1(a). Joe does some research about Group 1 elements of the Periodic Table.

Joe finds out the electron arrangement for the atoms of these elements.

Element	Electron arrangement
lithium	2.1
sodium	2.8.1
potassium	2.8.8.1

Describe the similarities and differences between the electron arrangement in the atoms of these elements.

---

[3]

(b). Joe uses the Periodic Table to make a prediction about the order of reactivity of the three elements.

Which order of reactivity for the three elements is correct?

Put a tick (✓) in the box next to the correct answer.

lithium > sodium > potassium ☐

lithium < potassium < sodium ☐

potassium > sodium > lithium ☐

lithium < sodium > potassium ☐

[1]

2. Lithium is an element in Group 1 of the Periodic Table. Lithium reacts with fluorine gas to form lithium fluoride.

(i) Complete the word and symbol equation for the reaction.

lithium + fluorine → .....

2..... + F_2 → 2LiF

[2]

(ii) Draw straight lines to join each **substance** to its correct **description**.

Substance	Description
lithium	non-metal
fluorine	compound
lithium fluoride	metal

[2]

3(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.

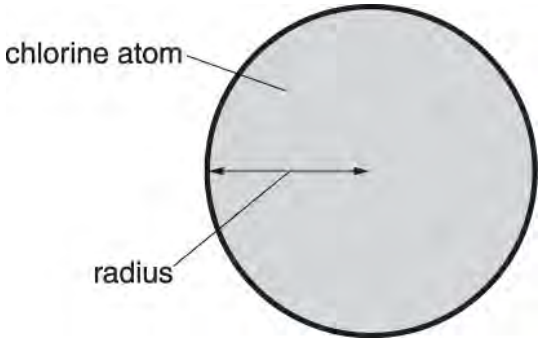
Identify the elements and state where they are found in the modern Periodic Table.

---

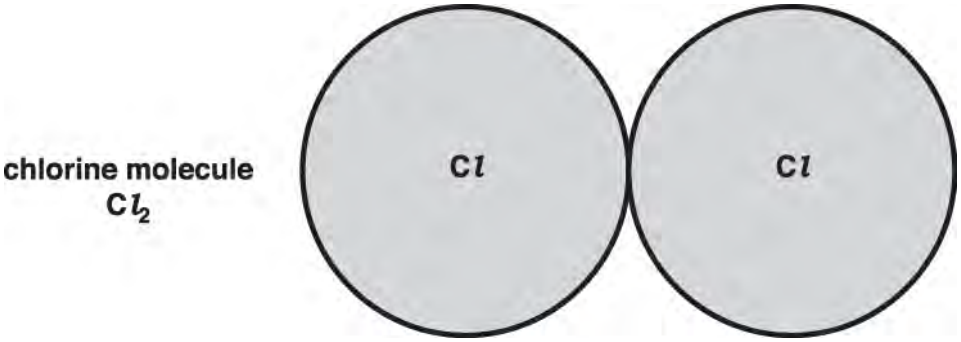
[2]

4. Len looks up data about the sizes of atoms of chlorine and some other Group 7 elements.

The size of an atom is measured by measuring its **radius**.



Two atoms bond together to make a molecule.

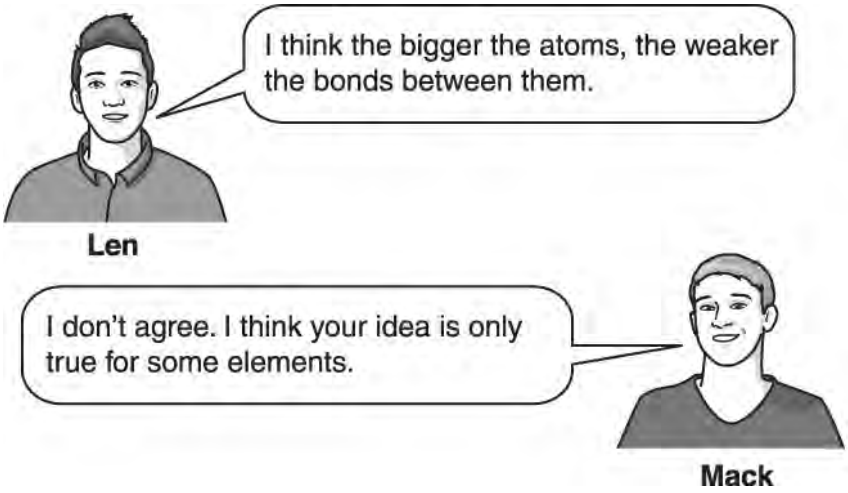


Len also finds out the **energy needed to break the bond** that holds the atoms together in a molecule.

This is his data.

Element	Radius of an atom (pm)	Energy needed to break bond(kJ / mol)
Fluorine F_2	42	155
Chlorine Cl_2	79	242
Bromine Br_2	94	193
Iodine I_2	115	151

He talks about the data with Mack.



Use examples and data from the table to explain why Len's idea is only true for some elements.

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

[6]

5. Silver chloride is a salt that is used to make lenses that darken in bright light.

Terry uses silver nitrate to make some silver chloride in a precipitation reaction.

This is the symbol equation for the reaction.

$$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$$

Use these words to write a word equation for this reaction.

sodium chloride
silver chloride
sodium nitrate
silver nitrate

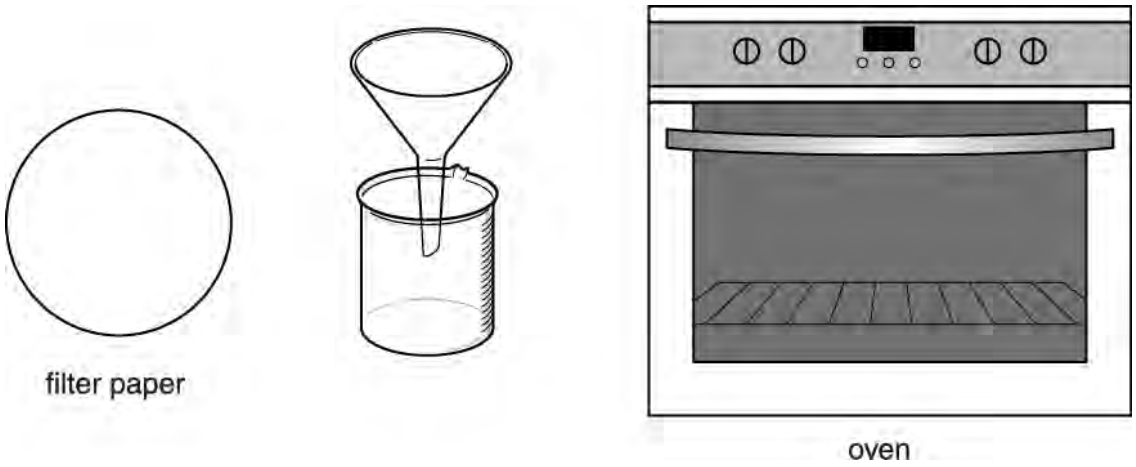
[2]

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

In the reaction, silver chloride forms as a precipitate.

Terry wants to make a pure, dry sample of silver chloride from the reaction mixture.

The diagram shows the apparatus he uses.



Describe how Terry should use this apparatus to make a pure, dry sample of silver chloride.

---

[3]

(b). The lenses go dark because a solid forms when light shines on silver chloride.

The solid is silver metal.

What is the name of the other element that forms in the reaction?

Put a ring around the correct answer.

carbon chlorine hydrogen iodine water

[1]

7. The halogens have different colours and states at room temperature.

Draw straight lines to connect each **element** to its correct **colour** and **state** at room temperature.

colour	element	state
grey	chlorine	solid
green	bromine	liquid
orange	iodine	gas

[3]

8. The table shows some information about the relative formula masses for some compounds.

Name of compound	Formula	Relative atomic masses of atoms in the formula		Relative formula mass of compound
lithium chloride	LiC*l*	Li	7	7 + 35.5 = 42.5
		C*l*	35.5	
sodium chloride	NaC*l*	Na	23	23 + 35.5 = 58.5
		C*l*	35.5	
potassium chloride	KC*l*	K	39	39 + 35.5 = 74.5
		C*l*	35.5	

Explain the differences between the relative formula masses of these three compounds.

---

[2]

9(a). Alex plans to write an article about flame colours for a school science magazine.

He researches the flame colours of some compounds of metals from Group 1 in the Periodic Table.
He talks about his findings with other science students in an internet chat room.

Alex Hi everyone. Have any of you done any research into flame test colours for Group 1? I have found out that potassium and rubidium both give purple flames. I think that each group has its own flame colour.

Bea I've checked out your research and I agree about the flame colours for potassium and rubidium. I just looked up caesium and that's purple too!

Carl I flame-tested some Group 2 elements, none of them were purple. They were all different colours.

Dan Sodium is in Group 1 and gives a yellow flame.

Elly I've looked on the internet and I can't find any elements that give purple flame colours except the ones in Group 1.

Fay Lithium doesn't have a purple flame.

Why is it a good idea for Alex to chat to other students about his work before he writes his article?

---

[2]

(b). Alex's ideas are that in flame tests:

- all the elements in a group of the Periodic Table have the same flame colour
- each group has its own flame colour.

Explain how each piece of evidence in the chat **supports** or **does not support** Alex's ideas.

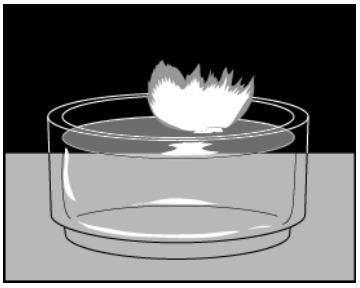
The quality of written communication will be assessed in your answer.

[6]

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

.

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



What is made when sodium reacts with water?

Put a ring around each of the **two** correct answers.

carbon dioxide

hydrogen

oxygen

sodium chloride

sodium hydroxide

[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 a 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]

(d). Why is it a good idea for Jake to watch videos of the reactions rather than do them himself?

Put a tick (✓) in the box next to the correct answer.

The reactions are too slow. ☐

Sodium and potassium are hazardous to handle. ☐

The chemicals must be heated to a very high temperature before they react. ☐

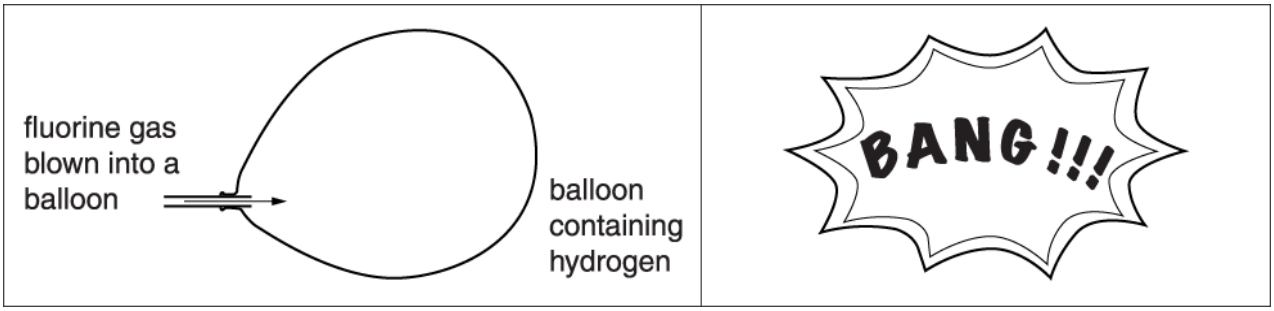
The gas that is made is toxic. ☐

[1]

11(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

Join the boxes to show the correct formula for each chemical in the reaction.

hydrogen	HF
fluorine	F_2
hydrogen fluoride	H_2

[2]

(b). Chlorine is also in Group 7.

Fill in the boxes to show the **word equation** for the reaction between **hydrogen** and **chlorine**.

[ ] + [ ] → [ ]

[2]

(c). Iodine is another Group 7 element.

It also reacts with hydrogen.

Predict the correct formula for the compound that is made when hydrogen reacts with **iodine**.

Put a ring around the correct answer.

ICl_2 H_2 I_2 HI HCl

[1]

(d). 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) Look at the order of fluorine, chlorine and iodine in Group 7 of the Periodic Table.

How does the reactivity of the Group 7 elements with hydrogen change as you go down the group?

---

[1]

(ii) What do you predict about the reaction between bromine and hydrogen?

Put a tick (?) in the box next to the best answer.

Hydrogen reacts with bromine when it is heated. ☐

Bromine is too unreactive to react with hydrogen. ☐

Hydrogen reacts with bromine more quickly than with chlorine. ☐

Hydrogen reacts with bromine more slowly than with iodine. ☐

[1]

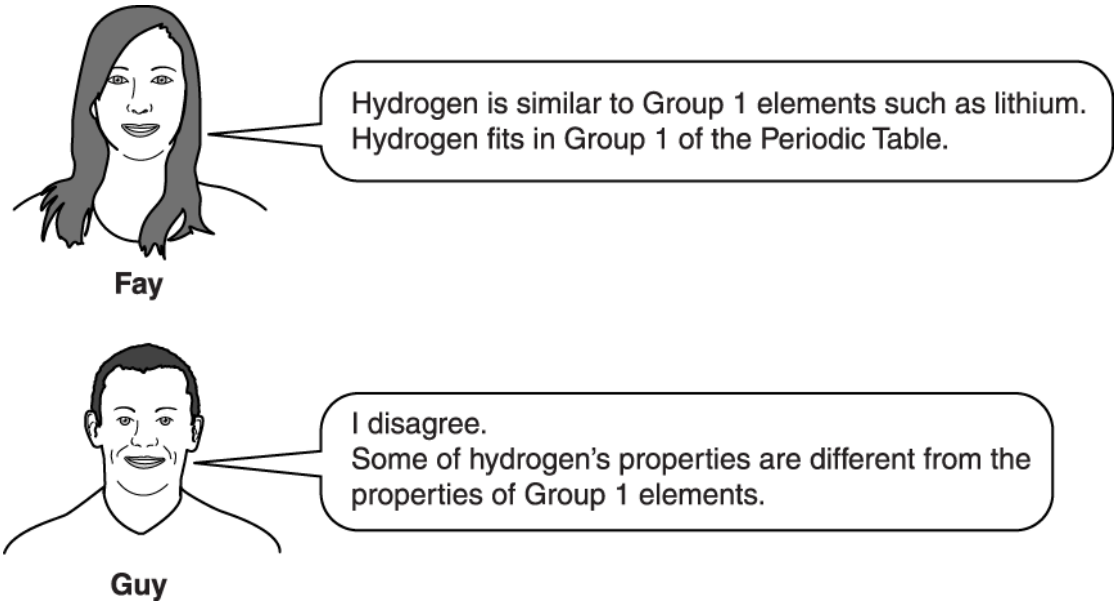
12. Hydrogen and lithium are elements.

Lithium is in Group 1 of the Periodic Table.

The table shows some information about the properties of hydrogen and lithium.

	Hydrogen	Lithium
State at room temperature	gas	solid
Type of element	non-metal	metal
Number of electrons in outer shell of an atom	1	1
Ion	H^+	Li^+
Formula of chloride	HC*l*	LiC*l*
Reactivity	'Pops' when lit. Does not react with water. Reacts with chlorine.	Only burns if heated strongly. Reacts with water. Reacts with chlorine.

Fay and Guy do not agree about where hydrogen fits in the Periodic Table.



How does the information in the table support each person's point of view?

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

---

[6]

13(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.

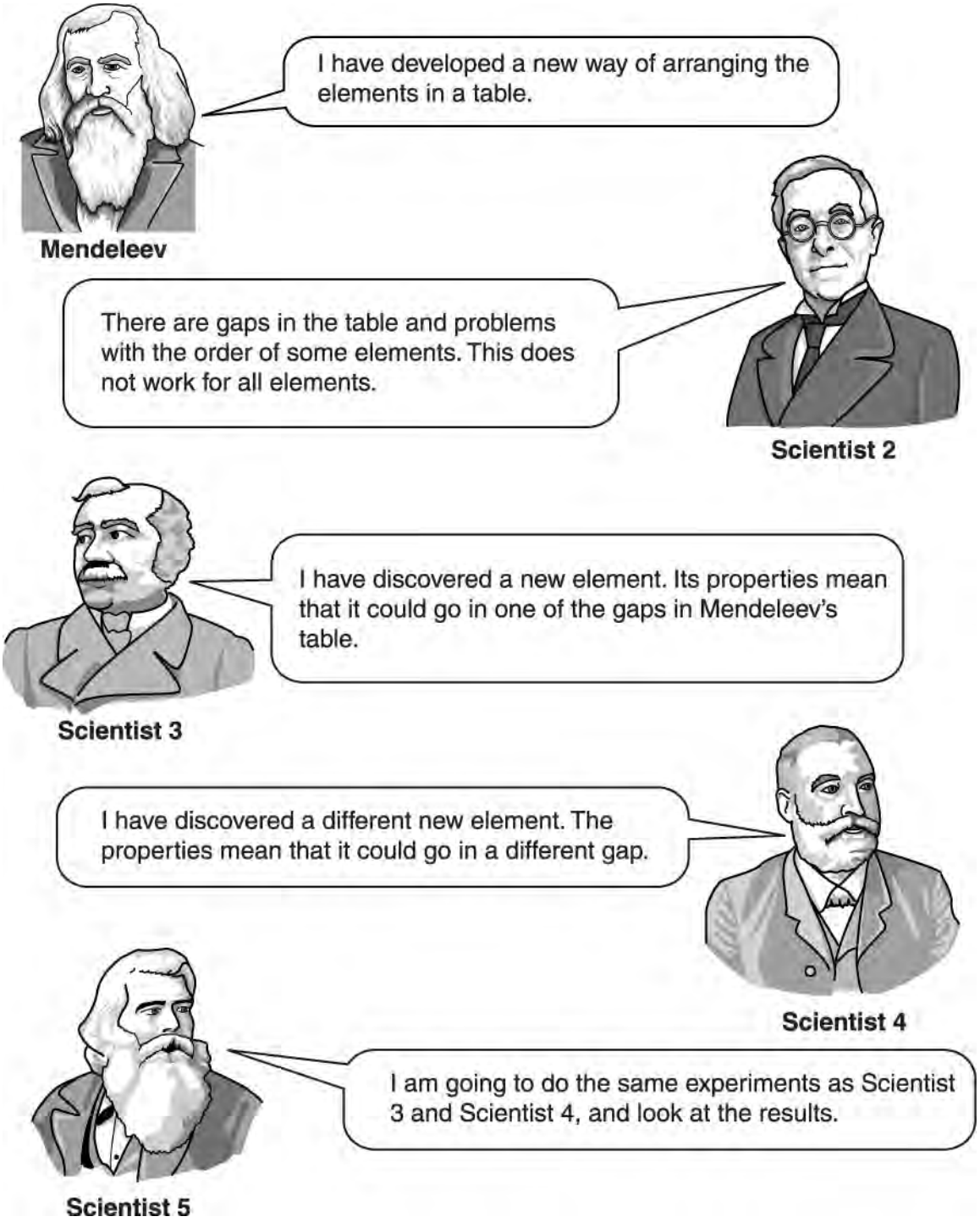
What is the formula for a **molecule** of astatine?

---

[1]

14(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]

15(a) Abbi does some experiments to investigate the reactivity of Group 7 elements.

.

Group 7

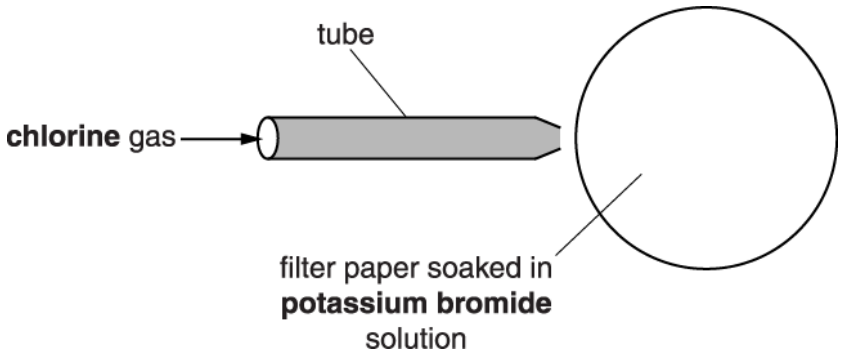
F fluorine
Cl chlorine
Br bromine
I iodine

For safety, Abbi does all of the experiments in a fume cupboard. Why is this necessary?

---

[1]

(b). Abbi passes chlorine gas over a filter paper soaked in potassium bromide solution. Chlorine gas is blown onto the filter paper down a tube.



The filter paper goes orange because bromine is made.

(i) Complete the word equation for this reaction.

chlorine + potassium bromide → bromine + potassium .....

[1]

(ii) What is the name for this type of reaction?

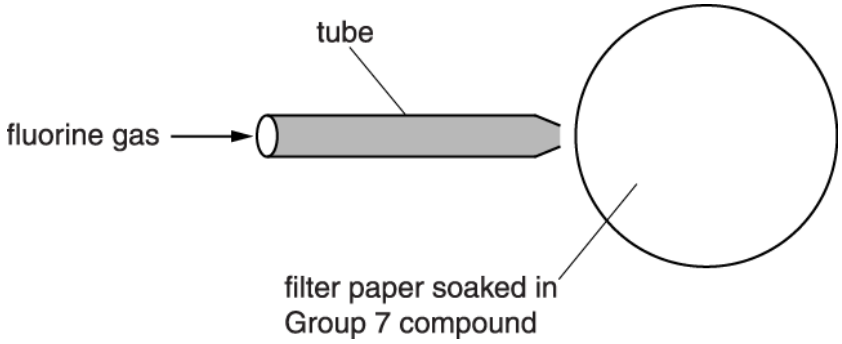
Put a ring around the correct answer.

combustion displacement electrolysis neutralisation

[1]

(c). Abbi does some experiments using fluorine.

She passes fluorine gas down a tube onto a filter paper.



The table shows her results.

Gas	Compound on filter paper	Colour change
fluorine	potassium chloride	paper goes pale green
fluorine	potassium bromide	paper goes orange
fluorine	potassium iodide	grey solid appears on paper

Explain why these colour changes happen.

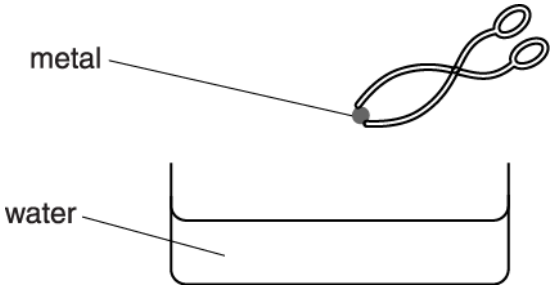
The quality of written communication will be assessed in your answer.

[6]

16(a) Jack investigates the reactions of some Group 1 metals with water.

.

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



Jack does experiments using lithium, sodium and potassium.

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

The table shows his results.

Metal	Time taken for the reaction to finish in s
lithium	35
sodium	12
potassium	5

What does the table show about the reactivity of the Group 1 metals?

Explain your answer.

---

[2]

(b). Jack adds a small piece of potassium to water in a beaker.

He adds some Universal Indicator to the water.

He uses a thermometer to measure the temperature change during the reaction.

He writes down his observations.

Draw straight lines to connect each **observation** with the correct **reason**.

Observation	Reason
Universal Indicator turns blue.	A flammable gas is made.
A flame appears around the potassium.	The reaction is exothermic.
The temperature of the water increases.	Potassium has a very low density.
Potassium stays on the surface of the water.	An alkali is made.

[2]

(c). Potassium is stored in oil.

Jack leaves a piece of potassium out of the oil for a few minutes.

He notices that the shiny surface of the potassium becomes dull very quickly.

What is the potassium reacting with?

Put a (ring) around the correct answer.

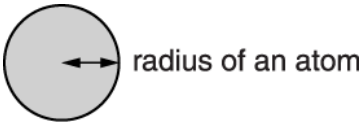
hydrogen **oxygen** **nitrogen** **chlorine**

[1]

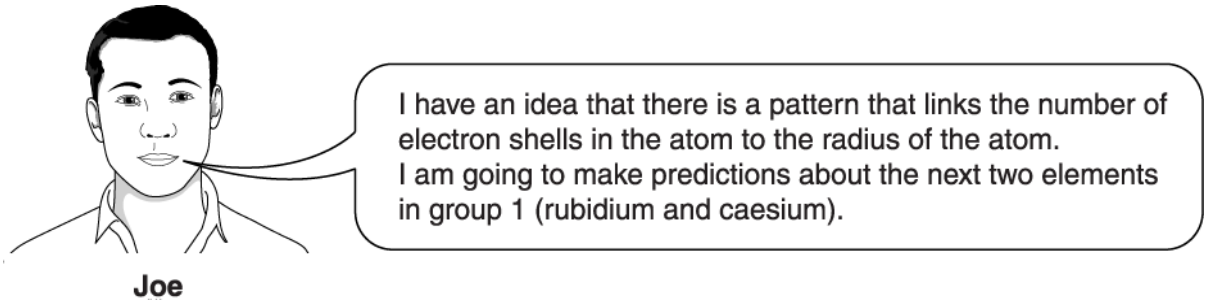
17. Joe does some research about Group 1 elements.

He finds out about the electron arrangement in the atoms of the first three elements in the Group.

He also finds data about the radius of each atom.



Element	Total number of electrons in each atom	Electron arrangement	Radius of the atom in pm
lithium	3	2.1	152
sodium	11	2.8.1	186
potassium	19	2.8.8.1	231



How does the data support Joe's idea and what predictions can he make about rubidium and caesium?

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

[6]

18(a) Amir investigates the halogens.

.

Table 4.1 shows some information about the halogens.

Complete **Table 4.1** by filling in the missing information.

	Chlorine	Bromine	Iodine
Appearance and state at room temperature and pressure	yellow-green gas		grey solid
Colour as a gas	yellow-green	red-brown	
Product when reacted with sodium		NaBr	NaI

[3]

Table 4.1

(b). Amir reacts some chlorine solution with a solution of potassium bromide.

The solution turns brown.

(i) Complete **word** and **chemical** equations for the reaction that happens.

chlorine + potassium bromide → _ _ _ _ _ _ _ _ _ _ _ _ _ _ + bromine

Cl_2 + 2 _ _ _ _ _ _ _ _ → 2KC*l* + Br_2

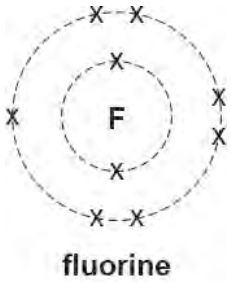
[3]

(ii) Use the equations in **(i)** to explain why the solution turns brown.

---

[1]

19. The diagram shows the arrangement of electrons in an **atom** of fluorine.



fluorine

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

Name of atom	fluorine
Atomic Number	9
Number of electrons	9
Number of protons	
Number of neutrons	
Periodic Table Group	

[3]

20(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 ----------

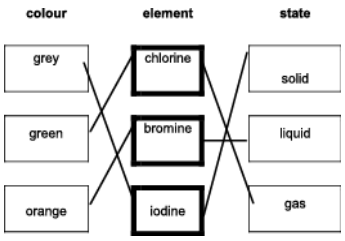
[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		they all have one electron in their outer shell ✓ they all have different numbers of shells / down the group have more shells ✓ the number of electrons in the inner shells is different / some have full shells of 8 electrons / gives numbers of shells ✓	3	
	b		potassium > sodium > lithium ✓	1	
			Total	**4**	
2		i	lithium + fluorine → lithium fluoride ✓ 2Li ✓ + F_2 → 2LiF	2	
		ii	✓ lithium → metal ✓ fluorine → non-metal ✓ lithium fluoride → ionic compound	2	All three correct = (2) One or two correct = (1)
			Total	**4**	
3	a		gaps are for undiscovered elements ✓ he predicted properties / new elements matched his predictions / new elements had the properties he predicted ✓	2	
	b		Cd and Zn / cadmium and zinc ✓ transition metals ✓	2	Both elements required for 1 mark
			Total	**4**	
4			**[Level 3]** Makes correct statements about energy and size of atoms. **AND** Identifies, with a reason, that fluorine does not fit the pattern. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)	6	**This question is targeted at grades up to C** **Indicative scientific points may include:** **Statements about energy and size of atoms** • chlorine needs most energy to break bond • iodine needs least energy to break bond • compares energy needed to break bonds for two atoms.

Question			Answer/Indicative content	Marks	Guidance
			[Level 2] Makes correct statements about energy and size of atoms. OR Identifies, with a reason, that fluorine does not fit the pattern. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Makes a statement about energy or size of atom. 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)		• the bond energy decreases (down the group) • compares size of two atoms • fluorine is smallest atom • iodine is largest atom • the radius increases (down the group) • (generally) as the atoms get larger/radius increases, bond energies get smaller. Ignore 'the bigger the atom, the weaker the bonds (in the question) Fluorine does not fit… • because bond energy for fluorine is lower than expected / lower than rest of pattern / lower than chlorine/bromine • because bond energy of fluorine is similar to bond energy of iodine Accept 'stonger' for more energy and 'weaker' for less energy throughout Use the L1, L2, L3 annotations in RM Assessor; do not use ticks. Examiner's Comments Candidates produced high quality answers, many gaining marks in the level 2 marking band. Typically they discussed or compared either the bond energies of two or more atoms, or the sizes. Many recognised that fluorine did not fit the pattern, but did not always express their ideas clearly enough to access level 3.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
5			silver nitrate + sodium chloride → silver chloride + sodium nitrate Fully correct (2) silver nitrate on LHS and silver chloride on RHS; (1)	2	allow (1) for correct names written under formulae with no '+' **or** '→' Examiner's Comments Most candidates could write a correct word equation from the formula equation given, although some omitted signs and arrows and others confused silver with sodium and got it the wrong way round. A significant number did not respond at all.
			Total	2	

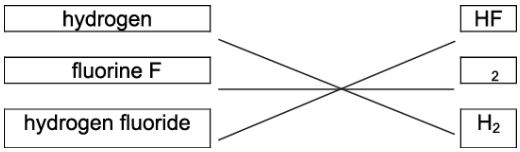
Question			Answer/Indicative content	Marks	Guidance
6	a		filter paper goes into funnel; filter off solid / idea that solid or silver chloride is in filter paper/washing of solid; solid is dried (in oven);	3	**Check diagram** for indication of MP1 and/or 2 Do not allow MP3 if oven is used before filtration/filtration not mentioned. **Allow** filter paper into oven to dry **Examiner's Comments** Many omitted to answer and few gave good descriptions of the experiment. Few knew the term 'funnel' and many thought that the solution which ended up in the beaker was to be put in the oven to get AgCl.
	b		chlorine	1	Examiner's Comments Many candidates correctly chose chlorine as the other element formed when light shines on silver chloride. The most popular incorrect choice was hydrogen although significant numbers of all incorrect responses were seen.
			Total	**4**	
7				3	All correct (3) 4/5 lines correct (2) 2/3 lines correct (1) ☐Examiner's Comments The colours and states of the halogens required were not well known and few candidates got 3 marks.
			Total	**3**	

Question			Answer/Indicative content	Marks	Guidance
8			first mark (one of): all the compounds have different / higher / greater / bigger (relative formula) masses going down the group; the mass increases by 16 as you go down the group; each has a different **metal** (atom); lithium chloride has the lowest / potassium chloride has the highest second mark (one of): the (relative atomic) masses of lithium, sodium and potassium are all different; there are different numbers of protons and neutrons in each (metal)	2	Examiner's Comments Very few candidates achieved both marks, and less than half achieved on mark. Marks were lost as candidates often discussed reactivity instead of formula or atomic mass.
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
9	a		getting more data / information (1) checking Alex's results / peer assessment / comparing results / idea that other people may or may not agree / if others agree it is more likely that he is right (1)	2	Examiner's Comments Very few candidates were able to achieve both marks for this question; most got a mark for the idea of comparing results, or checking results, but most did not appreciate the idea of more data.

Question			Answer/Indicative content	Marks	Guidance
	b		**Level 3 (5–6 marks)** Explains points linked to support and a point linked to lack of support for Alex's idea OR a point linked to support and points linked to lack of support for Alex's idea. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Identifies a point linked to support AND a point linked to lack of support for Alex's idea. Points may be identified by person's name only. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Identifies a point linked to support or lack of support for Alex's idea. Points may be identified by person's name only. Links may not be emphatically stated. 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 C Indicative scientific points may include: Points that support Alex's Ideas • K and Rb give purple flames (Bea) / two people have got the same colours for K and Rb (Alex and Bea) • Cs also gives a purple flame (Bea) / Cs is also in Group 1 • Group 2 elements don't give purple flames (Carl) • No other elements except group 1 have purple flames (Elly) • Bea / Elly / (partly) Carl support Alex's ideas (insufficient at level 3) Points that do not support Alex's ideas • Na gives a yellow flame / not a purple flame / Na is in group 1 (Dan) • Li does not give a purple flame (Fay) / Li is in group 1 • Elements in Group 2 all have different coloured flames (Carl) • Fay / Dan / (partly) Carl do not support Alex (insufficient at level 3) Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This six-mark extended-writing question was well answered by many candidates, and even those who struggled with extended writing were prepared to attempt the question; often achieving over three marks. The best responses were those where candidates had clearly stated the evidence supporting or not supporting Alex, and also the name of those students who had found the evidence for their claims. Some only achieved level 1 marks because their evidence only supported or disagreed with Alex without balance to the discussion.

Question			Answer/Indicative content	Marks	Guidance
			Total	8	
10	a		hydrogen (1) sodium hydroxide (1)	2	Examiner's Comments This question differentiated well between candidates of different abilities. Sodium hydroxide was given as a response more often than hydrogen, and sodium chloride proved a popular distractor.
	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 other indicator given then accept Litmus (goes blue) for 1 mark only Examiner's Comments This proved a challenge for many candidates; a majority did not achieve any marks for this. Many were unable to name a suitable indicator, or give the correct pH for an alkaline solution. Common incorrect responses included “indicator” without specifying a name or the resultant colour change.
	c		the two reactions have different rates the two reactions make different alkalis	1	**both** needed Examiner's Comments This was also poorly answered; very few candidates achieved the mark (both responses were required for a mark).
	d		sodium and potassium are hazardous to handle	1	Examiner's Comments Most candidates were able to select the box for “sodium and potassium are difficult to handle.”
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
11	a			2	all correct = 2 1 or 2 correct = 1 **Examiner's Comments** An overwhelming majority of candidates were able to achieve full marks on this question. However, there were a small number who only drew 1 or 2 lines.
	b		hydrogen + chlorine ? hydrogen chloride	2	LHS correct (1) RHS correct (1) Allow correct symbols for all chemicals; balancing not necessary e.g. Cl_2 not Cl **Examiner's Comments** This was generally answered well. Common mistakes were; hydrochlorine / hydrochloride, hydrochloric acid and incorrect formulae (although the question did not require formulae in the responses).
	c		HI	1	**Examiner's Comments** Most candidates answered this question well; there were few incorrect responses.
	d	i	less reactive (down the group)	1	**ignore** not as strong **allow** the reactions take longer / get slower **allow** more heat needed to cause a reaction **Examiner's Comments** Many correct responses were given, although there were a significant number who stated that the elements became more reactive down the group.
		ii	hydrogen reacts with bromine when it is heated	1	**Examiner's Comments** About half the candidates selected the correct response, and half an incorrect response (choices seemed to be random).
			Total	**7**	

Question			Answer/Indicative content	Marks	Guidance
12			**Level 3 (5–6 marks)** Comparisons are made for some similarities **and** differences for hydrogen and lithium. **Both** sides of argument are discussed. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** A comparison is made between a similarity **and** a difference for lithium and hydrogen. Quality of written communication impedes communication of the science at this level. **Level 1 (1–2 marks)** Points are linked to one person's point of view, but not to both. Quality of written communication partially 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 C** **Relevant points include:** **Similarities (Fay)** • Both have 1 electron in the outer shell • Both form an ion with a single positive charge • Both react with chlorine • Both form a chloride with a similar formula **Differences (Guy)** • Hydrogen is a gas but lithium is a solid • Hydrogen is a non-metal and lithium is a metal • Hydrogen is flammable / pops when lit, whereas lithium only burns when heated strongly • Hydrogen does not react with water but lithium does **ignore** other properties mentioned that are not given in the table. **Use the L1, L2, L3 annotations in Scoris; do not use ticks.** **Examiner's Comments** There were many good responses given to this question. The best responses were those that clearly organised information into those that agreed with Fay, and those that supported Guy. Level 1 response's had a tendency to start off well with Fay and give several similarities. When Guy's ideas were discussed candidates stated responses such as ‘and from the table there are differences/as Guy said there are differences’. These were too vague. Also weaker responses did not compare differences eg hydrogen is a gas and lithium isn't. Often candidates reached Level 2 by stating several similarities but

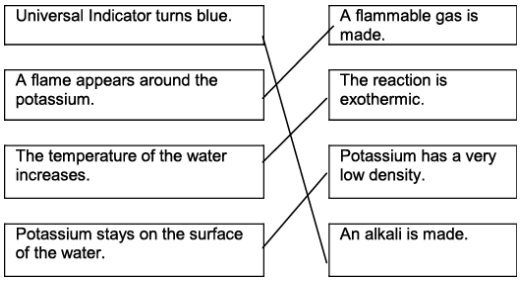
Question			Answer/Indicative content	Marks	Guidance
					few differences were offered even though they may have inferred several more. Those that got Level 3 gave all similarities and differences organised into a coherent response.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
13	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** There was a lot of confusion here with the negative numbers. The value of -59 was often thought to be higher than -35 so candidates identified trends the wrong way round. Bromine was often chosen and if bromine was selected then the candidates were unable to give a correct explanation. 2 marks were rarely awarded.
	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** There were a lot of negative values, but candidates could not access this without bromine as the answer to (a).
	c		At_2	1	**do not accept** at_2 or AT_2 **do not accept** At2. 2 must be smaller than letters or subscripted. **Examiner's Comments** 'At' and no response were both given as regularly as 'At2'. Many candidates gave 'As' or 'As2' as an incorrect response.
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
14	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 were able to identify at least one of the scientists that were carrying out a peer review and some went on to explain their choice using the information given. Others either gave a general description of peer review or simply quoted the information given in the question without explaining why this was peer review.
	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 There were some good responses to this question which showed an understanding that the newly discovered elements fitted into the gaps left by Mendeleev. Many candidates just referred to elements going into the gap or referred to empty gaps without relating this to Mendeleev and his idea that new elements would be discovered with properties that would fit these gaps. The importance of matching properties was not well understood.
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
15	a		Gases are toxic / idea of taking gases away / must not breathe in;	1	**Allow** vapours / 'fumes' for gases **Allow** harmful / corrosive / dangerous for toxic **Ignore** flammable Gases / fumes / hazards MUST be qualified Examiner's Comments Many candidates understood that the main reason for using a fume cupboard is for the protection from dangerous gases and gave good responses to this question. Some candidates just referred to a range of hazards not related to the use of a fume cupboard.
	b	i	chloride	1	Do not accept 'chlorine' Examiner's Comments Most candidates could correctly name the second product as a chloride, with chlorine being the most common error although it did not appear as frequently as in previous examinations. Other incorrect responses were other halides, especially bromide.
		ii	displacement	1	Examiner's Comments Only the better candidates could identify the reaction as being a displacement. Combustion or neutralisation were the most commonly seen incorrect responses.

Question			Answer/Indicative content	Marks	Guidance
	c		[Level 3] Links some colour changes to a correct product and a reaction. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Gives correct product for some colour changes OR links one colour change to a correct product and a reaction. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Gives correct product for a colour change OR reference to a reaction 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 E Indicative scientific points may include: Reason for colour changes • KCl green because of chlorine made • KBr orange-brown because of bromine made • KI grey solid because of iodine made Reaction • Reactions happen / fluorine reacts idea • Displacement happens • (Chlorine / bromine / iodine) produced • Fluorine is at the top of Group 7 • Fluorine is very reactive • Fluorine is more reactive than the other elements • Reactivity decreases down the group Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments The best answers to this level of response question identified the given colour changes as a consequence of a displacement reaction of the fluorine with the halides. Some answers suggested that the reaction was between fluorine and potassium. Many candidates interpreted the colour changes as being the effect of pH on Universal Indicator and so answered in terms of neutralisation rather than displacement.
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
16	a		more reactive down the group; (1) (more reactive metal) finishes quicker / takes less time; (1)	2	**Allow** Li is the least reactive / K is the most reactive / more protons / higher RAM are more reactive **Allow** K is quicker than Li / the bottom one is quickest / more protons / higher RAM the faster the reaction Examiner's Comments Most candidates understood that the data showed that the reactions were getting quicker down the group but only the better candidates were able to relate this to increasing reactivity.
	b			2	All correct = 2 3 or 2 correct = 1 Examiner's Comments Responses to this question showed a good knowledge and understanding of the reaction between potassium and water. The significance of the blue colour with universal indicator was the best understood and the increase in temperature the least.
	c		oxygen	1	Examiner's Comments The role of oxygen in the dulling of the surface of potassium was well known. Nitrogen was the most common misconception.
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
17			**[Level 3]** Links trends in number of shells to atomic radius, including a comparative prediction for rubidium and caesium. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Describes trends in the data, linking electrons to atomic radius **and** makes a prediction about caesium and / or rubidium. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Describes a trend in the data without making it clear that the pattern is 'down the group' **or** makes a prediction about caesium and / or rubidium. 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 C Indicative scientific points may include: Describes the trends in the data • atomic radius increases down the group • number of electrons increases down the group • number of electron shells increases down the group **Allow** answers that imply 'down the group'. Links • More shells gives a bigger radius • More electrons gives a bigger radius Prediction • caesium and / or rubidium will have more shells • caesium and / or rubidium will have a larger atomic radius • caesium and / or rubidium will have more electrons • caesium and / or rubidium will have 1e in outer shell • caesium and / or rubidium will have more 16 / 8 more electrons than potassium • suggests possible electron arrangements based on the data e.g. Rb is 2.8.8.8.1 Comparative prediction • rubidium will have fewer shells than caesium • caesium will be the biggest atom. • Caesium would have 8 more electrons than rubidium Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments

Question			Answer/Indicative content	Marks	Guidance
					There were some excellent responses to this level of response question where the candidates clearly linked the radius of the atoms with the number of electron shells and then went on to make predictions for the other two elements. These candidates often showed planning by highlighting the key ideas in the stem of the question, to ensure that they covered all the required points. Many responses looked at the data and described trends in the number of electrons and the atomic radius without relating them to the question asked, which was about electron shells. Others only partially answered the question by either not including any predictions or by only making predictions.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
18	a		<table><tr><th></th><th>Chlorine</th><th>Bromine</th><th>Iodine</th></tr><tr><td>Appearance at room temperature and pressure</td><td>Green gas</td><td>Red liquid ✓</td><td>Grey solid</td></tr><tr><td>Colour as a gas</td><td>yellow-green</td><td>Red-brown</td><td>Purple/ mauve Violet ✓</td></tr><tr><td>Product with sodium</td><td>NaCl ✓</td><td>NaBr</td><td>NaI</td></tr></table>	3 (AO 1.1 × 3)	ALLOW all the usual alternatives for colour of bromine Examiner's Comments Most candidates gave the correct formula for sodium chloride, and knew the colour of bromine. Unfortunately, they often missed out any reference to bromine being a liquid. Others suggested that it is a gas or a solid. The higher ability candidates were also able to give some variant of purple for the colour of iodine vapour.
	b	i	potassium chloride ✓ KBr ✓	2 (AO 2.2 × 2)	Symbol for Br must be correct Examiner's Comments This part was well answered. The most common mistakes were to write potassium chlor*ine* instead of potassium chloride and, less frequently, to write the formula of potassium bromide as KBr2.
		ii	(because) bromine is formed / bromine is red-brown ✓	1 (AO 2.1)	DO NOT ALLOW 'bromide' references Examiner's Comments This part was well answered.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
19			protons: 9 ✓ neutrons: 10 ✓ Group :17 / 7✓	3 (AO 3 × 2.1)	Examiner's Comments Most candidates were able to gain credit on this question and a number could use the Periodic Table to get full marks.
			Total	3	
20	a		4 ✓	1 (AO 2.1)	Examiner's Comments Most candidates identified carbon and silicon from group 14 on the modern Periodic Table and thus correctly chose Mendeleev's group 4.
	b		they were not yet discovered / he didn't know about them ✓	1 (AO 2.1)	Examiner's Comments Many candidates understood that the noble gases had not been identified when Mendeleev was working.
	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 A significant minority of candidates identified three elements in the modern group 8 which are not in Mendeleev's table (Ru, Os & Hs).
			Total	4	