1(a). Group 1 and Group 7 of the Periodic Table both contain reactive elements.

Sodium, Na, reacts with water, H_2O.

Write a balanced symbol equation for this reaction.

[2]

(b). Complete the table below to show the molecular formula, state and colour of the three Group 7 elements.

	Chlorine	Bromine	Iodine
Molecular formula			
State (at room temperature)			
Colour			

[3]

2(a). Mendeleev organised the elements into the first Periodic Table.
The diagram shows some elements from Mendeleev's groups 2 and 3.

Group 2	Group 3
Be	B
Mg	Al
Cd	(gap)
Zn	(gap)

Mendeleev left gaps in his table.

Two gaps are shown in Group 3.

Explain why these gaps were so important.

---

[2]

(b). Two of the elements in Mendeleev's Group 2 are not in Group 2 of the modern Periodic Table.

Identify the elements and state where they are found in the modern Periodic Table.

---

[2]

3(a). Silver chloride is a salt that is used to make lenses that darken in bright light.

Silver chloride can be made from silver nitrate in a precipitation reaction.

This is the symbol equation for the reaction.

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

(i) Explain how this equation shows that silver chloride forms as a precipitate.

---

[1]

(ii) Write a word equation for the reaction.

[1]

(b). When light shines on silver chloride, AgCl, a solid forms which makes the lenses go dark.

The solid is silver metal.

Suggest the name of the **other** element that forms in the reaction.

---

[1]

4(a). The table gives some information about the elements in Group 7.

Complete the table by filling in the missing information.

Element	Normal state at room temperature	Colour at room temperature
fluorine	gas	pale yellow
chlorine		
bromine		
iodine		grey

[2]

(b). Which statements about the atoms of the elements in Group 7 are true?

Put ticks (?) in the boxes next to the two correct answers.

They all have the same number of electron shells. ☐

They all have the same number of outer shell electrons. ☐

They all form ions with the same charge. ☐

They all have the same charge on the nucleus. ☐

They all form ions by losing electrons. ☐

[2]

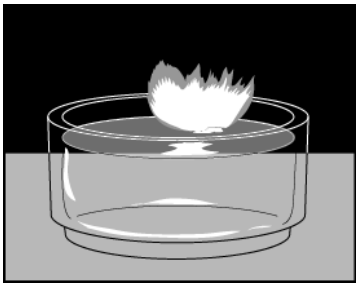
(c). Group 7 elements are *diatomic*.
What does this mean?

---

[2]

5(a). Sodium and potassium are elements in Group 1 of the Periodic Table.

Jake watches a video of the reaction between sodium and water.



Complete the word equation for the reaction between sodium and water.

sodium + water $\rightarrow$ ..... + ...

[2]

(b). Jake thinks that the reaction makes an alkali.

How could you show that a solution has an alkaline pH?

.....

.....

[2]

(c). Jake watches another video. This video shows the reaction of **potassium** with water.

How is this reaction different from the reaction of sodium with water?

Put ticks (✓) in the boxes next to the **two** correct answers.

The two reactions make different gases. ☐

The reaction of sodium takes less time than the reaction of potassium. ☐

The reaction with potassium makes an acid. ☐

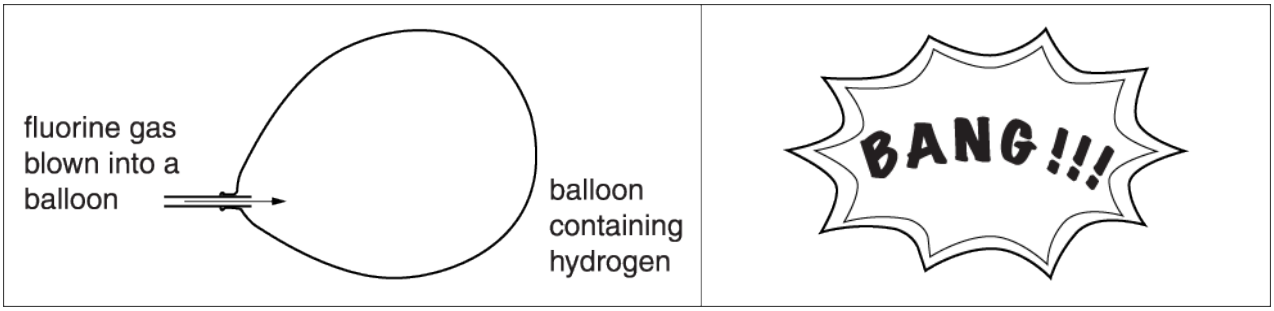
The two reactions have different rates. ☐

The two reactions make different alkalis. ☐

[1]

6(a). Hydrogen reacts with the elements in Group 7 of the Periodic Table.

Hydrogen and fluorine explode when they are mixed together.



The word equation for the reaction is

hydrogen + fluorine ⟶ hydrogen fluoride

The formula for hydrogen fluoride is HF.

Write a balanced **symbol** equation for the reaction between hydrogen and fluorine.

[2]

(b). Iodine is another element in Group 7.

Predict the **name** and the **formula** of the compound that is made when **iodine** reacts with hydrogen.

name _____

formula _____

[2]

(c). The table shows what happens when fluorine, chlorine and iodine react with hydrogen.

Element	Reaction when mixed with hydrogen
fluorine	explodes at room temperature
chlorine	a small spark is enough to make the mixture explode
iodine	reacts slowly when heated strongly

(i) Describe the trend in reactivity of the Group 7 elements with hydrogen.

---

[1]

(ii) Bromine reacts steadily with hydrogen when it is heated.
Does this fit the trend of reactivity of the other halogens?
Explain your reasoning.

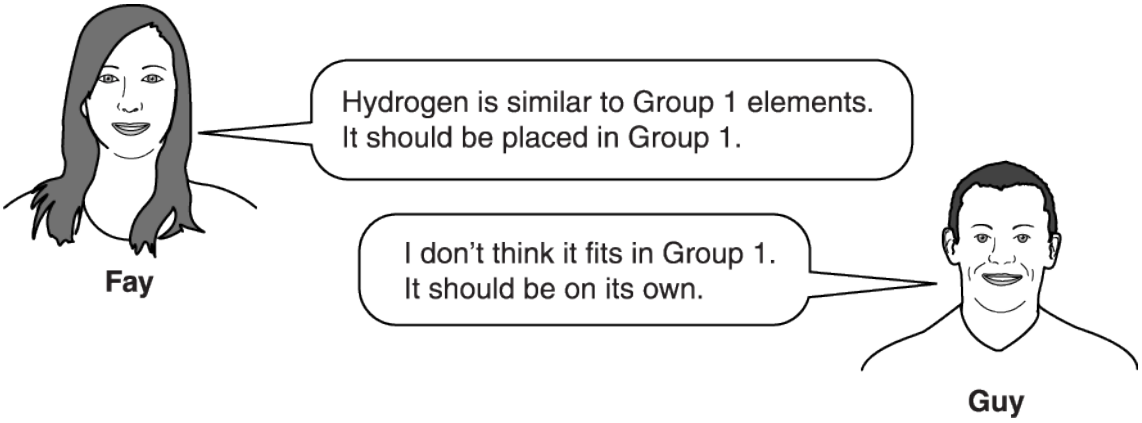
---

[2]

7. The table shows some information about the element hydrogen.

Properties of hydrogen	
State at room temperature	gas
Type of element	non-metal
Atomic number	1
Number of electrons in outer shell of an atom	1
Maximum number of electrons the outer shell can hold	2
Ion	H^+
Formula of chloride	HC*l*
Reactivity	Very flammable. Reacts with both metals and non-metals. Does not react with water.

Fay and Guy are discussing where hydrogen fits in the Periodic Table.



Use information in the table and your knowledge of Group 1 elements to evaluate the ideas of Fay and Guy.

The quality of written communication will be assessed in your answer.

---

[6]

8(a). Jack writes down data about some elements in Group 7.

Element	Formula of molecule	Normal physical state (room temperature 20 °C)	Melting point in °C	Boiling point in °C
fluorine	F_2	gas	?220	?188
chlorine	Cl_2	gas	?101	?35
bromine	Br_2	liquid	?7	?59
iodine	I_2	solid	114	184

Jack has made a mistake. One of the boiling points is wrong.

Which boiling point in the table is wrong?

Explain how you made your choice.

---

[2]

(b). Estimate the correct value for the boiling point.

°C **[1]**

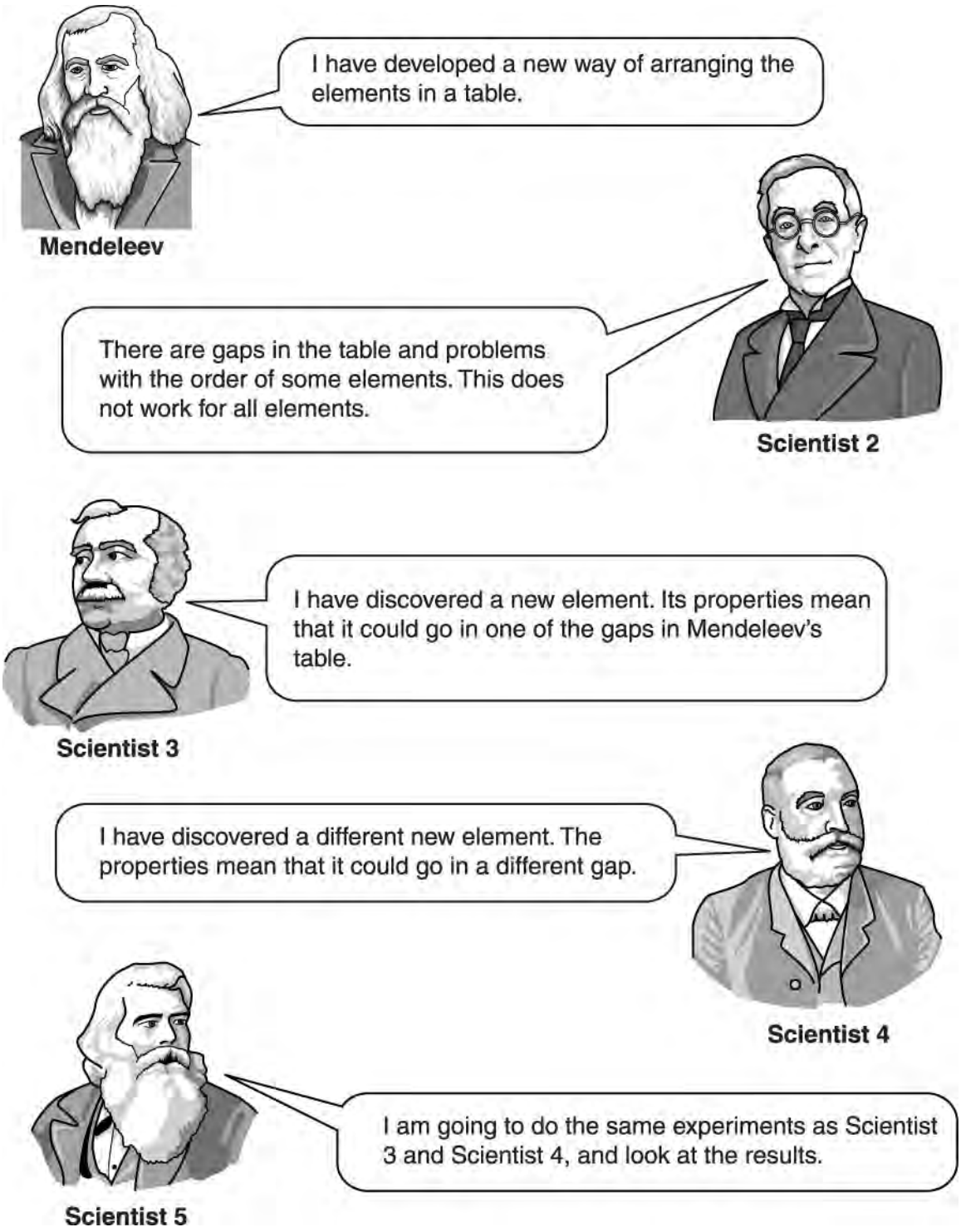
(c). Astatine is another element in Group 7 of the Periodic Table.

What is the formula for a **molecule** of astatine?

---

[1]

9(a). Mendeleev developed the modern Periodic Table. Other scientists were involved.



Which **two** scientists are doing a peer review?

Explain how what they say is peer review.

---

[3]

(b). Mendeleev's ideas were supported by the discoveries of **Scientist 3** and **Scientist 4**.

Explain why.

---

[2]

10(a) Abbi does some experiments with Group 7 elements.

.

Group 7

F fluorine
Cl chlorine
Br bromine
I iodine

Abbi does an experiment using chlorine.

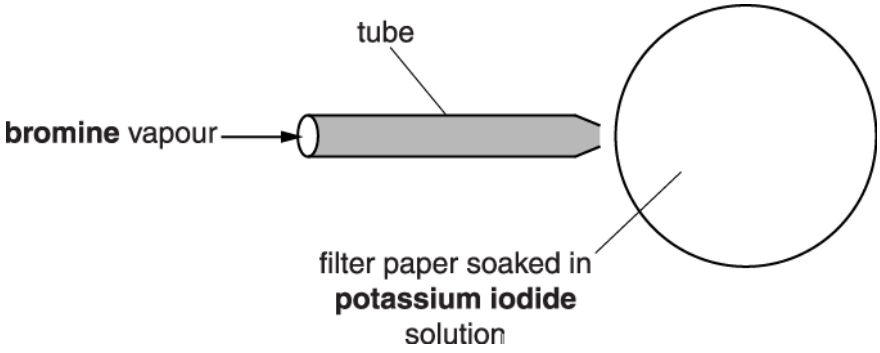
She uses a fume cupboard.

Explain why chlorine is hazardous.

---

[2]

(b). Abbi passes bromine vapour over a filter paper soaked in potassium iodide solution. Bromine vapour is blown onto the filter paper down a tube.



A grey solid appears on the filter paper because **iodine** is made.

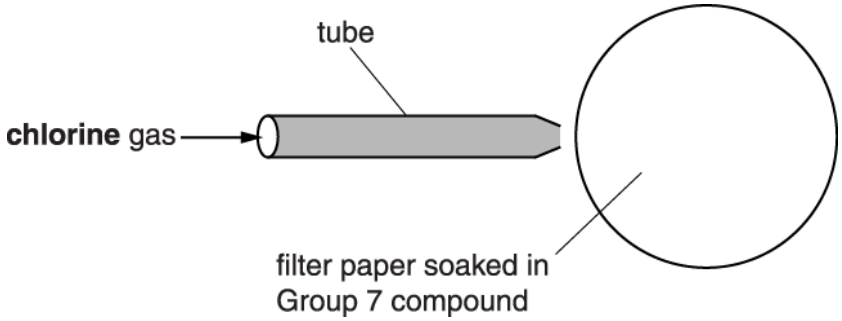
Complete the symbol equation for this reaction.

Br_2 + 2KI → [ ] + [ ]

[2]

(c). Abbi repeats the experiment using chlorine gas.

She passes chlorine gas down a tube onto filter papers soaked in some other Group 7 compounds.



The table shows which compounds she uses.

Gas	Group 7 compound on filter paper
chlorine	potassium fluoride
chlorine	potassium chloride
chlorine	potassium bromide
chlorine	potassium iodide

Before the experiment the solutions of the compounds are all colourless.

State and explain what Abbi will **see** when chlorine gas passes over each Group 7 compound.

The quality of written communication will be assessed in your answer.

---

[6]

11(a) Jack investigates the reactions of some Group 1 and Group 2 metals with water.

.

He adds a small piece of each metal to water and measures how long it takes for the reaction to finish.

He uses the same amount of metal and the same amount of water each time.

The table shows his results.

Metal	Group	Time taken for reaction to finish in s
lithium	1	35
sodium	1	12
potassium	1	5
magnesium	2	not finished after 2 minutes
calcium	2	40
strontium	2	9

What conclusions can you make from the data about the reactivity of Group 1 and Group 2 metals with water?

---

[3]

(b). Which of the following statements about the reactions of the Group 1 metals with water are **true** and which are **false**?

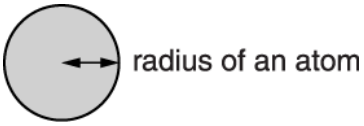
Put a tick (?) in one box in each row.

	True	False
The reactions make hydrogen gas.		
Each reaction makes a different metal oxide.		
The reaction mixture gains mass during every reaction.		
The pH of each solution is neutral at the end of the reaction.		

[2]

12. Joe does some research about atoms of Group 1 elements.

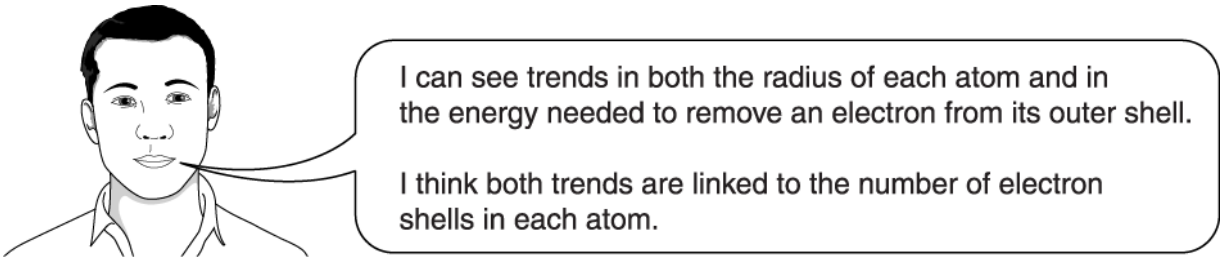
He finds data about the radius of each atom.



He also finds data about the energy needed to remove one electron from the outer shell (energy level) of each atom.

Element name	Total number of electrons in each atom	Radius of the atom in pm	Energy needed to remove one outer shell electron in arbitrary units
lithium	3	152	520
sodium	11	186	490
potassium	19	231	420

Joe works out the number of electron shells in each atom and puts forward a hypothesis.



Joe

What trends does the table show? How does the number of **electron shells** in each atom link to these trends?

You may use diagrams to show the electron shells in each atom to support your answer.

The quality of written communication will be assessed in your answer.

[6]

13(a) Ling carries out an investigation of the halogens.

.

Ling reacts some chlorine solution with a solution of potassium bromide.

The solution turns brown.

Explain why.

Include an **ionic** equation in your answer.

[3]

(b). Ling sees that the element astatine, At, is below iodine in Group 7.

She makes some predictions about astatine.

Which predictions about astatine are correct?

Tick (✓) **two** boxes.

Astatine is white. ☐

Astatine is a gas. ☐

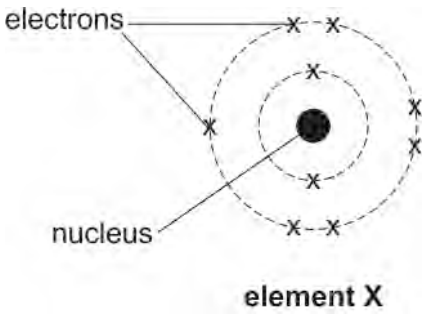
Astatine reacts with sodium to form NaAt. ☐

Astatine is less reactive than iodine. ☐

[1]

14(a) The diagram shows the arrangement of electrons in an atom of an element, **element X**.

.



element X

Use the diagram and the Periodic Table to identify the element and to complete the missing information in the table.

Name of element	
Number of electrons	9
Number of protons	
Number of neutrons	
Periodic Table Group	

[3]

(b). The diagram below shows the arrangement of electrons in **an ion** of another element from the same group, **element Y**.

ion of element Y

(i) What is the charge on the ion?

Explain your answer.

Charge ----------

Explanation ----------

---------- [2]

(ii) Explain how you can tell from the diagrams that **element X** and **element Y** are in the same group of the Periodic Table.

---------- [1]

15(a) About 150 years ago, Dimitri Mendeleev developed an early version of the Periodic Table.
. His Periodic Table had eight groups. He put elements with similar properties into the same group.

The table shows some of the elements that Mendeleev grouped together.

Mendeleev's groups							
1	2	3	4	5	6	7	8
Li Na K Cu	Be Mg Zn	B A*l*	C Si	N P	O S Cr	F C*l* Br	Fe Co Ni

Some of Mendeleev's groups contain similar elements to groups in the modern Periodic Table.

Which group in Mendeleev's table contains the elements now found in Group 14 of the modern Periodic Table?

Group ______________________________ **[1]**

(b). None of the elements from Group 18 of the modern Periodic Table are shown on Mendeleev's table.

Suggest a reason why.

____

____ **[1]**

(c). Mendeleev put some of the transition metals into his Group 8.

He put some other transition metals into the other groups.

Give the symbols for **three** transition metals in Mendeleev's table that he did **not** put in Group 8.

1 ----------

2 ----------

3 ----------

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		$2Na + 2H_2O$ ☐ $2NaOH + H_2$ ✓✓	2	One mark for correct symbols One mark for balancing
	b		<table><tr><td></td><td>Chlorine</td><td>Bromine</td><td>Iodine</td></tr><tr><td>Formula</td><td>Cl_2</td><td>Br_2</td><td>I_2✓</td></tr><tr><td>State</td><td>gas</td><td>Liquid</td><td>Solid✓</td></tr><tr><td>Colour</td><td>Green/yellow</td><td>red/brown/ orange</td><td>Purple/grey✓</td></tr></table>	3	(1) for each correct row
			Total	**5**	
2	a		gaps are for undiscovered elements ✓ he predicted properties / new elements matched his predictions / new elements had the properties he predicted ✓	2	
	b		d and Zn / cadmium and zinc ✓ transition metals ✓	2	Both elements needed for one mark
			Total	**4**	
3	a	i	(s) shows it is a solid / (s) is the state symbol / state symbol is a solid;	1	Must be linked to idea of state symbol **Ignore** 'it shows it's a solid' alone **Examiner's Comments** Most stated that 'a solid is formed'. This was not awarded a mark because it does not 'use the equation to show'. Some candidates did discuss the state symbol (s) linked to precipitate, but most failed to gain a mark.
		ii	silver nitrate + sodium chloride ? silver chloride + sodium nitrate	1	**Examiner's Comments** About half the candidates correctly wrote the word equation. Common incorrect answers included using incorrect names such as 'sodium chorine' or 'sodium nitrogen oxide'.
	b		chlorine	1	**Accept** Cl_2 **Do not allow** 'chloride'or 'Cl' **Examiner's Comments** Most did not realise that silver chloride would produce chlorine when it breaks down to form silver. Oxygen and hydrogen were commonly seen.

Question			Answer/Indicative content	Marks	Guidance
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
4	a		gas liquid solid (1) green orange / red-brown (1)	2	**Accept** green-yellow / yellow as colour of chlorine. **Accept** red or orange-brown, brown, orange. **Reject** other colours. **Ignore** 'dark' 'light' 'pale' etc **Examiner's Comments** Many candidates gained no marks for this question. The states and colours of the halogens were not well known. Some thought that chlorine was orange. Many thought that iodine was a liquid.
	b		Box 2; Box 3;	2	**Examiner's Comments** Most gained at least one, and many gained both of these marks about the structure of Group 7 atoms and ions.
	c		two atoms / pair of atoms; in each molecule / (covalently) bonded together;	2	**Accept** 'which share a pair of electrons' / 'joined together' **Do not allow** ionic bond **Do not allow** molecules/ions joined together **Ignore** double/triple **Ignore** any examples / diagrams / formulae **Examiner's Comments** Most candidates did not know the meaning of the term 'diatomic'; many gave properties of halogens such as reactivity or state. Those who had an idea of the meaning often showed only partial understanding which was not enough to gain credit such as 'they go round in pairs'. Many confused molecules, elements and atoms, stating that 'it contains two elements' or 'it contains two molecules'.

Question			Answer/Indicative content	Marks	Guidance
			Total	6	
5	a		sodium hydroxide (1) hydrogen (1)	2	Either order **Allow** correct formula (NaOH and H_2) **Examiner's Comments** About a third of candidates correctly completed the word equation for the reaction of sodium with water. Common errors were to incorrectly name either the alkali or the gas. Common incorrect answers included sodium oxide, carbon dioxide, oxygen or water being formed.
	b		add UI or pH paper / solution (1) goes blue / purple / check the colours against a reference idea / gives pH above 7 (1) **OR** pH probe (1) gives pH above 7 (1)	2	If no correct indicator is given, accept Litmus (goes blue) for 1 mark only **Examiner's Comments** About a fifth of candidates did not correctly describe how to test pH. Most knew that 'an indicator' is needed, but at this level of demand it is expected that they name an indicator fully, such as 'Universal Indicator'. The use of a pH meter was less commonly stated.
	c		the two reactions have different rates the two reactions make different alkalis	1	Both needed **Examiner's Comments** This question demanded two correct answers for a single mark. A common incorrect choice was that 'the reaction of sodium takes less time than the reaction of potassium'. Just under half of the candidates selected the two correct responses.
			Total	5	

Question			Answer/Indicative content	Marks	Guidance
6	a		$H_2 + F_2$? *2HF* correct formulae (1) correct equation balanced (1)	2	 **Do not allow** h_2 h^2 H^2 F^2 **Allow one mark** for balancing if formulae of hydrogen and / or fluorine contain minor errors e.g. h_2 h^2 H^2 F^2 **Examiner's Comments** Candidates found writing this equation very challenging. Most did not know the formulae for hydrogen and fluorine. The most common error was to represent fluorine as 2F. As the balancing was dependent on the correct formulae, this led to most candidates failing to score.
	b		hydrogen iodide (1) HI (1)	2	**Do not allow** hydrogen iodine **Accept** 2HI **Examiner's Comments** About a third of candidates did not score any marks for deducing the name and formula of hydrogen iodide. Some who did score wrote the correct formula but gave an incorrect name, such as ‘iodine hydroxide’ or ‘hydrogen iodine’.
	c	i	become less reactive (down the group)	1	**Examiner's Comments** This question was well answered with most candidates correctly interpreting the trend in the table.

Question			Answer/Indicative content	Marks	Guidance
		ii	less reactive than chlorine / reacts more slowly than chlorine (1) more reactive than iodine / reacts faster than iodine (1)	2	Chlorine or iodine must be mentioned. **Ignore** repeated observations from the table. **Ignore** 'because the reactivity decreases down the group'. **If 2 marks are not scored. Allow (1)** for idea of fitting between chlorine and iodine; **Examiner's Comments** Candidates need to take care when answering this type of question that they address the task fully. Rather than discuss the trend in reactivity linked to the position of bromine in the group, some merely re-quoted the observations in the table.
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
7			**Level 3 (5–6 marks)** Discusses **properties of group 1** and links why some properties mean that **hydrogen fits** and some properties mean that it **does not fit**. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Discusses **properties of group 1** and links why a property of **hydrogen fits** and why a property **does not fit**. Quality of written communication partially impedes communication of the science at this level. **Level 1 (1–2 marks)** Links some properties of hydrogen for why **hydrogen fits** OR **does not fit** group 1. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A/A*** **Relevant points include:** **Fay: Hydrogen fits** Group 1 because… • it has same number / one electron in its outer shell • forms an ion with a single positive charge / 1 + charge • forms a chloride with a similar formula to Group 1 chlorides (LiCl etc) • very flammable / very reactive • reacts with non-metals / group 7 elements / halogens **Guy: Hydrogen does not fit / should be alone** because… • it is a gas • non-metal • does not react with water • forms compounds with metals (as well as non-metals) • (alone because) maximum electrons in outer shell is 2 • may gain an electron (to form an ion / give a full shell) • forms covalent bonds **Properties about Group 1** • contains solids • contains metals • elements are flammable / reactive • has 1 electron in the outer shell • idea that outer shell of common Group 1elements holds up to 8 electrons • form ions with single positive charge • very reactive with water • only form compounds with non metals • react with group 7 elements / halogens • do not react with other metals. **Use the L1, L2, L3 annotations in Scoris; do not use ticks.** **Examiner's Comments**

Question			Answer/Indicative content	Marks	Guidance
					This question was well answered and a full range of achievement was seen. The commonest score for the question was 4 marks at Level 2. Candidates typically classified the properties of hydrogen from the table into 'fitting' or 'not fitting' the statements of Fay and Guy, but two broad types of error in the answers limited the candidates' scores. Firstly, some answers did not fully link the properties of hydrogen to the properties of group 1. The question specifically asked candidates to 'use their knowledge of group 1 elements'. Therefore some answers were incomplete. For example, saying 'hydrogen doesn't fit with group 1 because it is a gas' is a lower level answer than 'hydrogen doesn't fit with group 1 because it is a gas but group 1 elements are all solids'. Secondly, some answers gave very confusing accounts that compared the properties incorrectly, for example stating that group 1 are all non-metals or that hydrogen must always gain electrons to form an ion.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
8	a		(boiling point for) bromine / ?59; (1) bromine is a liquid / must have a boiling point above 20°C / above room temperature / should be higher than chlorine / boiling point should increase (down the group) / boiling point should be higher than the melting point (1)	2	**ignore** 'it is too low' alone **ignore** 'it does not fit the pattern' **If chlorine is given as answer….** **For (1) mark max accept** 'chlorine (or ?35) because boiling points should increase (down the group)' / 'chlorine boiling point should be lower than bromine (or below -59)' /AW **ignore** 'chlorine boiling point should be lower' alone, needs a comparison **Examiner's Comments** Most candidates gained both marks for identifying bromine as having an incorrect boiling point, often linked to its liquid state or to a correct comparison with its melting point. Candidates, who suggested chlorine as the answer, were awarded a single mark if they gave a correct reason linked to the general trend in boiling points in the table.
	b		Must give bromine as answer in (a) (+)59 / accept answers between 20 and 150°C	1	Must be a numerical value **accept** a numerical range if both values fall between 20 and 150°C **Examiner's Comments** Just less than half of the candidates went on to suggest a boiling point for bromine that was in the acceptable range (above room temperature but well below that of iodine).
	c		At_2	1	**do not accept** at_2 or AT_2. **do not accept** At_2. 2 must be smaller than letters or subscripted. **Examiner's Comments** Most candidates correctly gave the formula for astatine. Common errors included presenting astatine as atomic (At) or giving an incorrect symbol for the element (for example As_2).

Question			Answer/Indicative content	Marks	Guidance
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
9	a		Scientist 2 and scientist 5; (1) Scientist 2 is evaluating / judging / analysing / criticising Mendeleev's work; (1) Scientist 5 is checking / repeating another scientist's work / checking results / look for repeatability; (1)	3	**Ignore** 'reviewing' (in the Q) **Allow** 'give feedback' **Ignore** 'talking about' 'discussing' (not enough) **Allow** 'do the same experiment' / 'repeat the experiment' **Examiner's Comments** Most candidates identified 2 and 5 correctly as the scientists involved in peer review. In this question, marks were given for a straight 'lift' of information from the question stem. Saying that scientist 5 was 'repeating experiments' was enough to gain credit. For scientist 2, candidates needed to explain that his peer review was based on his criticism, evaluation or assessment of Mendeleev's work. Candidates need to take care not to merely repeat the question. Answers which said that scientist 5 was 'reviewing' the work did not gain credit as they closely repeated the question.

Question			Answer/Indicative content	Marks	Guidance
	b		2 from Mendeleev: left gaps for undiscovered elements / made predictions about properties; Scientists: Idea of fitting / matching (in the gaps); Idea that properties of new elements agree with or support Mendeleev's predictions;	2	 Ignore ‘goes in the gaps’ (in the Q) Allow example of a property that matched Examiner’s Comments The majority of candidates scored at least partial credit here. However, in this question, repeating the information in the stem or in the speech bubbles was not enough to show that candidates understood how Mendeleev’s ideas were supported. Some candidates repeated information such as ‘they discovered new elements which go in the gaps’. The strongest answers made it clear that the properties of the new elements matched Mendeleev’s predictions based on the gaps he deliberately left for elements he expected to be later discovered.
			Total	5	

Question			Answer/Indicative content	Marks	Guidance
10	a		Toxic / corrosive / respiratory problems / irritates or damages lungs; gas;	2	**Allow** poisonous **Ignore** harmful / hazardous / dangerous / can kill **Allow** vapour Examiner's Comments ??Most knew that chlorine is a toxic gas. Candidates need to make sure that when asked about hazardous chemicals that they clearly identify the hazard. Those who said that chlorine is 'harmful' or 'hazardous' or 'will kill you' did not score; candidates need to identify the nature of the hazard. 'Toxic', 'poisonous' or 'corrosive' were all accepted.
	b		I_2 + 2KBr; (2) For (1) mark at least one formula correct I_2 / KBr: ;	2	**Allow** BrK Formulae and balancing fully correct = (2) Examiner's Comments Just under half of all candidates scored partial credit, usually for correctly giving the formula of either KBr or I_2. Common reasons for failing to score included representing iodine as 2I or potassium bromide as K_2Br_2.

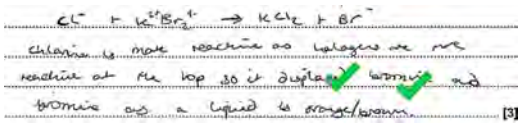
Question			Answer/Indicative content	Marks	Guidance
	c		[Level 3] Links two reactions with reactivity and correct observations. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Links a reaction to either the correct observation or to reactivity. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Makes a correct statement about observations, reactions or reactivity. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Indicative scientific points may include: Observations • KF (and KCl) no change / accept yellow or green colour seen (due to chlorine) • KBr orange / brown / yellow-brown / red-brown (**ignore** yellow or red alone) • KI grey colour **accept** brown (**ignore** violet / purple) **Ignore** states, look for colours alone **QWC is impeded** if other incorrect observations given e.g. precipitates or incorrect colours for elements (ignore bromine red or yellow and iodine violet or purple) Reactions • No reaction with KF (and KCl) • Reaction occurs with KBr (may be implied if observations are given) • Reaction occurs with KI (may be implied if observations are given) **Allow Level 1 only** for no reaction between chlorine and potassium chloride Reactivity • Cl_2 less reactive than F_2 / cannot displace F_2 • Cl_2 more reactive than Br_2 / can displace Br_2 • Cl_2 more reactive than I_2 / can displace I_2 • Reactivity gets less down the group **QWC is impeded** if 'chlorine' is confused with 'chloride' etc. **Use the L1, L2, L3 annotations in Scoris; do not use ticks.** Examiner's Comments The question asked for a statement and an

Question			Answer/Indicative content	Marks	Guidance
					explanation of what would be seen when chlorine was passed over solutions of potassium halides. In this type of question, candidates need to pause to think about what they need to include in their answer; in this case, a description of observations linked to an explanation. Many answers did not include observations; some gave observations but did not include an explanation for the changes. These answers were limited to the lower levels. Answers at level 3 both described the correct colour changes and explained these in terms of the reactivity of the elements compared to chlorine. Some candidates thought that all combinations would give a reaction, including chlorine with potassium fluoride. In answers which described observations, candidates knew some or all of the colours of the halogens. In this case incorrect statements of state e.g. bromine gas or liquid, were not penalised but were ignored. Similarly, correct colours for elements in states other than those in the question (for example purple linked to iodine) were also ignored.
			Total	10	

Question			Answer/Indicative content	Marks	Guidance
11	a		group 1 more reactive down the group / group 1 react faster down the group; (1) group 2 more reactive down the group / group 2 react faster down the group; (1) group 1 more reactive than group 2 / group 1 react faster than group 2; (1)	3	**Accept** for 2 marks 'In BOTH groups the reactivity increases going down the group' **Ignore** comparison between individual metals alone. **Ignore** answers which only mention time taken Examiner's Comments ??Candidates needed to use the information in the table to make conclusions about reactivity. Many candidates interpreted the information well and presented their conclusions clearly. Most gained some marks. The most common reason that some candidates did not score was that they repeated the information in the table, for example saying 'the times get shorter' rather than interpret the information to make a conclusion about reactivity ('the elements become more reactive down the group'). Some candidates gained partial credit by spotting some, but not all of the three trends in the data.
	b		TFFF	2	All correct = (2) 2 or 3 correct = (1) 1 correct = 0 Examiner's Comments ??Most gained a single mark. The second box, which stated that 'Each reaction makes a different metal oxide' proved most challenging, with many candidates classifying this statement as correct, even though the question was about elements reacting with water.
			Total	5	

Question			Answer/Indicative content	Marks	Guidance
12			[Level 3] Identifies trends in both radius and energy **AND** links electron shells to one of the trends. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Identifies both trends (atomic radii and energy needed to remove an electron) **AND** describes the electron arrangement in two or more atoms. **OR** Identifies one trend and gives a level 3 link between electron shells and the trend. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Describes at least one trend in the data **OR** describes the electron arrangement in two or more atoms. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Indicative scientific points may include: **Links electron shells to trends in radius / energy (level 3)** • more (electron) shells causes a larger atomic radius / idea that the atom is larger if it has more shells • statement of idea that outer shell electrons are further away from nucleus in bigger atoms. • More electron shells need less energy to remove electron / easier to remove an electron • More electron shells lead to more shielding. • Further from nucleus, less energy needed to remove electron / easier to remove an electron **Describes electron arrangement (level 2 and 1)** • Li 2,1. Na 2,8,1 K 2,8,8,1 / draws correct diagrams • identifies the number of electron shells in at least two atoms • identifies a trend in electron shells / down the group there are more shells / atoms with more electrons have more electron shells. **Describes the trends in the data (all levels)** • atomic radius increases with increasing electron number or down the group • energy needed to remove electron decreases with increasing electron number or down the group • larger radius, less energy needed to remove electron or larger radius, easier to remove an electron **Use the L1, L2, L3 annotations in Scoris; do not use ticks.** **Examiner's Comments**

Question			Answer/Indicative content	Marks	Guidance
					This question relied on the interpretation of data. Candidates processed the data well, showing that they are skilled at manipulating unfamiliar data. About a quarter of candidates gained a level 1 or zero marks. This was usually because they did not engage fully with the question. To gain a level 2, the answer needed to discuss the data in the context of electron shells. Many candidates referred only to numbers of electrons (which were given in the table) rather than discussing electron shells (which is what the question asked about). However, those who did discuss the arrangement of electrons in shells showed very good understanding of concepts such as the effect of increasing distance of outer electrons from the nucleus. Some very high level responses were seen. Well over a third of candidates gained a level 3. Some candidates showed poor communication skills by confusing electrons with atoms in their answers.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
13	a		Bromine/Br_2 identified ✓ displaced (by the chlorine) / chlorine is more reactive than bromine ✓ $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ ✓	3 (AO 3 × 1.1)	**ALLOW** from equation **IGNORE** 'replace' **DO NOT ALLOW** '<u>chloride</u> displaces bromide **ALLOW** 'chlorine displaces bromide' for MP2 **IGNORE** K^+ ions <u>Examiner's Comments</u> Most candidates knew that chlorine is more reactive than bromine and many went on to explain that this means that bromine is displaced, causing the brown colour. The ionic equation was the main discriminatory mark, with only the higher ability candidates giving a correct equation. Common errors were incorrect formula (such as 2Br) or attempting to write full equations which included the potassium ions. Exemplar 1  This candidate knows that chlorine is more reactive than bromine [1] and that bromine is displaced (giving an orange-brown colour) [1]. Notice, however, that the ionic equation contains potassium and has several incorrect formulae, including incorrect formulae for the two halogens involved in the reaction. This was a typical common error.
	b		Astatine reacts with sodium to form NaAt ✓ Astatine is less reactive than iodine ✓	1 (AO 2.1)	
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
14	a		fluorine protons: 9 neutrons : 10 group: 7 / 17	3 (AO 3 × 2.1)	All 4 correct = ✓ ✓ ✓ 3 correct = ✓ ✓ 1 or 2 correct = ✓ Examiner's Comments This question was well answered. Almost all candidates correctly identified both the group and the element. Some put the numbers of protons and neutrons in the wrong order.
	b	i	- 1 ✓ it has gained (an) electron ✓	2 (AO 2.1) (AO 1.1)	ALLOW '-' IGNORE 'negative' ALLOW M2 for idea of gaining electrons, even if M1 is not awarded. ALLOW 'has (one) more electron than protons' Examiner's Comments Most knew that the atom had gained an electron. When giving a charge on an ion, 'negative' is not enough, a negative ion could have a range of charges. Best answered stated clearly that the charge is '–1'.
		ii	the atoms both have 7 electrons in the outer shell / both atoms have the same number of electrons in the outer shell / both need one electron to give a full outer shell ✓	1 (AO 1.1)	
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
15	a		4 ✓	1 (AO 2.1)	
	b		they were not yet discovered / he didn't know about them ✓	1 (AO 2.1)	Examiner's Comments Both of these part questions were very well answered. Candidates interpreted the information well and applied it to the context.
	c		In any order: Cu Zn Cr ✓✓	2 (AO 2× 2.1)	ALLOW names IGNORE Fe Co Ni DO NOT ALLOW any other additional elements (apply list principle) All three correct = 2 marks Two or one correct = 1 mark Examiner's Comments Most earned at least one mark for identifying one transition metal correctly. Others either included non-transition metals in the list or used their periodic table to find examples of transition metals that were not from Mendeleev's table. It is important that candidates read the question carefully to ensure that they follow the instructions.
			Total	4	