AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.1.1.5

Size and mass of atoms

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
Available paper years	**2020–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.1.1.5 Size and mass of atoms

Answer 01 · Mark scheme November 2020 | 8464/C/1H | Original Q6

06.1	atoms have a positively charged nucleus. mass is concentrated in the nucleus in the centre of atoms.		1 1	AO1 5.1.1.3

06.2	$\frac{4 \times 10^{-7}}{2400}$ $= 1.66666 \times 10^{-10}$ $= 1.67 \times 10^{-10}$ (m)	 allow 0.000 000 000 167 (m) allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question	1 1 1	AO2 5.1.1.5

06.3	(moles Au = $\frac{0.175}{197}$ =) 0.000888		1	AO2 5.3.1.1 5.3.2.2
	(moles Cl_2 = 0.000888 × $\frac{3}{2}$ =) 0.00133	allow a correct calculation using an incorrectly calculated value of moles of gold	1	
	(mass Cl_2 =) 0.00133 × 71	allow a correct calculation using an incorrectly calculated value of moles of chlorine	1	
	= 0.0946 (g)		1	
	= 94.6 (mg)	allow a correct conversion using an incorrectly calculated mass of chlorine	1	

	alternative approach: (from equation 2 moles of Au reacts with 3 moles of Cl_2) (so) 394 g Au reacts with 213 g Cl_2 (1) 1 g Au reacts with ($\frac{213}{394}$ =) 0.54 g Cl_2 (1) 0.175 g Au reacts with 0.54 × 0.175 g Cl_2 (1) = 0.0946 (g) (1) = 94.6 (mg) (1)	 allow a correct calculation using an incorrectly calculated value of mass of gold and / or chlorine allow a correct calculation using an incorrectly calculated value of mass of gold and / or chlorine allow a correct conversion using an incorrectly calculated mass of chlorine		

Total			**10**

5.1.1.5 Size and mass of atoms

Answer 01 · Mark scheme

November 2020 | 8464/C/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.5 Size and mass of atoms

Answer 02 · Mark scheme

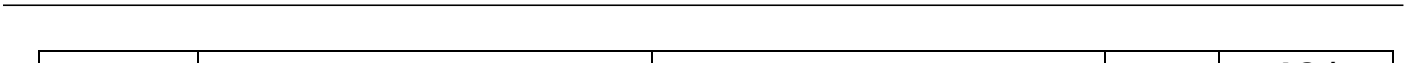
November 2021 | 8464/C/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(Group) 0 **or** noble gases		1	AO2 5.1.2.2
01.2	B		1	AO2 5.1.1.3
01.3	A		1	AO3 5.1.1.3
01.4	(atoms with the) same number of protons	allow atoms with the same atomic number allow atoms of the same element ignore the same number of electrons	1	AO1 5.1.1.5
	(but with) different numbers of neutrons	ignore (but with) different mass numbers do **not** accept (but with) different relative atomic mass	1	
01.5	$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$		1	AO2 5.1.1.6
	= 39.138		1	
	= 39.1	allow correctly rounded answer to **1** decimal place from an incorrect calculation using all the values given in the question	1	
Total			**8**	

5.1.1.5 Size and mass of atoms

Answer 02 · Mark scheme

November 2021 | 8464/C/1H | Original Q1



5.1.1.5 Size and mass of atoms

Answer 03 · Mark scheme

June 2023 | 8464/C/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	electron → proton → neutron		1	AO1 5.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(times heavier =) $\frac{1.673 \times 10^{-27}}{9.109 \times 10^{-31}}$ = 1837	 allow 1836.645076 correctly rounded to at least 3 significant figures	1 1	AO2 5.1.1.5

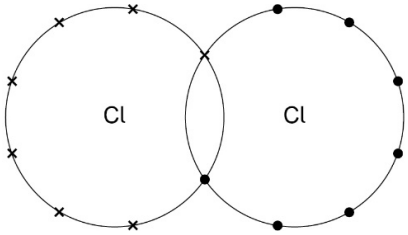
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	46		1	AO2 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	36		1	AO2 5.1.1.4 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(A_r =) $\frac{(35 \times 75.77) + (37 \times 24.23)}{100}$ = 35.4846 = 35.48	 allow an answer correctly calculated to 2 decimal places from an incorrect calculation which uses the values in the question	1 1 1	AO2 5.1.1.6

5.1.1.5 Size and mass of atoms

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6		allow any combination of circles, dots, crosses, $e^{(-)}$ for electrons		AO1 5.1.2.6 5.2.1.1
	one shared pair in overlap		1	5.2.1.4
	each chlorine atom with 6 non-bonded electrons (on outer shell)	ignore any inner shell electrons	1	
		the diagram below scores 2 marks		
				

Total Question 4	10

5.1.1.5 Size and mass of atoms

Answer 04 · Mark scheme

June 2025 | 8464/C/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	atoms have a charged nucleus the mass of an atom is concentrated in the nucleus		1 1	AO1 5.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(particle **X**) has more electrons than protons	allow (particle **X**) has a different number of protons and electrons allow because atoms have the same number of protons and electrons do **not** accept (particle **X**) has a different number of neutrons	1	AO3 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	$^{79}_{35}Br^-$		1	AO2 5.1.1.5

5.1.1.5 Size and mass of atoms

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(going down the group) molecules increase in size	allow (going down the group) atoms increase in size	1	AO1 5.1.2.6 5.2.2.4
	(so the) forces between the molecules increase **or** (so the) intermolecular forces increase		1	
	(so) more energy is needed to break the intermolecular forces	allow (so) more energy is needed to separate the molecules	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	covalent	ignore intermolecular forces	1	AO1 5.1.2.6 5.2.1.1

Question	Answers	Mark	AO / Spec. Ref.
03.6	chlorine + sodium bromide → bromine + sodium chloride allow Br_2 for bromine allow NaCl for sodium chloride	1	AO2 5.1.2.6

5.1.1.5 Size and mass of atoms

Answer 04 · Mark scheme

June 2025 | 8464/C/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	(going down the group the) the outer shell / electrons become further from the nucleus	allow energy level for shell allow the atoms become larger allow the atoms have more shells	1	AO1 5.1.2.6
	(so) there is less (electrostatic) attraction between the nucleus and the outer electron(s)	allow (so) there is more shielding between the outer electron(s) and the nucleus	1	
	(so) gaining an electron is more difficult		1	

Total Question 3	12

5.1.1.5 Size and mass of atoms

Answer 02 · Examiner comments November 2021 | 8464/C/1H | Original Q1

Question 1 (standard demand)

01.1 More than two thirds of students knew that Group 0, the noble gases, had not been discovered when Mendeleev's version of the periodic table was published.

01.2 The plum pudding model was identified by more than four fifths of students.

01.3 Chadwick discovered the neutron. Just under half of students were able to make the link between this discovery and the figure which represented an atom containing neutrons.

01.4 The question required students to answer in terms of 'subatomic particles'; the answer was that isotopes are atoms with the same number of protons but different numbers of neutrons. Just over one third of students gained two marks.

01.5 Many students gained the first mark by showing that the weighted average had to be divided by 100. The evaluation of this gained the second mark which then needed to be correctly rounded to one decimal place. Approximately one third of students gained all three marks.

Answer 03 · Examiner comments June 2023 | 8464/C/1H | Original Q4

Question 4 (standard and standard/high demand)

04.1 Nearly half of the students correctly selected the order of discovery of the electron, proton and neutron. A third of students thought that the proton was discovered before the electron and chose the fourth option.

04.2 Just over a third of students calculated the number of times a proton is heavier than an electron. Most students were able to correctly round their answers to 3 significant figures although those who gained 1 mark invariably evaluated the ratio correctly but then incorrectly rounded the answer (1836.645076) usually by 'truncating' this to 1836. The most common error here was to invert the mathematical expression.

04.3 More than three-quarters of students deduced the number of neutrons in the bromine $^{81}_{35}Br$ atom.

04.4 Only 20% of students deduced the number of electrons in the bromide $^{81}_{35}Br^-$ ion. The majority gain the number of electrons in a bromine atom.

04.5 This question was a good discriminator. Just under a third of students gained all 3 marks with a few students gaining 2 of the 3 marks for not giving their answer to 2 decimal places.

04.6 More than three-quarters of students correctly drew a dot and cross diagram for chlorine. When only one mark was gained this was usually for the two shared electrons in the overlap between the atoms. Some failed to show that there are six unshared electrons on each chlorine atom.

5.1.1.5 Size and mass of atoms

Answer 04 · Examiner comments

June 2025 | 8464/C/1H | Original Q3

Question 3 (Standard and Standard/High demand)

03.1 Just under half of students gave the two correct conclusions of the alpha particle scattering experiment as atoms have a charged nucleus and the mass of an atom is concentrated in the nucleus. The most popular incorrect distractor was electrons orbit the nucleus at specific distances.

03.2 Overall this question was well attempted with very few failing to offer an answer. The two most common incorrect responses were 'number of protons not equal to the number of electrons so X is an isotope' and 'protons should be the same as neutrons'.

03.3 Just than half of students used the number of subatomic particles to correctly deduce that particle X was $^{79}_{35}Br^-$. The most popular incorrect distractor was $^{79}_{35}Se^-$

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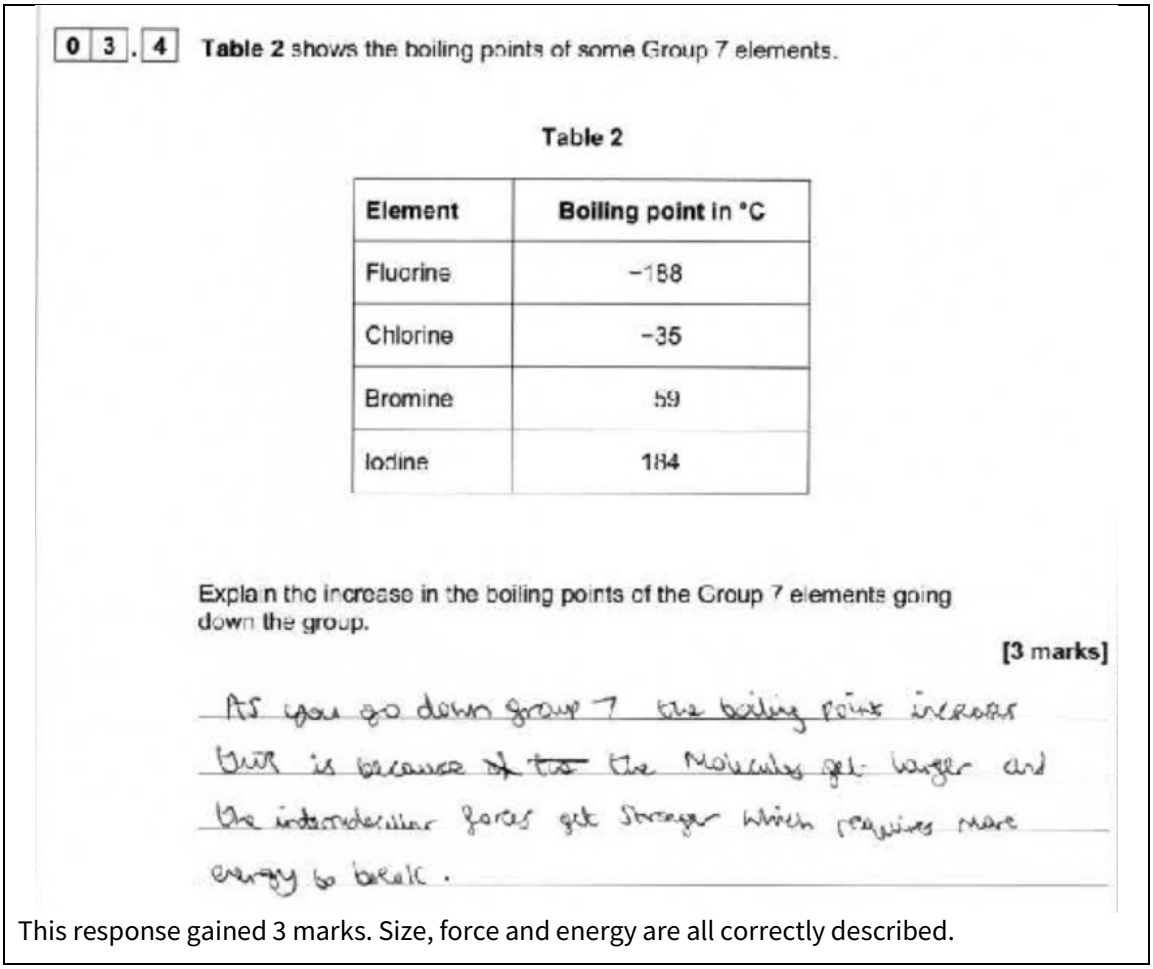
5.1.1.5 Size and mass of atoms

Answer 04 · Examiner comments June 2025 | 8464/C/1H | Original Q3

03.4 Students found this question difficult with very few achieving 3 marks, and many failing to score. The most commonly awarded mark was MP1 which was related to the size of the atom. A large number of students answered in terms of reactivity rather than the physical property of boiling point, so references relating to the distance from the nucleus to the outer shell or outer electrons were common which were incorrect in this context. Linking boiling point to the ease of gaining electrons was another common response, together with incorrect references to electrostatic forces of attraction between the nucleus and electrons, again confusing reactivity and boiling points. There was also a significant number of students who used 'forces' and 'bonds' inconsistently and therefore could not be awarded marks as it was not clear what they meant.



0 3 . 4 **Table 2** shows the boiling points of some Group 7 elements.

Table 2

Element	Boiling point in °C
Fluorine	−188
Chlorine	−35
Bromine	59
Iodine	184

Explain the increase in the boiling points of the Group 7 elements going down the group.

[3 marks]

As you go down group 7 the boiling point increases this is because ~~of the~~ the Molecules get larger and the intermolecular forces get stronger which requires more energy to break.

This response gained 3 marks. Size, force and energy are all correctly described.

03.5 More than three quarters of students deduced that the bonding in the compound ClF_3 was covalent as two non-metals had combined. Ionic and metallic were common incorrect responses.

03.6 The majority of students added sodium chloride and bromine to complete the word equation. The most common error was the mixing up of bromine with bromide and chlorine with chloride.

03.7 Students found this question difficult with very few achieving 3 marks, and many failing to score. Common errors for MP1 were students stating that the 'elements' have more shells or 'more outer shells'. A common error for MP2 was not mentioning the 'outer shell electrons' or referenced attraction between the nucleus and the 'outer shell' which was insufficient for the mark. The most commonly awarded mark was MP3 which related to the difficulty of gaining of an electron. References to attracting electrons were common but this was not creditworthy as it does not necessarily suggest electrons being gained. There were many students who were very close to 3 marks but scored 0 due to these incorrect or incomplete statements.

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5.1.1.5 Size and mass of atoms

Answer 04 · Examiner comments

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0 3 . 7 Explain why Group 7 elements become less reactive going down the group.

[3 marks]

Group 7 elements become less reactive because as you go down a group, the number of shells increases so ~~they~~ the strength of the attraction between the positive nucleus and negative electrons is weaker as the distance is greater, this means the nucleus is less likely to be able to attract another electron for its outer ~~ten~~ layer.

This response gained 0 marks. MP1 was not awarded as 'atoms' (have more shells) is missing. MP2 was not awarded as 'outer' (electrons) is omitted. MP3 is not gained as attracting electrons does not necessarily suggest an electron is gained. This is an example of answers that were very close to each of the 3 marks but scored 0 due to incomplete statements for each one.

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