18, 7
Iodine	114	183	2, 8, 18, 18, 7

Use information from the table to help you to answer these questions.

Write the correct number in the box to complete the sentence.

- (i) All these elements are in Group 7 because they have _____ electrons in their outer shell.

(1)

- (ii) Draw a ring around the correct word in the box to complete the sentence.

	gas.
--	------

At 20 °C bromine is a	liquid. solid.
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(1)

- (iii) Use the periodic table on the **Data Sheet** to name the Group 7 element that is **not** shown in the table.

(1)

- (c) A student investigated the reactivity of three Group 7 elements.

The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown in the table.

Solutions of	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No change		Solution turned brown
Iodine	No change	No change	

Explain how these results show that chlorine is more reactive than bromine and iodine.

(2)

(Total 8 marks)

Q4.

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

- (a) Name the products formed when chlorine solution reacts with potassium iodide solution.

(1)

(b) Explain why chlorine is more reactive than iodine.

(3)

(c) Chlorine reacts with hydrogen to form hydrogen chloride.

Explain why hydrogen chloride is a gas at room temperature.

Answer in terms of structure and bonding.

(3)

Q5.

The table shows the properties of four elements from Group VII of the Periodic Table.

(a) Complete the spaces in the table.

(4)

(b) Comment briefly on the trend in melting points for these four elements.

(1)

(c) Explain, in as much detail as you can:

(i) why the reactions of these elements with hydrogen are similar.

(ii) why their reactivity with hydrogen decreases from fluorine to iodine.

(4)
(Total 9 marks)

Q6.

This question is about the elements in Group 7 of the periodic table.

Table 1 shows the melting points and boiling points of some of the elements.

Table 1	
Element	Melting point in °C
Fluorine	-220
Chlorine	-101
Bromine	-7

(a) What is the state of bromine at 100 °C?

Use **Table 1**.

Tick (✓) **one** box.

Gas	
Liquid	
Solid	

(1)

- (b) What temperature does chlorine gas condense at to form a liquid?

Use **Table 1**.

Temperature = _____ °C

(1)

- (c) Complete the sentences.

Going down Group 7 the melting points _____.

This is because the size of the molecules increases so the intermolecular forces

_____.

(2)

A teacher investigated the reaction of iron with chlorine.

The diagram below shows the apparatus used.

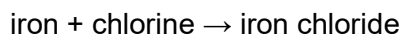
- (d) Why did the teacher do the investigation in a fume cupboard?

Tick (✓) **one** box.

Chlorine gas is coloured.	
Chlorine gas is flammable.	
Chlorine gas is toxic.	

(1)

- (e) The word equation for the reaction is:



Iron chloride is a solid.

The teacher weighed the glass tube and contents:

- before the reaction
- after the reaction.

What happened to the mass of the glass tube and contents during the reaction?

Give **one** reason for your answer.

The mass of the glass tube and contents _____

Reason _____

(2)

The teacher repeated the investigation with bromine gas and with iodine gas.

Table 2 shows the results.

Table 2	
Element	Observation
Chlorine	Iron burns vigorously with an orange glow
Bromine	Iron burns with an orange glow
Iodine	Iron slowly turns darker

- (f) Fluorine is above chlorine in Group 7.

Predict what you would observe when fluorine gas reacts with iron.

Use **Table 2**.

(1)

- (g) Balance the equation for the reaction between iron and bromine.



(1)

- (h) Calculate the relative formula mass (M_r) of FeBr_3

Relative atomic masses (A_r): Fe = 56 Br = 80

Relative formula mass (M_r) = _____

(2)

(Total 11 marks)

Q7.

The graph shows the melting point of four elements in Group 7 of the periodic table.

- (a) What is the melting point of fluorine?

(1)

- (b) Room temperature is 20°C .

Which element is solid at room temperature?

_____ (1)

(c) Look at the periodic table on the Data Sheet.

Using data from the graph, describe the trend of melting points of the elements in Group 7.

_____ (2)

(d) The elements in Group 7 are non-metals.

Which **two** of the following are properties of non-metals?

Place a tick () in the box against each correct property.

Brittle (if solid)	
Good conductor of heat	
High boiling point	
Poor conductor of electricity	

(2)
(Total 6 marks)

Q8.

Fluorine is a very useful element. It is placed in group 7 of the Periodic Table.

Use your knowledge of the elements in group 7 to help you answer these questions. You may find that information in the Data Sheet may help you with this question.

(a) Name another element in group 7 of the Periodic Table.

_____ (1)

(b) Cylinders filled with fluorine molecules are commercially available. What would you expect the formula of a fluorine molecule to be?

_____ (1)

(c) Fluoride ions are added to drinking water to help prevent tooth decay. What is the charge on fluoride ions in the water?

_____ (1)

(d) Fluorine reacts with the non-metal sulphur to make sulphur hexafluoride (SF_6).

(i) What type of bonding would you expect in sulphur hexafluoride?

(1)

(ii) Explain the reason for your answer to part (i).

(1)

(Total 5 marks)

Q9.

This question is about the periodic table.

In the 19th century, some scientists tried to classify the elements by arranging them in order of their atomic weights.

The figure below shows the periodic table Mendeleev produced in 1869.

His periodic table was more widely accepted than previous versions.

(a) The atomic weight of tellurium (Te) is 128 and that of iodine (I) is 127

Why did Mendeleev reverse the order of these two elements?

(1)

(b) Mendeleev left spaces marked with an asterisk *

He left these spaces because he thought missing elements belonged there.

Why did Mendeleev's periodic table become more widely accepted than previous versions?

(3)

(c) Mendeleev arranged the elements in order of their atomic weight.

What is the modern name for atomic weight?

Tick (✓) **one** box.

Atomic number	
Mass number	
Relative atomic mass	
Relative formula mass	

(1)

(d) Complete the sentence.

In the modern periodic table, the elements are arranged in order of

(1)

Chlorine, iodine and astatine are in Group 7 of the modern periodic table.

(e) Astatine (At) is below iodine in Group 7.

Predict:

- the formula of an astatine molecule
- the state of astatine at room temperature.

Formula of astatine molecule _____

State at room temperature _____

(2)

(f) Sodium is in Group 1 of the modern periodic table.

Describe what you would see when sodium reacts with chlorine.

(2)

(Total 10 marks)

Mark schemes

Q1.

(a) for elements that had not been discovered (at that time)
allow for missing elements

or

so that elements with similar properties are grouped together

ignore references to atomic number / mass / weight

(b) Mendeleev

(c) noble gases

(d) the elements all have one electron in the outer shell

(e) 63 (°C)

allow a value in the range 49 to 88 (°C)

(f) any **one** from:

- floats
- moves (on the surface)
- melts

allow forms a ball

- fizzes / bubbles
- flame

ignore colour of flame

allow explodes / disappears

ignore references to heat / temperature / sounds

(g)

Element	State at 150 °C	Symbol	Formula of the compound with hydrogen
Fluorine	gas	F	HF
Chlorine	gas	Cl	HCl
Bromine	gas	Br	HBr
Iodine	liquid	I	HI
Astatine	solid	At	HAt

(g) Br₂

Q2.

(a) 7

(b) small molecule

(c) F₂

(d) the reactivity decreases (going down Group 7)
allow the reactivity decreases from chlorine to iodine 1

(because) chlorine displaces bromine and iodine
allow (because) chlorine has two reactions
allow (because) neither bromine nor iodine can displace chlorine 1

(and) bromine displaces iodine **or** iodine does not react
allow (and) bromine has one reaction
or iodine has no reactions
allow (and) iodine cannot displace bromine 1

(e) 80 1

(f) (1.2 kg =) 1200 (g)
or (900 g =) 0.9 (kg) 1

or

allow an answer correctly calculated from:

or

an answer of 75 (%) scores 2 marks 1

[9]

Q3.

(a) (i) Halogens 1

(ii) They consist of molecules 1

They have coloured vapours 1

(b) (i) 7 / seven 1

(ii) liquid 1

(iii) astatine
allow obvious mis-spelling
ignore At 1

(c) chlorine reacts with (the) bromide [owtte]

1

chlorine reacts with (the) iodide [owtte]

allow chlorine reacts with both

or

chlorine has more reactions for 2 marks

or

*bromine reacts with one **and** iodine does not react at all for 2 marks*

1

Q4.

(a) potassium chloride **and** iodine

either order

allow KCl for potassium chloride and I₂ for iodine

1

(b) (chlorine's) outer electrons / shell closer to the nucleus

allow chlorine has fewer shells

allow chlorine atom is smaller than iodine atom

ignore chlorine has fewer outer shells

1

(so) the chlorine nucleus has greater attraction for outer electrons / shell

allow chlorine has less shielding

*do **not** accept incorrect types of attraction*

1

(so) chlorine gains an electron more easily

1

max 2 marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine

allow converse statements

allow energy levels for shells throughout

(c) hydrogen chloride is made of small molecules

allow hydrogen chloride is simple molecular

1

(so hydrogen chloride) has weak intermolecular forces*

1

(intermolecular forces) require little energy to overcome*

1

do **not accept reference to bonds breaking unless applied to intermolecular bonds*

Q5.

(a) (i) 9

(ii) 2.8.7 gas

(iii) liquid

each for 1 mark

4

- (b) increase as go down the table/F → I/down group/ as more protons/as atoms get bigger

for 1 mark

1

- (c) (i) reactions depend on taking/sharing electrons same number of electrons in outer shell/highest energy level
- (ii) F → I electrons in a higher energy level/further from nucleus so less easy to gain/hold electrons

each for 1 mark

4

[9]

Q6.

- (a) gas

1

- (b) -35 (°C)

allow any value between -35 °C and -100 °C

1

- (c) increase

1

increase

allow become stronger

1

- (d) chlorine gas is toxic

1

- (e) increased

1

chlorine (atoms) are now part of the solid (iron chloride)

or

the mass of the chlorine (atoms) is now also measured

1

- (f) burns very vigorously

allow burns violently

allow brighter (orange) glow

allow (orange) flame

allow explodes

1

- (g) $2 \text{Fe} + 3 \text{Br}_2 \rightarrow 2 \text{FeBr}_3$

allow multiples

1

- (h) $56 + (3 \times 80)$

1

= 296

Q7.(a) $-220(^{\circ}\text{C})$ *accept without unit do **not** credit if no minus sign no tolerance allowed*

1

(b) iodine

allow I or I₂

1

(c) increase down (the groups)

*N.B. must be **one** comparative or superlative for either position in group or melting point to obtain 2 marks**e.g. accept lowest in group has highest melting point for 2 marks accept highest in group has lowest melting point for 2 marks**accept highest mass numbers or proton numbers or atomic numbers have highest melting point for 2 marks**allow F has lower **or** lowest melting point for 1 mark**allow 'Increase from F to 1', i.e. referring to graph rather than periodic table for 1 mark**F has a low melting point no marks*

2

(d) brittle

1

poor conductor of electricity

maximum 1 mark if three boxes ticked no marks if all four boxes ticked

1

[6]

Q8.

(a) any (must be named)

1

(b) F_2

1

(c) $-\text{F}^-$

1

(d) (i) covalent

1

(ii) made of molecules etc. type of bonding when non-metals react.

1

[5]

Q9.

(a)

*ignore reference to atomic structure
ignore references to Cr, Mn and Mo*

any **one** from:

- so elements / iodine / tellurium were in groups with similar properties
- iodine has similar properties to Br / Cl / F / Group 7
allow corresponding argument in terms of tellurium
- iodine has different properties to Se / S / O / Group 6
allow corresponding argument in terms of tellurium

1

(b)

ignore reference to atomic structure

Mendeleev had predicted properties of missing elements

1

elements were discovered (that filled the spaces / gaps)

1

properties (of these elements) matched Mendeleev's predictions
allow atomic weights (of these elements) fitted in the spaces / gaps

1

if no other mark awarded, allow 1 mark for in previous versions of the periodic table the pattern of similar properties broke down

1

(c) relative atomic mass

1

(d) (increasing) atomic / proton number

ignore (increasing) electron number

*do **not** accept relative atomic / proton number*

1

(e) (formula) At₂

ignore incorrect state symbol

1

(state) solid

allow (s)

ignore s

1

(f) any **two** from:

- flame
allow burns
- (white) solid forms
allow (white) smoke forms
- colour of gas / chlorine disappears / fades

2