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EDEXCEL GCSE CHEMISTRY: QUESTIONS BY TOPIC

Groups in the Periodic Table (6)

GCSE Chemistry (Foundation) Topic 6

13 questions · 132 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Chemistry 1CH0, Foundation Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

13 questions · 132 marks · lowest tariff first



7-MARK QUESTIONS

1 question in this booklet



1 The elements in group 7 of the periodic table are called the halogens.

(a) Give the symbol of the element astatine.

Use the periodic table to help you.

(1)

(b) (i) What is the colour of chlorine gas at room temperature?

(1)

☐ A yellow-green

☐ B red-brown

☐ C purple

☐ D black

(ii) Damp blue litmus paper can be used to test for chlorine gas.

Use words from the box to complete the sentences.

(2)

blue

orange

red

white

yellow

When damp blue litmus paper is added to chlorine gas there are **two** colour changes.

The damp blue litmus paper changes from blue to

The colour of the litmus paper then changes to



(c) Figure 1 shows the atomic number and boiling point of some of the halogens.

halogen	atomic number	boiling point in °C
fluorine	9	–188
chlorine	17	–35
bromine	35	59
iodine	53	

Figure 1

(i) Describe the trend in the boiling points of the first three halogens in Figure 1.

(2)

.....

.....

(ii) Using the information in Figure 1, predict the boiling point of iodine.

Write your prediction on the answer line below.

(1)

boiling point of iodine = ... °C

(Total for Question 1 = 7 marks)



8-MARK QUESTIONS

2 questions in this booklet



3 This question is about the noble gases.

(a) (i) State, in terms of outer shell electrons, why the noble gases are unreactive.

(1)

(ii) Figure 4 shows an airship, filled with helium, floating above the ground.

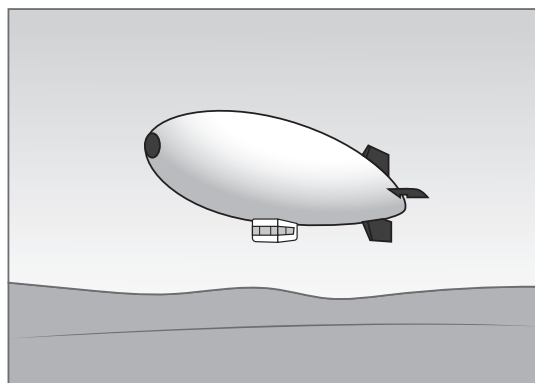


Figure 4

Helium, hydrogen and krypton are gases.

Figure 5 shows the reactivity and density, at room temperature and pressure, of helium, hydrogen and krypton.

gas	reactivity	density in g cm^{-3}
helium	unreactive	0.00018
hydrogen	very reactive	0.00009
krypton	unreactive	0.00380

Figure 5

The density of air is $0.001225 \text{ g cm}^{-3}$.

Helium is used in airships.

Explain why hydrogen and why krypton are **not** used in airships.

(3)

.....

.....

.....

.....

(b) Mendeleev produced one of the earliest periodic tables.

State why he could **not** include any of the noble gases in his periodic table.

(1)

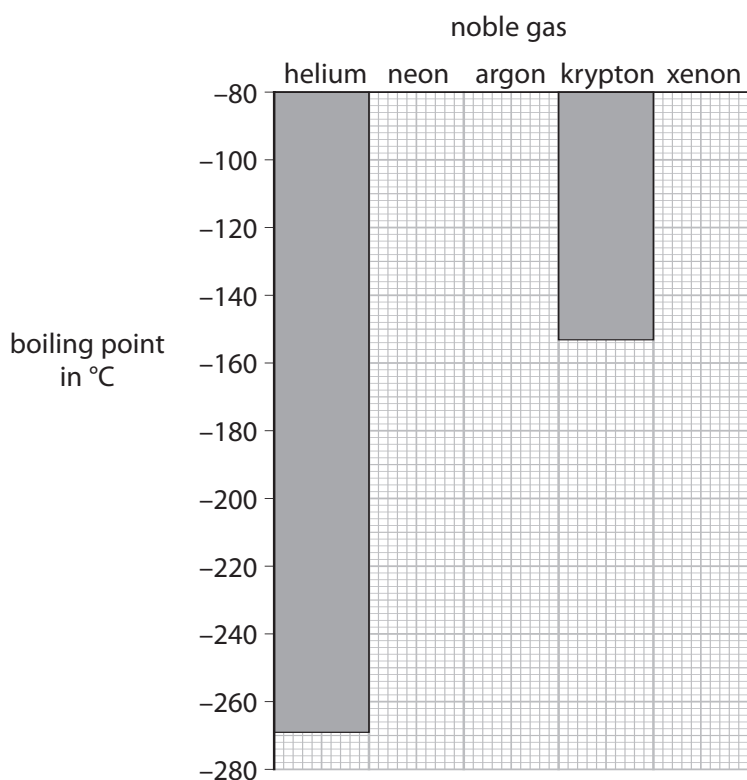
(c) Figure 6 shows the boiling points of some of the noble gases.

noble gas	boiling point in °C
helium	-269
neon	-246
argon	-186
krypton	-153
xenon	

Figure 6

(i) Complete the bar chart to show the boiling points of neon and argon.

(2)



(ii) Predict the boiling point of xenon.

(1)

boiling point of xenon = ... °C

(Total for Question 3 = 8 marks)



2 This question is about elements in group 1 of the periodic table.

- (a) Figure 3 shows the symbols of the first three elements in group 1 of the periodic table and their melting points.

symbol	melting point in °C
Li	181
Na	98
K	64

Figure 3

Use the periodic table to answer these questions.

- (i) Give the symbol of **another** element in group 1.

(1)

.....

- (ii) Give the atomic number of lithium.

(1)

.....

- (iii) Describe the trend in the melting points of the elements in Figure 3.

(2)

.....

.....



(b) The elements in group 1 react very vigorously with water.

A student suggests this method to see what happens when sodium reacts with water.

- step 1** put on safety glasses and a laboratory coat
- step 2** cut a $2\text{ cm} \times 2\text{ cm} \times 2\text{ cm}$ cube of sodium
- step 3** put a few drops of water in the container shown in Figure 4
- step 4** add the sodium to the water in the container and observe the reaction

(i) Figure 4 shows a diagram of the container the student suggested for step 3.

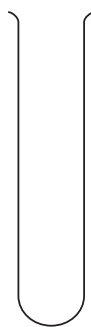


Figure 4

Give the name of the container shown in Figure 4.

(1)



- (ii) A teacher says that the method is not safe because the reaction is too vigorous.

Explain changes that could be made to step 2 and to step 3 that would make the method safer.

(3)

step 2: change and explanation

.....

.....

.....

step 3: change and explanation

.....

.....

.....

(Total for Question 2 = 8 marks)



9-MARK QUESTIONS

3 questions in this booklet



5 Fluorine, chlorine, bromine and iodine are elements in group 7 of the periodic table.

(a) (i) State the name given to the group 7 elements.

(1)

(ii) Name one other element that is in group 7.

Use the periodic table on the back of this exam paper to help you.

(1)

(iii) Which element is liquid at room temperature and pressure?

(1)

☐ **A** fluorine

☐ **B** chlorine

☐ **C** bromine

☐ **D** iodine

(iv) Which element is dark-grey in colour at room temperature and pressure?

(1)

☐ **A** fluorine

☐ **B** chlorine

☐ **C** bromine

☐ **D** iodine

(b) Tin reacts with chlorine to form tin chloride.

A sample of tin chloride contains 1.19 g of tin and 1.42 g of chlorine.

Calculate the empirical formula of this tin chloride.

(relative atomic masses: Cl = 35.5, Sn = 119.0)

You must show your working.

(3)

empirical formula of this tin chloride = ...



(c) Tin also reacts with fluorine.

The reaction between fluorine and tin is much more vigorous than the reaction between chlorine and tin.

Figure 8 shows the electronic configurations of fluorine and chlorine.

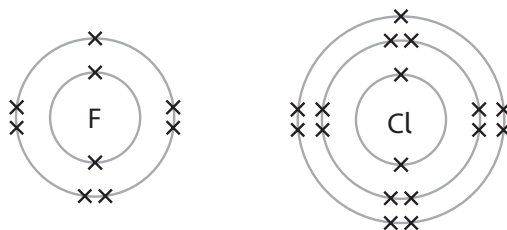


Figure 8

Explain, in terms of their electronic configurations, why fluorine reacts with tin more vigorously than chlorine reacts with tin.

(2)

.....

.....

.....

.....

(Total for Question 5 = 9 marks)

6 This question is about elements in group 7, the halogens.

(a) Which halogen is a green gas at room temperature and pressure?

(1)

- ☐ A bromine
- ☐ B chlorine
- ☐ C fluorine
- ☐ D iodine

(b) Bromine, chlorine and iodine all react with heated iron wool.

Figure 9 shows the speed of these reactions.

halogen	description of reaction with heated iron wool
bromine	reacts quickly
chlorine	reacts very quickly
iodine	reacts slowly

Figure 9

(i) When iron wool is heated with chlorine, iron chloride is formed.

Write the word equation for this reaction.

(2)

.....

.....

(ii) Give the name of the halogen in Figure 9 that is the most reactive with iron.

(1)

.....



(iii) 34.4 % of the mass of iron chloride is iron.

Calculate the mass of iron and the mass of chlorine in 125 g of iron chloride.

(3)

.....

.....

.....

mass of iron = ... g mass of chlorine = ... g

(c) Alkenes react with halogens.

When iron chloride is added to the reaction mixture, the reaction is much faster but the products are the same.

Use words from the box to complete the sentences.

an acid	a catalyst	higher	lower	a reactant	unchanged
---------	------------	--------	-------	------------	-----------

(2)

The iron chloride speeds up the reaction because it is

After the reaction, the mass of iron chloride is

(Total for Question 6 = 9 marks)



6 This question is about bromine.

(a) Give the colour and physical state of bromine at room temperature.

(2)

colour

physical state

(b) Bromine reacts with hydrogen to form hydrogen bromide.

(i) Write the word equation for this reaction.

(2)

..... + ... →

(ii) Hydrogen bromide dissolves in water to form a solution.

This solution of hydrogen bromide reacts with alkalis.

State the type of reaction that occurs when a solution of hydrogen bromide reacts with an alkali.

(1)

.....
.....



(c) Bromine and the other halogens react with hot iron wool.

Figure 11 shows the relative speed of some of these reactions.

halogen	relative speed of reaction
fluorine	
chlorine	reacts very quickly
bromine	reacts quickly
iodine	reacts slowly

Figure 11

Fluorine also reacts with hot iron wool.

Use Figure 11 to predict the relative speed of this reaction.

(1)

.....

.....

(d) Potassium bromide contains 32.8% potassium by mass.

Calculate the mass of potassium and the mass of bromine in 500 g potassium bromide.

(3)

.....

.....

.....

.....

mass of potassium = ... g

mass of bromine = ... g

(Total for Question 6 = 9 marks)



10-MARK QUESTIONS

1 question in this booklet



5 Chlorine, bromine and iodine are elements in group 7 of the periodic table.

(a) Chlorine is toxic.

State **one** safety precaution that should be taken when using chlorine in the laboratory.
(1)

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

(i) Write the word equation for this reaction.
(1)

..... →

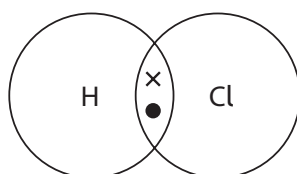
(ii) Hydrogen chloride dissolves in water to form an acidic solution.

State what is **seen** when blue litmus paper is placed into this solution.
(1)

(iii) A chlorine atom has seven electrons in its outer shell.

A hydrogen atom has one electron in its outer shell.

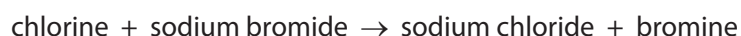
Complete the dot and cross diagram of a molecule of hydrogen chloride.
Show outer shell electrons only.
(1)



(iv) Name the type of bonding in a molecule of hydrogen chloride.
(1)

.....

(c) If chlorine solution is added to sodium bromide solution a reaction occurs.



Give a reason why this reaction occurs.

(1)

(d) Figure 8 shows apparatus used to find out if a solution conducts electricity.

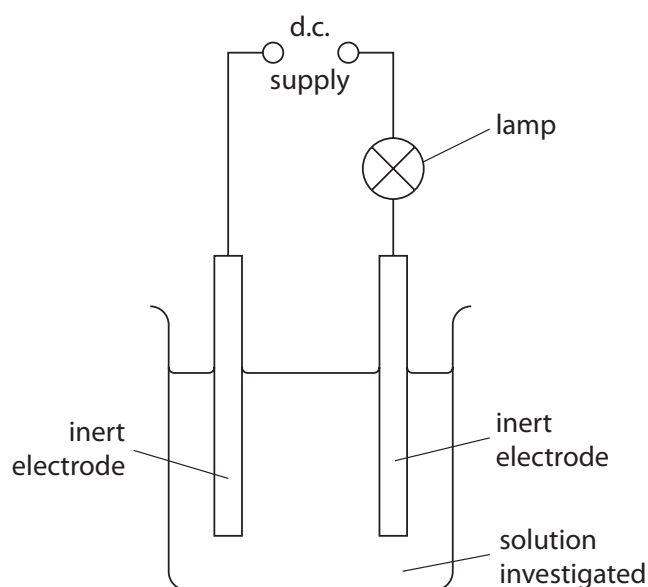


Figure 8

Glucose solution and sodium chloride solution are tested.
Glucose is a typical simple molecular covalent compound.
Sodium chloride is an ionic compound.

(i) State what would happen to the lamp when glucose solution is tested.

(1)

(ii) State what would happen to the lamp when sodium chloride solution is tested.

(1)

- (e) Figure 9 shows how the conductivity of one solution changes as its concentration increases.

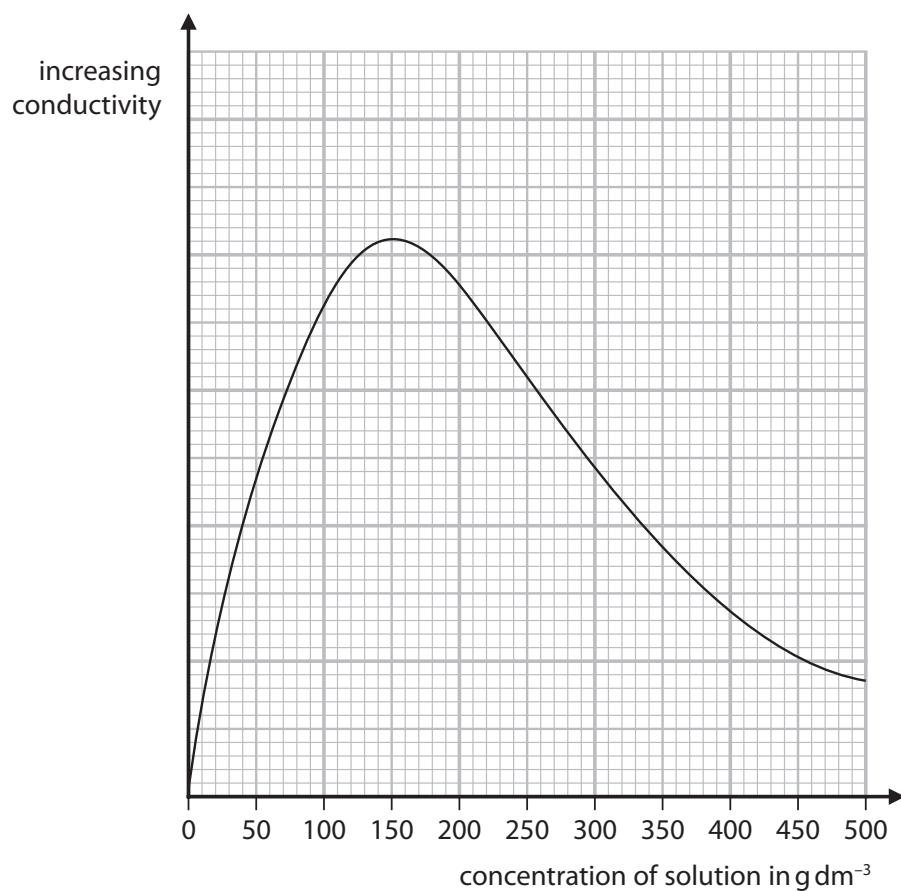


Figure 9

Describe how the conductivity of this solution changes as its concentration increases from 0 to 500 g dm⁻³.

(2)

.....

.....

.....

.....

(Total for Question 5 = 10 marks)

11-MARK QUESTIONS

2 questions in this booklet



8 (a) A chlorine atom contains 17 electrons, 18 neutrons and 17 protons.

(i) State the mass number of this chlorine atom.

(1)

(ii) Give the electronic configuration of this chlorine atom.

(1)

(b) Describe what you would **see** if damp, blue litmus paper is placed into chlorine gas.

(2)



(c) Chlorine exists as diatomic molecules.

In a molecule, two chlorine atoms are joined by a covalent bond.

(i) Describe what is meant by a **covalent bond**.

(2)

(ii) Explain why chlorine is a gas, rather than a liquid, at room temperature.

(2)

(d) When the gas hydrogen chloride, HCl , is dissolved in water, a solution forms.
Blue litmus paper dipped in this solution turns red.

State why the litmus paper turns red.

(1)

- (e) (i) Figure 13 lists the halogens in the order in which they appear in group 7 of the periodic table.

The melting points of four of the halogens are given.

halogen	melting point in °C
fluorine	−220
chlorine	−101
bromine	−7
iodine	
astatine	302

Figure 13

Estimate the melting point of iodine.

(1)

..... °C

- (ii) Bromine reacts with heated iron.

Give the name of one halogen that would react with iron more vigorously than bromine.

(1)

.....

(Total for Question 8 = 11 marks)



6 Lithium is an alkali metal.

(a) (i) State which group of the periodic table contains the alkali metals.

(1)

(ii) Which of the following is a property of lithium?

(1)

- ☐ A hard
- ☐ B high density
- ☐ C high melting point
- ☐ D malleable

(b) A teacher adds a small piece of lithium to water containing universal indicator.

The universal indicator changes colour.

(i) State the colour change shown by the universal indicator.

(1)

from to

(ii) Place ticks (✓) in boxes next to **two** observations that are made when lithium reacts with water.

(2)

observations	(✓)
a green precipitate forms	
effervescence is seen	
the lithium sinks in the water	
the lithium gets smaller and disappears	
the temperature of the solution decreases	

(iii) When lithium is added to water, lithium hydroxide and a gas are produced.

What is the name of the gas produced in this reaction?

(1)

- ☐ A carbon dioxide
- ☐ B chlorine
- ☐ C hydrogen
- ☐ D oxygen

(iv) Lithium hydroxide contains lithium ions, Li^+ .

Describe how a lithium atom becomes a lithium ion.

(2)

.....

.....

.....

.....

(v) Calculate the percentage by mass of hydrogen in lithium hydroxide, LiOH .

$$\% \text{ by mass of element} = \frac{\text{relative atomic mass of element}}{\text{relative formula mass of compound}} \times 100$$

(relative atomic masses: $\text{Li} = 7$, $\text{O} = 16$, $\text{H} = 1.0$)

(3)

.....

.....

.....

.....

percentage by mass of hydrogen = ...

(Total for Question 6 = 11 marks)

12-MARK QUESTIONS

2 questions in this booklet



8 (a) An atom of potassium has atomic number 19 and mass number 39.

(i) Give the electronic configuration of this potassium atom.

(1)

.....

(ii) This potassium atom forms the ion K^+ .

Which row shows the number of protons and the number of neutrons in this potassium ion, K^+ ?

(1)

	number of protons	number of neutrons
☐ A	19	19
☐ B	19	20
☐ C	20	19
☐ D	20	20

(b) Potassium and caesium are in the same group of the periodic table.

Explain, in terms of electrons, why potassium and caesium are in the same group.

(2)

.....

(c) Fluorine boils at -188°C .

There are forces between fluorine molecules.

Explain, in terms of these forces, why the boiling point of fluorine is low.

(2)

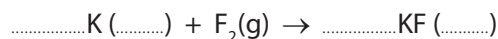
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- (d) Potassium reacts with fluorine to form potassium fluoride.
Potassium fluoride is a solid.

Complete the balanced equation for this reaction and add the state symbols.

(3)



- (e) What are the elements in group 1 of the periodic table called?

(1)

- ☒ **A** alkali metals
☒ **B** fullerenes
☒ **C** halogens
☒ **D** noble gases

- (f) Figure 14 shows the melting points and boiling points of elements in group 7 of the periodic table.

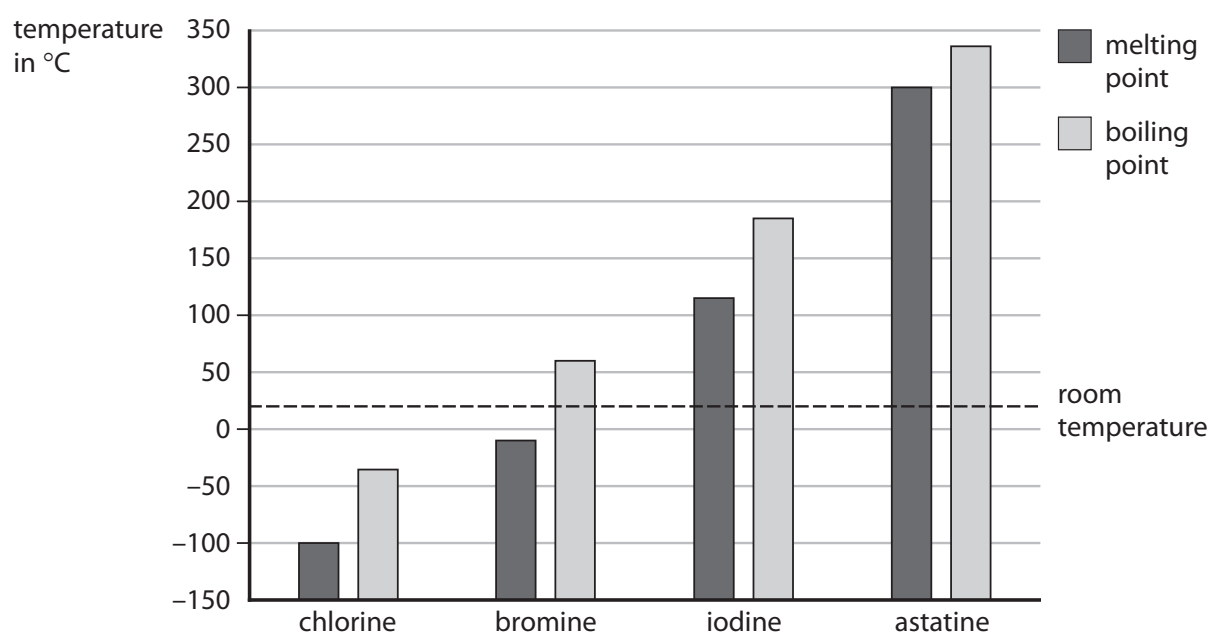


Figure 14

- (i) Give, using Figure 14, the boiling point of bromine.

(1)

boiling point of bromine = ... °C

- (ii) State which **two** elements from Figure 14 are solids at room temperature.

(1)

(Total for Question 8 = 12 marks)



6 Chlorine is an element in group 7 of the periodic table.

(a) What name is given to group 7 of the periodic table?

(1)

- ☐ A alkali metals
- ☐ B halogens
- ☐ C noble gases
- ☐ D transition metals

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.

(2)

..... →

(ii) Chlorine, Cl_2 , is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

.....
.....
.....
.....

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

.....
.....
.....
.....

(iv) Sodium chloride contains sodium ions, Na^+ , and chloride ions, Cl^- .

Use this information to state the formula of sodium chloride.

(1)

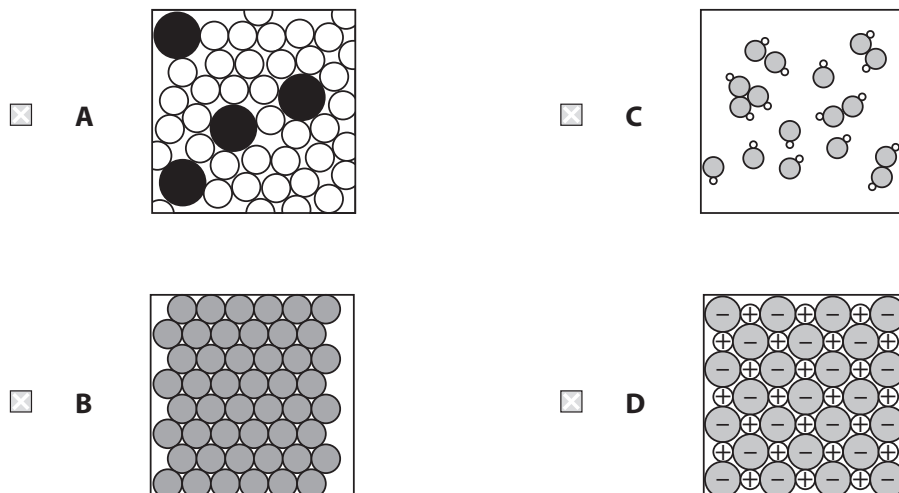
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(v) Sodium chloride is made of a giant structure of ions.

Which diagram shows the arrangement of particles in sodium chloride?

(1)



(vi) Sodium chloride solution conducts electricity.

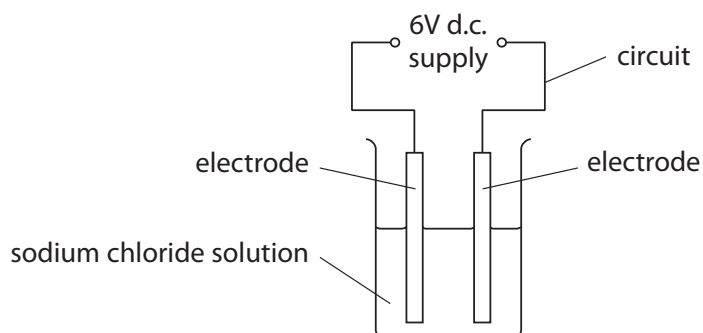


Figure 11

State what can be put into the circuit in Figure 11 to show that a current is flowing.

(1)

(c) Figure 12 shows a flow diagram of how hydrochloric acid can be made.

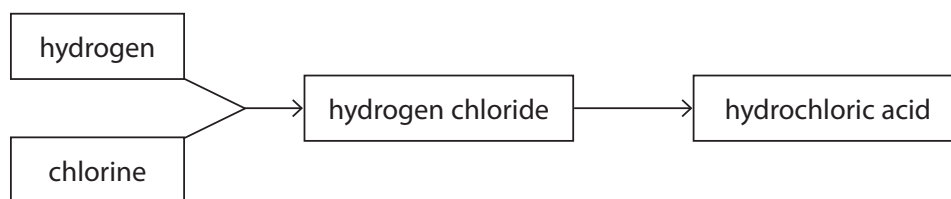


Figure 12

- (i) Balance the equation for the reaction between hydrogen and chlorine to form hydrogen chloride.

(1)



- (ii) State how hydrogen chloride can be converted into hydrochloric acid.

(1)

.....

.....

(Total for Question 6 = 12 marks)

13-MARK QUESTIONS

2 questions in this booklet



9 This question is about gases.

(a) When sodium is added to water, hydrogen gas is produced.

Which observation shows that a gas has been produced?

(1)

- ☐ A a white precipitate forms
- ☐ B effervescence is seen
- ☐ C the sodium sinks in the water
- ☐ D the water changes to a pink colour

(b) Some damp litmus paper is placed in a gas.
The litmus paper is bleached.

Which gas bleaches damp litmus paper?

(1)

- ☐ A carbon dioxide
- ☐ B chlorine
- ☐ C hydrogen
- ☐ D oxygen

(c) When calcium carbonate is heated it decomposes.



When 5.000 g of calcium carbonate is heated, the mass of solid remaining is 2.800 g.

Calculate the mass of carbon dioxide that has been released.

Give your answer to three significant figures.

(2)

.....
.....

mass of carbon dioxide = ... g

(d) A diagram of an atom of helium is shown in Figure 15.

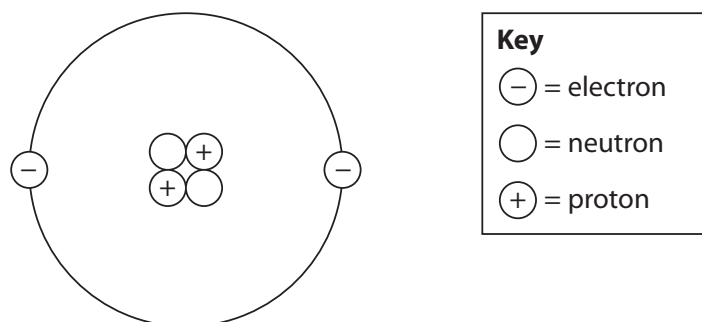


Figure 15

(i) Explain, using Figure 15, why helium is inert.

(2)

.....

.....

.....

(ii) Helium is used to fill balloons.

State one property of helium, apart from it being inert, that makes it suitable for filling balloons.

(1)

.....

(Total for Question 9 = 13 marks)



9 Figure 18 shows some information about some group 1 metals.

group 1 metal	atomic number	relative atomic mass
lithium	3	7
sodium	11	23
potassium	19	39
rubidium	37	85
caesium	55	133

Figure 18

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

.....

.....

.....

.....

(b) Which row shows two correct properties of group 1 metals?

(1)

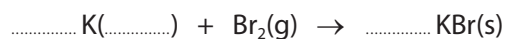
properties of group 1 metals		
☐ A	compounds are white in colour	high density
☐ B	low melting points	compounds are blue in colour
☐ C	soft enough to be cut by a knife	low melting points
☐ D	high density	conduct electricity

(c) The word equation for the reaction of potassium with bromine is

potassium + bromine → potassium bromide

Add the missing state symbol and balance the equation for this reaction.

(2)



(d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

Explain the meaning of the term **isotopes**.

(2)

.....

.....

.....

.....

*(e) The reactivity of the group 1 metals increases from lithium to caesium.

Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.

These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.

Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.

You may use word equations in your answer.

(6)

.....

.....

.....

.....

.....

.....

.....

.....



(Total for Question 9 = 13 marks)



MARK SCHEMES

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Question number	Answer	Additional guidance	Mark
1(a)(i)	At	allow AT/ at / aT	AO1 1 (1)

Question number	Answer	Mark
1(b)(i)	A yellow-green is the only correct answer B is not correct because this is the colour of bromine C is not correct because this the colour of iodine vapour D is not correct because this the (assumed) colour of astatine	AO1 1 (1)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	red (1) white (1)	mark independently allow 1 mark for white then red	AO1 1 (2)

Question number	Answer	Additional guidance	Mark
1(c)(i)	a description including: (boiling point) increases (1) - as atomic number increases / down the group (1)	MP2 dependent on MP1. allow ORA allow 'goes up', 'gets higher' etc for increases allow temperature increases ignore hotter/ warmer down the group allow 'down the halogens' allow 'from fluorine to iodine' allow 'down the periodic table' ignore down the table alone 'positive correlation between bpt and atomic number' scores 2	A03 1 (2)

Question number	Answer	Mark
1(c)(ii)	allow any number greater than 59	A03 2 (1)

Total for Question 1 = 7 marks



Question number	Answer	Mark
3(a)(i)	(outer shell is) full/ complete	(1) AO1

Question number	Answer	Additional guidance	Mark
3(a)(ii)	An explanation linking - hydrogen is flammable / could ignite (1) - krypton is more dense than air (1) (so krypton) air ship would not float (1)	allow krypton has a high density	(3) AO3

Question number	Answer	Mark
3(b)	had yet to be discovered / unknown / did not know about them	(1) AO1

Question number	Answer	Additional guidance	Mark
3(c)(i)	neon bar correct (1) argon bar correct (1)	if no other mark scored, allow 1 for neon -252 and argon -192	(2) AO2

Question number	Answer	Mark
3(c)(ii)	allow any value from -152 to -90	(1) AO1

Question number	Answer	Additional guidance	Mark
2(a)(i)	Rb / Cs / Fr	symbols must have uppercase letter then lowercase letter reject answers with any other symbols ignore any names	(1) A02 1

Question number	Answer	Mark
2(a)(ii)	3 / three	(1) A02 1

Question number	Answer	Additional guidance	Mark
2(a)(iii)	A description including (the melting points) decrease (1) - as the atomic number increases/ as you go down {the group / the alkali metals / group 1} (1)	allow (melting points) {go down / get smaller} ignore less heat needed to melt it MP2 depends on MP1 allow (going) down (the table / list) allow down the periodic table ignore references to boiling point higher the atomic number, lower the melting point (2) ORA higher in {group/ table} the higher the melting point (2) ORA	(2) A03 1

Question number	Answer	Additional guidance	Mark
2(b)(i)	test tube / boiling tube	ignore just 'tube', testing tube	(1) A02 2

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An explanation to include any three from: Step 2 - cut a <u>smaller</u> piece of sodium (1) - so less reaction / slower reaction (1) Step 3 - use a larger {container / trough} (of water) (1) - there is more water so more heat is absorbed (1)	reject use powdered sodium for MP1 and MP2 MP2 is dependent on MP1 allow less sodium / smaller volume of sodium / $1(\text{cm}^3) \times 1(\text{cm}^3) \times 1(\text{cm}^3)$ cube / smaller mass of sodium ignore use less cubes allow smaller reaction / it is less reactive ignore so reaction is less vigorous MP4 is dependent on MP3 allow name of larger container: beaker/ flask ignore use larger test tube / boiling tube ignore change container ignore add more water ignore add a safety screen / observe from a distance	(3) A03 3a



Question number	Answer	Mark
5(a)(i)	halogens	(1) AO1

Question number	Answer	Additional guidance	Mark
5(a)(ii)	astatine	allow At / At ₂	(1) AO1

Question number	Answer	Mark
5(a)(iii)	C bromine A and B are not correct as they are gases at room temperature and pressure D is not correct as iodine is a solid at room temperature and pressure	(1) AO1

Question number	Answer	Mark
5(a)(iv)	D iodine A is not correct as fluorine is pale yellow at room temperature and pressure B is not correct as chlorine is green at room temperature and pressure C is not correct as bromine is red-brown liquid at room temperature and pressure	(1) AO1

Question number	Answer	Additional guidance	Mark
5(b)	$\frac{1.19}{119}$ and $\frac{1.42}{35.5}$ (1) 0.01 : 0.04 (1) SnCl ₄ . (1)	allow ECF	(3) AO2

Question number	Answer	Additional guidance	Mark
5(c)	An explanation linking fluorine has fewer electron shells (1) (so) electron more easily attracted to nucleus (1)	allow less shielding (1) ignore fewer electrons ignore fewer outer electron shells	(2) AO1

Question number	Answer	Mark
6(a)	B chlorine is the only correct answer A, C and D are incorrect because only chlorine is green	(1) A01 1

Question number	Answer	Additional guidance	Mark
6(b)(i)	iron + chlorine → (1) → iron chloride (1)	allow = for → MP1: allow iron wool/ reactants in either order/ ignore heat MP2: reject if extra products but ignore heat reject more than one arrow for both marks e.g. iron → chlorine → iron chloride if symbol equation given only allow: $\text{Fe} + \text{Cl}_2 \rightarrow \text{FeCl}_2$ (2) OR $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$ (2) all formulae must have correct capital and small letters and subscripts	(2) A02 1

Question number	Answer	Additional guidance	Mark
6(b)(ii)	chlorine	allow CL / Cl / Cl ₂	(1) A03 2



Question number	Answer	Additional guidance	Mark
6(b)(iii)	iron = 43 and chlorine = 82 scores 3 with or without working $\frac{34.4}{100} \times 125$ (1) = 43 given as mass of iron (1) $125 - 43 = 82$ given as mass of chlorine (1) OR $\frac{65.6}{100} \times 125$ (1) = 82 given as mass of chlorine (1) $125 - 82 = 43$ given as mass of iron (1)	one correct and one incorrect (or missing) value with or without working scores 2 allow ECF allow ECF but must add up to 125g for MP3 allow ECF but must add up to 125g for MP3 allow final answers reversed on answer lines for 2 marks with or without working.	(3) A02 1
Question number	Answer		Mark
6(c)	- catalyst (1) - unchanged (1)		(2) A01 1



Question number	Answer	Additional guidance	Mark
6(a)	colour: red-brown / reddish-brown / brownish-red / dark red (1) physical state: liquid (1)	ignore orange / brown / red (alone)	(2) AO1 1

Question number	Answer	Additional guidance	Mark
6(b)(i)	hydrogen + bromine → hydrogen bromide (2) hydrogen + bromine → (1) → hydrogen bromide (only) (1)	if balanced equation attempted, must have correct formulae and correct balancing: $\text{H}_2 + \text{Br}_2 \rightarrow 2 \text{HBr}$ (2)	(2) AO2 1

Question number	Answer	Additional guidance	Mark
6(b)(ii)	neutralisation	allow exothermic / acid-base	(1) AO1 1

Question number	Answer	Additional guidance	Mark
6(c)	reacts {very, very quickly / extremely quickly / reacts instantly / fastest}	must imply faster than "very quickly" allow 'faster than chlorine'	(1) AO3 2b



Question number	Answer	Additional guidance	Mark
6(d)	mass of potassium = 164 (g) AND mass of bromine = 336 (g) with or without working scores 3 potassium : $\frac{32.8}{100} \times 500$ (1) = 164 (g) (1) bromine : $500 - 164 = 336$ g (1)	mass of potassium = 164 (g) OR mass of bromine = 336 (g) with or without working scores 2 If answers on answer line are the wrong way round with or without working, score 2 marks If 164 or 336 appear on the incorrect final answer line, score 1 ecf for correct evaluation of a percentage for bromine allow $100 - 32.8 = 67.2$ $\frac{67.2}{100} \times 500 = 336$	(3) AO2 1

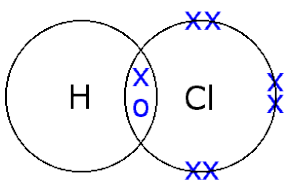
Total for question 6 = 9 marks



Question number	Answer	Additional Guidance	Mark
5(a)	use of fume-cupboard / fume hood	allow adequate ventilation gloves (to prevent skin absorption) ignore breathing apparatus, gas mask, mask, PPE	(1)

Question number	Answer	Additional guidance	Mark
5(b)(i)	hydrogen + chlorine → hydrogen chloride	answer must contain a "+" between reactants allow reactants on LHS in either order allow $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ allow multiples on balanced equation ignore state symbols	(1)

Question number	Answer	Mark
5(b)(ii)	(turns) red / pink	(1)

Question number	Answer	Additional guidance	Mark
5(b)(iii)		6 electrons drawn in outer shell of Cl (1) ignore inner shells of electrons even if incorrect	(1)

Question number	Answer	Additional guidance	Mark
5(b)(iv)	covalent	ignore other words reject ionic / metallic	(1)

Question number	Answer	Additional guidance	Mark
5(c)	chlorine is more reactive than bromine / chlorine can displace bromine	ignore "chlorine is more reactive" alone	(1)

Question number	Answer	Additional guidance	Mark
5(d)(i)	(lamp) does not light up / unlit / 'nothing'	ignore turn off / no reaction	(1)

Question number	Answer	Additional guidance	Mark
5(d)(ii)	(lamp) lights up / glows / works	ignore becomes brighter / dimmer	(1)

Question number	Answer	Additional guidance	Mark
5(e)	A description including - conductivity increases and then decreases (1) AND any one <i>quantitative description</i> from - conductivity increases (from 0) to 150 (g dm⁻³) (1) - conductivity reaches maximum at 150 (g dm⁻³) (1) - conductivity then decreases from 150 (to 500) (g dm⁻³) (1)	allow positive correlation for increases and negative correlation for decreases	(2)

(Total for Question 5 = 10 marks)

Question Number	Answer	Additional guidance	Mark
8(a)(i)	35	reject 35.5	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
8(a)(ii)	2.8.7	allow any separator including gaps e.g. 2 8 7 send to review any diagrams	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
8(b)	A description to include • (blue litmus) (first turns) red (1) • (then) bleaches / turns white (1)	allow shades of red and pink but not other colours e.g. red-purple allow colour disappears/goes colourless ignore yellow/ colour fades /discolours white then red = 0; just 'goes white' = 1	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
8(c)(i)	A description to include • shared electron(s) (1) • {a pair of / two} (electrons) (1)	allow a diagram for both mark points reference to ionic bonding/ions scores 0 e.g. gains two electrons = 0	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
8(c)(ii)	An explanation linking any two from - intermolecular forces / forces between molecules (1) (intermolecular) forces {weak / take little energy to break} / little energy to separate molecules (1) - boiling point is below room temperature / has a low boiling point (1)	if answer relates to the breaking of any type of bond first two marking points cannot be scored (but 3rd could) allow “attractions” instead of “forces”	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
8(d)	(the solution is) acid(ic) / contains {hydrogen ions/ H ⁺ }	allow pH < 7 allow hydrogen chloride is acidic If incorrect identity of acidic solution then 0 marks (e.g. chlorine is acidic = 0)	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
8(e)(i)	any value from 20 to 301	allow a range within these numbers e.g. 25 to 45 answer may be given in the table. if values are given on the answer line and the table mark only the answer on the answer line	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
8(e)(ii)	fluorine/ chlorine	reject iodine / astatine allow F/F₂/Cl/Cl₂	(1) AO 2 1

(Total for Question 8 = 11 marks)



Question number	Answer	Additional guidance	Mark
6(a)(i)	(group) 1 / one	ignore alkali metals	A01 1 (1)

Question number	Answer	Mark
6(a)(ii)	D malleable is the only correct answer A, B and C are incorrect because they are not properties of alkali metals	A01 1 (1)

Question number	Answer	Additional guidance	Mark
6(b)(i)	from green to {purple / blue}	reject colours in reverse order allow named shades e.g. light green, dark blue reject any other colours given	A02 2 (1)

Question number	Answer	Additional guidance	Mark												
6(b)(ii)	<table><tr><th>observations</th><th>(✓)</th></tr><tr><td>a green precipitate forms</td><td></td></tr><tr><td>effervescence is seen</td><td>✓</td></tr><tr><td>the lithium sinks in the water</td><td></td></tr><tr><td>the lithium gets smaller and disappears</td><td>✓</td></tr><tr><td>the temperature of the solution decreases</td><td></td></tr></table>	observations	(✓)	a green precipitate forms		effervescence is seen	✓	the lithium sinks in the water		the lithium gets smaller and disappears	✓	the temperature of the solution decreases		if 1-2 ticks: 1 mark per correct tick if 3 ticks: 1 mark only if both correct ticks included if 4-5 ticks: 0 marks	AO1 2 (2)
observations	(✓)														
a green precipitate forms															
effervescence is seen	✓														
the lithium sinks in the water															
the lithium gets smaller and disappears	✓														
the temperature of the solution decreases															

Question number	Answer	Mark
6(b)(iii)	C hydrogen is the only correct answer A, B and D are incorrect because hydrogen is formed when sodium reacts with water	AO1 1 (1)

Question number	Answer	Additional guidance	Mark
6(b)(iv)	A description to include: - loses electron(s) (1) {one / an} (electron) (1)	reject shares electron(s) for MP1 and MP2 ignore mention of any bonding type allow {transfers / donates / gives away} electron(s)	AO1 1 (2)

Question number	Answer	Additional guidance	Mark
6(b)(v)	4.166666...correctly rounded with or without working scores 3 $7 + 16 + 1 = 24$ (1) $\frac{1}{24}$ (= 0.0416666666) (1) $0.0417 \times 100 = 4.2$ (1)	4.1$\dot{6}$ scores 3 marks with or without working 24 seen scores 1 allow ECF from Mr calculated by adding at least two Ar <u>with working</u> allow ECF to MP3 using $\frac{1}{Mr} \times 100$ or $\frac{2}{Mr} \times 100$ only	AO2 1 (3)

Total for Question 6 = 11 marks



Question number	Answer	Additional guidance	Mark
8(a)(i)	2.8.8.1	allow any separator including gaps e.g. 2 8 8 1 send to review any diagrams	(1)

Question number	Answer	Mark
8(a)(ii)	B 19 (protons) 20 (neutrons) This is the only correct answer. A is incorrect because there are 20 neutrons in the ion C is incorrect because there are 19 protons and 20 neutrons D is incorrect because there are 19 protons in the ion	(1)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation linking - outer (electron) shell (1) (both have) {same number / 1} electron(s) (1)	allow both lose 1 electron (to form ion / to form noble gas configuration) reject same number of outer shells / same number of electrons MP2 depends on MP1	(2)

Question number	Answer	Additional guidance	Mark
8(c)	An explanation linking (intermolecular) forces are weak (1) - little energy needed (to overcome forces) (1)	allow intermolecular bonds / weak bonds between molecules ignore needs a low temperature to break	(2)

Question number	Answer	Additional guidance	Mark
8(d)	$2\text{K (s)} + \text{F}_2\text{ (g)} \rightarrow 2\text{KF (s)}$ 2 K (1) 2 KF (1) s, s (1)	ignore words	(3)

Question number	Answer	Mark
8(e)	A alkali metals A is the only correct answer. B is incorrect because fullerenes are not a group in the periodic table C is incorrect because halogens are group 7 D is incorrect because noble gases are group 0	(1)

Question number	Answer	Mark
8(f)(i)	any value between 51 (°C) and 70 (°C)	(1)

Question number	Answer	Mark
8(f)(ii)	iodine and astatine	(1)

(Total for Question 8 = 12 marks)



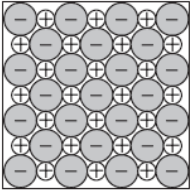
Question number	Answer	Mark
6(a)	B halogens A, C and D are names for other groups in the periodic table	(1) AO1-1

Question number	Answer	Additional guidance	Mark
6(b)(i)	Left side: sodium + chlorine (1) Right side: sodium chloride (1)	reactants in either order reject chloride on left hand side reject sodium chlorine on right hand side reject if other substances on right side use of formulae to produce a correctly balanced equation: $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ (2)	(2) AO2-1

Question number	Answer	Additional guidance	Mark
6(b)(ii)	A description to include (two or more) atoms joined together (1) - by a {covalent bond / shared pair of electrons} (1)	allow made up of more than one atom / group of atoms ignore 'compound atoms' MP2 depends on MP1 allow {(chemically) bonded / chemically joined} together reject references to ionic bonding for MP2 if no other mark scored, allow 'particles joined by a {covalent bond / shared pair of electrons} (1)	(2) AO1-1

Question number	Answer	Additional guidance	Mark
6(b)(iii)	An explanation linking - electrons (1) (electrons) {can move / are delocalised / can pass through / can flow} (1)	reject ions MP2 depends on MP1 allow charged particles can move / are delocalised (1) ignore 'free' alone allow free-moving electrons / delocalised electrons / free flowing electrons (2)	(2) AO2-1

Question number	Answer	Additional guidance	Mark
6(b)(iv)	NaCl / Na ⁺ Cl ⁻	allow ClNa ignore upper case A, upper case L, lower case n ignore numbers in front of formula reject Na⁺ + Cl⁻ as final answer / Na⁻Cl⁺	(1) AO3-1

Question number	Answer	Mark
6(b)(v)	D  is the only correct answer A, B and C represent different structure types	(1) AO2-1

Question number	Answer	Additional guidance	Mark
6(b)(vi)	ammeter / (light) bulb / lamp	allow buzzer / multimeter allow correct symbol (on diagram) ignore voltmeter / data logger (alone) ignore 'add arrows'	(2) AO3-3

Question number	Answer	Additional guidance	Mark
6(c)(i)	$\text{H}_2 + \text{Cl}_2 \rightarrow 2 \text{HCl}$	allow multiples	(1) AO2-1

Question number	Answer	Additional guidance	Mark
6(c)(ii)	{dissolve in / add} water	allow {make aqueous / dissolve into a solution} allow bubble through water / mix with water ignore dilute / make it a liquid reject other substances	(1) AO1-1

Total for Question 6 = 12 marks



Question number	Answer	Additional guidance	Mark
9(a)	B effervescence is seen is the only correct answer. A, C and D are incorrect as they are not linked to gas production		(1) AO1 2

Question number	Answer	Mark
9(b)	B chlorine is the only correct answer. A, C and D are incorrect because only chlorine bleaches litmus	(1) AO1 1



Question number	Answer	Additional guidance	Mark
9(c)	2.20 with or without working scores (2) $5(.000) - 2.8(00) = 2.2(00)$ (1) $= 2.20$ (1)	reject additional processing for MP1 (e.g $5 - 2.8 = 2.2$ then $\frac{2.2}{100} = 0.0220$) does not score MP1 – additional process of dividing by 100 does not score MP2 - using a number not in the question for MP2 final answer must be to 3sf, correct evaluation of expression using only numbers from the question 2.2 / 2.200 scores 1 mark $\frac{5.000}{2.800} = 1.79$ scores 1 mark $\frac{2.800}{5.000} = 0.560$ scores 1 mark [0.56 = 0] $5.000 \times 2.800 = 14.0$ scores 1 mark [14 = 0] $5.000 + 2.800 = 7.80$ scores 1 mark [7.8 = 0]	(2) AO2 1

Question number	Answer	Additional guidance	Mark
9(d)(i)	An explanation linking: - it has two electrons in outer shell/ it has a full outer shell / OWTTE (1) - so does not {gain/ lose/ transfer/ share} electrons (1)	MP1 – reject if number of electrons in outer shell is stated and not 2 ignore references to protons and neutrons allow helium has two electrons in its (only) shell / helium's (only) shell is full ignore helium does not need to react	(2) AO1 1



Question number	Answer	Additional guidance	Mark
9(d)(ii)	less dense than air	allow less dense than nitrogen allow low density / not (very) dense allow diffuses slowly out of balloon ignore less dense than oxygen ignore it is a gas / light / lightweight / inert/ unreactive/ non-flammable / lighter than air / makes balloon float / it rises/ it floats ignore non-toxic / not poisonous	(1) AO2 1



Question number	Indicative content	Mark
*9(e)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 (6 marks) Natural: Origins: • {carbon dioxide / water / gases} from volcanoes • the Earth cooled • so water vapour condensed (to form oceans/seas) reducing amount of water vapour • carbon dioxide {dissolves in/absorbed by} the oceans reducing amount of carbon dioxide • some carbon dioxide incorporated into sea animals' shells Natural: Evolution • plants evolved • photosynthesis • photosynthesis releases oxygen increasing amount of oxygen • photosynthesis absorbs carbon dioxide reducing amount of carbon dioxide Human effects • amounts of carbon dioxide in recent time increasing due to burning fossil fuels • amounts of carbon dioxide in recent time increasing due to agriculture • deforestation means less carbon dioxide absorbed • reforestation means more oxygen produced	(6) AO1



Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical knowledge, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates chemical knowledge, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant chemical knowledge throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)



Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then: Information directly copied from the table is not credited e.g water vapour goes down Water vapour has gone down (0) Humans respire giving carbon dioxide (0)
Level 1	1–2	<u>Additional Guidance</u> Candidate gives basic ideas only, these may or may not be linked	<u>Possible candidate response</u> Carbon dioxide is produced by volcanoes (1) Water vapour decreased because the earth cooled (1) Water vapour in the atmosphere condensed to form oceans (2) Trees photosynthesise and absorb carbon dioxide (2) Trees take in carbon dioxide and produce oxygen (2) Plants release oxygen, burning fossil fuels release carbon dioxide (2)
Level 2	3–4	<u>Additional Guidance</u> candidate gives basic idea about two areas. OR candidate gives a detailed explanation about one process	<u>Possible candidate response</u> Carbon dioxide is absorbed during photosynthesis by plants and burning fossils produces carbon dioxide (3) Trees photosynthesise which absorb carbon dioxide and release oxygen. The Earth cooled and water condensed to produce oceans, these oceans absorbed carbon dioxide (4) Trees photosynthesise which absorb carbon dioxide and release oxygen (3) Primitive plants evolved in oceans and started to photosynthesise which decreased the amount of carbon dioxide and increase the amount oxygen in the atmosphere. (4)
Level 3	5–6	<u>Additional Guidance</u> candidate explains ideas about all three areas	<u>Possible candidate response</u> Trees photosynthesise which absorb carbon dioxide and release oxygen. The Earth cooled and water condensed to produce oceans, these oceans absorbed carbon dioxide. Cars produce carbon dioxide (5) Trees photosynthesise which absorb carbon dioxide and release oxygen. The Earth cooled and water condensed to produce oceans, these oceans absorbed carbon dioxide. Burning fossil fuels produces carbon dioxide and deforestation has led to fewer trees and therefore less carbon dioxide being absorbed (6)



Question number	Answer	Additional guidance	Mark
9(a)	An explanation linking 1 <u>electron</u> (1) - in outer shell(s) (1)	allow 1 is the last number of the electronic configuration (1) ignore electronic configurations written out reject incorrect number of electrons MP2 depends on MP1 for outer allow {highest energy / last} for shell allow ring, energy level, orbital allow: 1 outer electron (2) 1 valence electron (2) have to lose 1 electron to get full outer shell (2) same number of electrons in outer shell (1) forms a +1 ion by losing one electron (1)	(2) AO1-1

Question number	Answer	Mark
9(b)	C soft enough to be cut by a knife / low melting point is the only correct answer A and D are incorrect because alkali metals do not have a high density B is incorrect because alkali metal compounds are not blue in colour	(1) AO1-1

Question number	Answer	Additional Guidance	Mark
9(c)	$2 \text{ K(s)} + \text{Br}_2(\text{g}) \rightarrow 2 \text{ KBr(s)}$ balancing (1) state symbol s (1)	allow multiples ignore 'two' ignore 'solid'	(2) AO2-1

Question number	Answer	Additional guidance	Mark
9(d)	An explanation linking (atoms) {of same element / with same number of protons} / all contain 19 protons / same atomic number (1) - different number of neutrons / different mass <u>number</u> / have 20, 21, 22 neutrons (1)	reject compound / molecule / ion / elements <u>s</u> once allow same protons ignore electrons reject different protons allow different / extra / more / fewer neutrons ignore different mass / relative atomic mass reject different electrons	(2) AO1-1



Question number	Indicative content	Mark
9(e)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. • lithium, sodium, potassium float on water • metals move around on the water • bubbles form / fizz / effervescence • hydrogen / gas produced • metal hydroxide solution formed • metal + water → metal hydroxide + hydrogen • purple solution formed if universal indicator present in the water • lithium slowly disappears • sodium forms a ball / melts • sodium disappears quickly • potassium burns with a lilac flame • potassium disappears very quickly • rubidium much more reactive (than potassium) • rubidium burns with coloured flame • caesium explosive / more reactive than rubidium	(6) AO1-1



Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question.
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question.
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question.



Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1–2	<u>Additional Guidance</u> Correctly describes the trend in reactivity of group 1 metals down the group. Gives at least 1 observation for reaction of one alkali metal and water. Identifies at least 1 product formed when alkali metals react with water. Writes at least one correct word equation	<u>Possible candidate response</u> potassium is more reactive than sodium (1) the metals get more reactive down the group (1) water with universal indicator turns purple when lithium is added (1) when potassium is added to water it moves on the surface with a lilac flame (2) when lithium is added to water, bubbles of hydrogen are formed (2) sodium makes sodium hydroxide (1) sodium + water → sodium hydroxide + hydrogen (2)
Level 2	3–4	<u>Additional Guidance</u> Compares reactions of at least 2 alkali metals including at least 1 observation. Compares at least 2 alkali metals including identifying at least 1 product of reaction with water. Gives at least 1 observation about reaction of alkali metals and makes prediction for Rb / Cs.	<u>Possible candidate response</u> lithium and sodium both float on the water (3) lithium is the least reactive because it moves less than the others, with fewer bubbles (4) lithium is less reactive than sodium because it produces fewer bubbles of hydrogen (4) sodium makes sodium hydroxide, potassium makes potassium hydroxide (3) potassium burns with a flame, caesium would explode (3) rubidium would give off more bubbles than potassium, and would move faster in the water (4)
Level 3	5–6	<u>Additional Guidance</u> Compares reactions of at least 3 alkali metals including at least 2 observations for at least one metal AND identifies at least one product of reaction with water. Compares at least 3 alkali metals, including predictions for Cs / Rb AND identifies at least one product of reaction with water.	<u>Possible candidate response</u> potassium is more reactive than sodium, which is more reactive than lithium. When added to water they move around the surface and then disappear, with lithium moving the slowest. The metals react to form metal hydroxides and hydrogen (6) sodium + water → sodium hydroxide + hydrogen potassium + water → potassium hydroxide + hydrogen rubidium + water → rubidium hydroxide + hydrogen (5)

Total for Question 9 = 13 marks

