AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.1.1.3

The development of the model of the atom (common content with physics)

Mark schemes and examiner comments

Tier	**Foundation**
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.

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 01 · Mark scheme November 2020 | 8464/C/1F | Original Q3

03.1	positively charged		1	AO2 5.1.1.3
03.2	the atom is mainly empty space.		1	AO2 5.1.1.3 5.1.1.7
03.3	the mass is concentrated at the centre of the atom.		1	AO1 5.1.1.3
03.4	halogens		1	AO1 5.1.2.6
03.5	fluorine		1	AO1 5.1.2.6
03.6	2.13 (g)		1	AO2 5.3.1.1
03.7	197 + (3 × 35.5) **or** 197 + 106.5 = 303.5		1 1	AO2 5.3.1.2
Total			**8**	

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 01 · Mark scheme

November 2020 | 8464/C/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 02 · Mark scheme

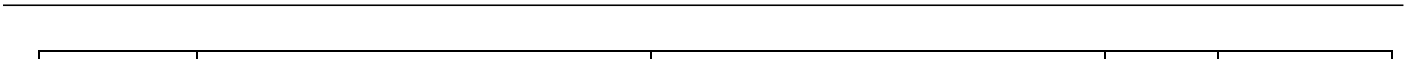
November 2021 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(Group) 0 **or** noble gases		1	AO2 5.1.2.2
06.2	B		1	AO2 5.1.1.3
06.3	A		1	AO3 5.1.1.3
06.4	(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	
06.5	$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$ = 39.138 = 39.1	 allow correctly rounded answer to **1** decimal place from an incorrect calculation using all the values given in the question	1 1 1	AO2 5.1.1.6
Total			**8**	

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 02 · Mark scheme

November 2021 | 8464/C/1F | Original Q6



5.1.1.3 The development of the model of the atom (common content with physics)

Answer 03 · Mark scheme

June 2023 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(number of protons) 4 (number of neutrons) 5		1 1	AO2 5.1.1.4 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	+2		1	AO2 5.1.1.7 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	gas		1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	freezing		1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	heat	allow evaporate / boil	1	AO1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6			1	AO1 5.1.1.3

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	chadwick		1	AO1 5.1.1.3

Total Question 1	**8**

5.1.1.3 The development of the model of the atom (common content with physics)

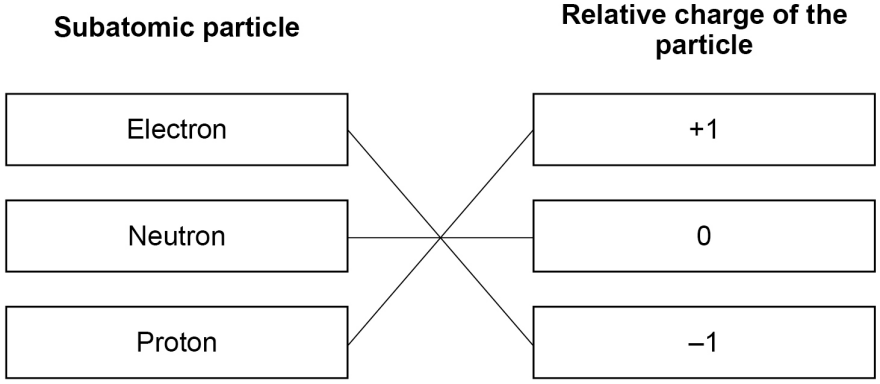
Answer 04 · Mark scheme

June 2025 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	electron		1	AO1 5.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	nucleus		1	AO1 5.1.1.3

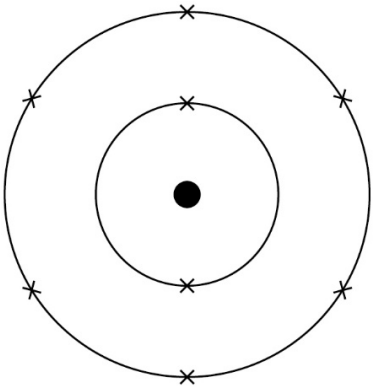
Question	Answers	Mark	AO / Spec. Ref.
01.3	 allow **1** mark for 1 or 2 correct do **not** accept more than one line from a box on the left	2	AO1 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the number of protons only		1	AO1 5.1.1.4

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$(A_r =) \frac{(10 \times 19.7) + (11 \times 80.3)}{100}$	allow $(A_r =) \frac{197 + 883.3}{100}$ allow $(A_r =) \frac{1080.3}{100}$	1	AO2 5.1.1.6
	= 10.803		1	
	= 10.8		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6		allow any combination of x, O, $e^{(-)}$, ● for electrons	1	AO2 5.1.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	model **B** shows the 3D arrangement of the ions		1	AO3 5.2.1.3
	model **B** shows the relative sizes of the ions		1	

Total Question 1	11

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 02 · Examiner comments November 2021 | 8464/C/1F | Original Q6

Question 6 (standard demand)

06.1 Just under half of students knew that Group 0, the noble gases, had not been discovered when Mendeleev's version of the periodic table was published.

06.2 The plum pudding model was identified by nearly three fifths of students.

06.3 Chadwick discovered the neutron. Students found difficulty in making the link between this discovery and the figure which represented an atom containing neutrons. Approximately one third of students gained the mark.

06.4 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. Less than one fifth of students gained a mark.

06.5 Just over one fifth of 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.

Answer 03 · Examiner comments June 2023 | 8464/C/1F | Original Q1

Question 1 (low demand)

01.1 Three-quarters of the students correctly deduced the number of protons and the number of neutrons in the beryllium atom. Some students gave the numbers the opposite way around.

01.2 The relative charge on a beryllium ion was given by just over 50% of the students. A charge of 1+ proved to be a good distractor.

01.3 More than 95% of the students were able to identify the arrangement of atoms as a representation of the gas state.

01.4 More than 80% of the students were able to identify the states from the diagram and to link them to freezing, as the process when a liquid changes into a solid.

01.5 About two-thirds of the students were able to identify the states and knew that heating was required to change the states. Condensing was a very common incorrect response which is the reverse process of the direction being asked about.

01.6 Just over three-quarters of students knew the correct order for the development of the model of the atom was tiny sphere, plum pudding and then nuclear model. The most common incorrect distractor also started with the tiny sphere model.

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 03 · Examiner comments June 2023 | 8464/C/1F | Original Q1

01.7 Just under half of the students knew that the existence of neutrons was discovered by Chadwick. Mendeleev was the most common incorrect answer.

5.1.1.3 The development of the model of the atom (common content with physics)

Answer 04 · Examiner comments

June 2025 | 8464/C/1F | Original Q1

Question 1 (Low and Standard demand)

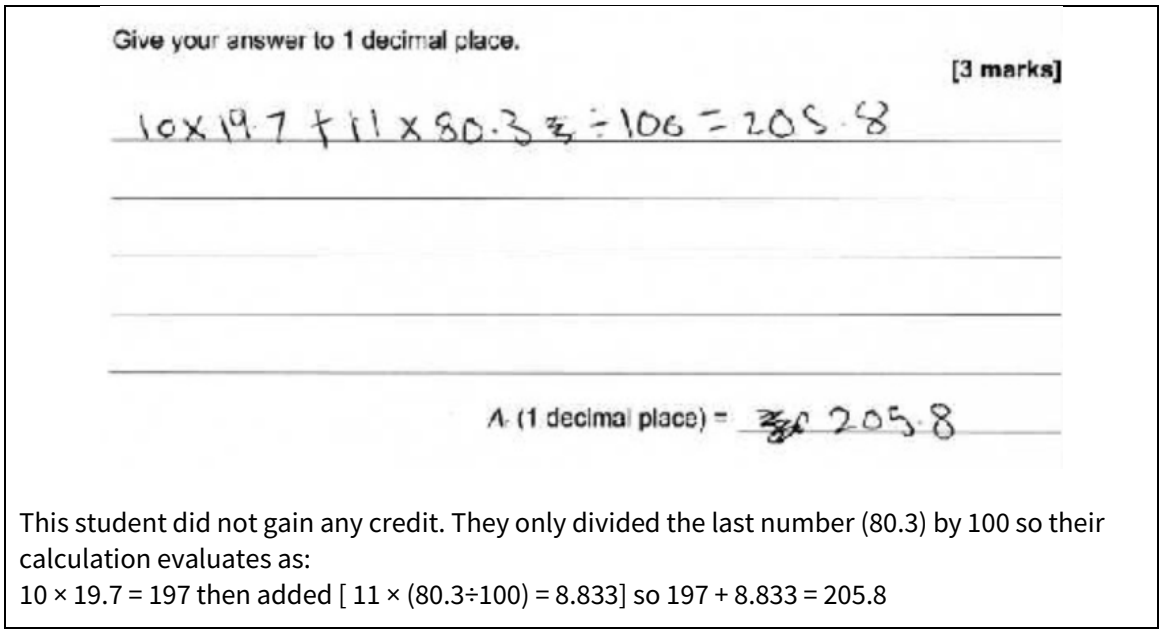
01.1 Just under half of students could name the electron as the first subatomic particle to be discovered. Proton was the most common incorrect response.

01.2 The majority of students knew that the name of the centre of an atom is the nucleus. Phonetic spellings were credited. Common incorrect answers were proton and neutron.

01.3 The majority of students correctly linked the relative charges with each subatomic particle. Many gained 1 mark for showing that the neutron has no charge.

01.4 Less than half of students knew that the atomic number is the number of protons in an atom. The number of number of neutrons + the number of protons in an atom was a more popular incorrect distractor.

01.5 The calculation of the relative atomic mass using the mass numbers and percentage abundance was correctly carried out by nearly two-third of students. The first mark was for the mathematical expression although some students did not divide 1080.3 by 100 and others used their calculator incorrectly. A small number of students who evaluated the expressions as 10.803 did not round their answer to 1 decimal place.


Give your answer to 1 decimal place. [3 marks]

$10 \times 19.7 + 11 \times 80.3 \div 100 = 205.8$

A (1 decimal place) = 205.8

This student did not gain any credit. They only divided the last number (80.3) by 100 so their calculation evaluates as:
10 × 19.7 = 197 then added [11 × (80.3÷100) = 8.833] so 197 + 8.833 = 205.8

01.6 Many students correctly arranged the 8 electrons on the two levels on the figure as 2,8. A number arranged the 8 electrons as 4,4 or 0,8 and others used a different numbers of electrons.

01.7 Less than 20% of students gained 2 marks for Model B shows the 3D arrangement of the ions and the relative sizes of the ions. The most popular incorrect distractors were the charges on the ions and the electronic structures of the ions.

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