



CrackingCHEM

GCSE | A-LEVEL

UNDERSTAND • APPLY • SUCCEED

AQA 7405

Atomic Structure I

Original exam questions | TEST IT → EXAM STYLE → HARDER MIXED

SPECIFICATION-LED. PROGRESSIVE. EXAM-FOCUSED.

AQA SPECIFICATION

3.1.1.1 | 3.1.1.2 | 3.1.2.1

TEST IT

9

EXAM STYLE

9

HARDER MIXED

3

STRETCH

1

22 ORIGINAL QUESTIONS

108 TOTAL MARKS

Independent practice material. Every question is original and has been designed from recurring AQA assessment patterns.

START HERE

How to use this pack

A deliberate progression from recall to independent problem solving

- 1 Complete TEST IT without the notes. Correct gaps before moving on.
- 2 For every calculation, scan the question and identify exactly what the examiner wants.
- 3 Choose an equation containing that target, rearrange it, insert known values, then chase any remaining unknown through another equation.
- 4 Complete HARDER MIXED last. These questions do not tell you which chemistry to use.

✓ TOF unit check

For $KE = \frac{1}{2}mv^2$ and $v = d/t$, mass must be in kg, distance in m and time in s. Convert the final answer only after the calculation is complete.

Write or type

The pale blue response lines are designed for both printing and electronic completion. In Word, click a line and type directly onto it.

Prefix reminder

Convert every value to the unit required by the equation before substituting.

Prefix	Symbol	Multiplier
mega	M	10^6
kilo	k	10^3
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

Originality and exam fit

The questions are original. Their structure, demand, command words and mark allocations are based on recurring AQA assessment patterns rather than on any single past-paper question.

SECTION A

TEST IT

Nine short questions tied directly to individual specification points

QUESTION 1 | TEST IT

Complete the table for the three fundamental particles.

Particle	Relative charge	Relative mass
proton		
neutron		
electron		

[6 marks]

QUESTION 2 | TEST IT

State where protons, neutrons and electrons are found in an atom. State where almost all of the mass of an atom is concentrated.

[4 marks]

QUESTION 3 | TEST IT

For the ion ${}^{34}_{16}\text{Q}^{2-}$, state the number of protons, neutrons and electrons.

[3 marks]

QUESTION 4 | TEST IT

(a) Define the term isotope.

[2 marks]

(b) Explain why isotopes of the same element have the same chemical properties.

[1 mark]

QUESTION 5 | TEST IT

The stages below are not in the correct order.

acceleration • data analysis • detection • drift • ionisation

(a) Put the stages in the correct order.

[2 marks]

(b) State how the ions are accelerated and the energy condition produced.

[2 marks]

(c) Explain why the drift region is evacuated.

[1 mark]

QUESTION 6 | TEST IT

Two singly charged ions are given the same kinetic energy. One ion is heavier. Explain why the heavier ion reaches the detector later.

[3 marks]

QUESTION 7 | TEST IT

Describe what happens when a positive ion reaches the detector and explain how the detector signal is related to abundance.

[2 marks]

QUESTION 8 | TEST IT

The table gives data from the mass spectrum of an element.

m/z	Relative abundance / %
19.9924	90.48
20.9938	0.27
21.9914	9.25

- (a) State the quantity shown on each axis of an elemental mass spectrum.

[2 marks]

- (b) Calculate the relative atomic mass of the element. Give your answer to four significant figures.

[3 marks]

- (c) Use your answer to identify the element.

[1 mark]

QUESTION 9 | TEST IT

- (a) Define relative atomic mass.

[2 marks]

- (b) Define relative molecular mass.

[2 marks]

- (c) State the term used instead of relative molecular mass for an ionic substance.

[1 mark]

SECTION B

EXAM STYLE

Nine original questions using recurring AQA structures and mark allocations

✓ Calculation routine

Target → equation → rearrange → substitute known values → find the next unknown → final unit and rounding.

QUESTION 10 | EXAM STYLE

In an experiment, positively charged particles are directed at a very thin metal foil. Most pass straight through. A very small proportion are deflected through large angles.

Use these observations to explain two conclusions about the structure of the atom and why the results do not support a model in which positive charge is spread uniformly through the atom.

[4 marks]

QUESTION 11 | EXAM STYLE

An element has two isotopes. Their accurate relative isotopic masses are 78.918 and 80.916. The abundance ratio of the lighter isotope to the heavier isotope is 4.35 : 1.00.

Calculate the relative atomic mass of the element. Give your answer to three decimal places.

[4 marks]

QUESTION 12 | EXAM STYLE

(a) Write an equation, including state symbols, for the formation of a singly charged positive ion from a gaseous atom Y by electron impact ionisation.

[1 mark]

(b) Explain how the ion produces a signal at the detector and how this signal is used to determine relative abundance.

[3 marks]

QUESTION 13 | EXAM STYLE

A large organic molecule M is analysed using electrospray ionisation.

(a) Describe how electrospray ionisation produces $[MH]^+$ ions from the sample.

[4 marks]

(b) Write an equation for the formation of $[MH]^+$.

[1 mark]

(c) The peak due to a singly charged $[MH]^+$ ion is at $m/z = 587.4$. Determine the relative molecular mass of M.

[1 mark]

QUESTION 14 | EXAM STYLE

A singly charged ion has a relative isotopic mass of 72.0. It is given a kinetic energy of 8.25×10^{-16} J and travels through a 1.40 m flight tube.

$$N_a = 6.022 \times 10^{23} \text{ mol}^{-1}$$

Calculate the time of flight in μs . Give your answer to three significant figures.

$$\text{KE} = \frac{1}{2}mv^2 \quad v = d/t$$

[5 marks]

QUESTION 15 | EXAM STYLE

An ion travels 1.12 m in 11.4 μs . Its kinetic energy is 6.75×10^{-16} J.

$$N_a = 6.022 \times 10^{23} \text{ mol}^{-1}$$

Calculate the mass number of the ion.

$$\text{KE} = \frac{1}{2}mv^2 \quad v = d/t$$

[5 marks]

QUESTION 16 | EXAM STYLE

A singly charged ion has a relative isotopic mass of 96.0 and a kinetic energy of 7.40×10^{-16} J. Its time of flight is 18.5 μ s.

$$N_a = 6.022 \times 10^{23} \text{ mol}^{-1}$$

Calculate the length of the flight tube. Give your answer to three significant figures.

$$KE = \frac{1}{2}mv^2 \quad v = d/t$$

[5 marks]

QUESTION 17 | EXAM STYLE

An element has two isotopes. The first isotope has an accurate relative isotopic mass of 57.935 and an abundance of 68.0%. The second isotope has an abundance of 32.0%. The relative atomic mass of the element is 58.573.

(a) Calculate the accurate relative isotopic mass of the second isotope. Give your answer to three decimal places.

[3 marks]

(b) State the mass number of the second isotope.

[1 mark]

QUESTION 18 | EXAM STYLE

An electron impact mass spectrum of a compound contains peaks at $m/z = 41$, 55 and 70. The peak at $m/z = 41$ is the base peak. The peak at $m/z = 70$ is the molecular ion peak.

(a) State the relative molecular mass of the compound.

[1 mark]

(b) Explain what is meant by the base peak and why it does not necessarily give the relative molecular mass.

[2 marks]

SECTION C

HARDER MIXED

Three mixed questions plus one clearly labelled stretch/synoptic challenge

Independent thinking

Several values are deliberately unfamiliar. The equations are not repeated beside every question.

QUESTION 19 | HARDER MIXED

Ions A^+ and B^+ are analysed in the same TOF mass spectrometer. They are given the same kinetic energy and travel the same distance.

relative isotopic mass of A = 64.0 $t_a = 13.6 \mu\text{s}$ $t_b = 15.3 \mu\text{s}$

(a) Explain why starting with $KE = \frac{1}{2}mv^2$ for ion B alone does not allow the mass of B to be calculated directly.

[1 mark]

(b) By making the kinetic energies equal, calculate the relative isotopic mass of B. Your working must show why the distance cancels.

[5 marks]

(c) State why the masses and speeds cannot be cancelled from the two-ion equation.

[1 mark]

QUESTION 20 | STRETCH / SYNOPTIC

Stretch note: this unfamiliar-data calculation goes beyond the usual named Atomic Structure I calculation requirement.

Element X has two isotopes, ^{24}X and ^{26}X , with abundances of 79.0% and 21.0% respectively. A sample of X_2 is analysed by electron impact mass spectrometry. Assume that molecular ions form without fragmentation.

(a) State the three possible m/z values for X_2^+ molecular ions.

[2 marks]

- (b) Calculate the expected percentage ratio of the three molecular-ion peaks.

[3 marks]

- (c) Explain why the middle peak can be formed in two different ways.

[1 mark]

QUESTION 21 | HARDER MIXED

A singly charged ion from an unknown element is given a kinetic energy of 7.50×10^{-16} J. It travels 1.25 m in 10.92 μ s.

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

- (a) Calculate the mass number of this isotope.

[5 marks]

The element has exactly two isotopes. The other isotope has a mass number two greater. Detector currents of 3.20 nA and 1.10 nA are produced by the lighter and heavier isotopes respectively.

- (b) Calculate the percentage abundance of each isotope.

[2 marks]

- (c) Calculate the relative atomic mass of the element. Give your answer to three decimal places.

[2 marks]

(d) Explain why the heavier isotope gives the smaller detector current.

[1 mark]

QUESTION 22 | HARDER MIXED

A reference ion with a relative isotopic mass of 125.0 has a time of flight of 18.6 μs . In the same instrument, a singly charged $[\text{MH}]^+$ ion has a time of flight of 23.3 μs . The ions travel the same distance and are given the same kinetic energy.

(a) Calculate the mass of the $[\text{MH}]^+$ ion relative to ^{12}C .

[4 marks]

(b) Determine the relative molecular mass of M.

[1 mark]

(c) Explain why electrospray ionisation is often chosen for a large molecule.

[1 mark]

(d) A second spectrum of M, obtained by electron impact, has a base peak at $m/z = 43$ and a molecular ion peak at $m/z = 195$. Explain which peak should be used to confirm the relative molecular mass.

[2 marks]

✓ DONE

Mark the pack using the separate answer booklet. Record the specification point behind every lost mark, then redo only those questions without the worked solution.



CrackingCHEM

GCSE | A-LEVEL

UNDERSTAND • APPLY • SUCCEED

AQA 7405

Atomic Structure I

Fully worked answers | AQA-style marking guidance

FULLY WORKED. PRECISELY MARKED. BUILT FOR IMPROVEMENT.

AQA SPECIFICATION

3.1.1.1 | 3.1.1.2 | 3.1.2.1

TEST IT

9

EXAM STYLE

9

HARDER MIXED

3

STRETCH

1

22 QUESTIONS MARKED

108 MARKS EXPLAINED

Independent practice material. Every question is original and has been designed from recurring AQA assessment patterns.

AQA MAP

How AQA assesses this topic

Patterns identified across seven exam years of AQA papers and mark schemes

Specification area	Recurring AQA demand	Frequent trap	Questions
Atomic models and particles	Interpret evidence; compare a historical model with the modern atom; state exact particle data and location.	Descriptions not linked to the observation; treating electron mass as zero.	1, 2, 10
A/Z, ions and isotopes	Direct or inverse particle counts; exact isotope definition; same chemistry explained by electron configuration.	Using proton number as the explanation for chemical behaviour; forgetting charge changes electrons.	3, 4, 17
TOF operation	Order the stages; explain constant kinetic energy, drift, detection and abundance; write ionisation equations.	Saying the detector measures mass; omitting state symbols; confusing current with flight time.	5–7, 12, 13
TOF calculations	Usually a five-mark chain: unit conversion, a linked equation, rearrangement, conversion using N_A and a correctly rounded result.	μs not converted; molar mass not converted to one ion; stopping before the requested unit; cancelling non-identical quantities.	14–16, 19, 21, 22
Spectra, A_r and M_r	Straight weighted means, ratios, missing values, integer mass numbers, molecular ions and $[\text{MH}]^+$ interpretation.	Using the tallest peak as M_r ; failing to subtract 1 for $[\text{MH}]^+$; giving a unit for A_r or M_r .	8, 11, 13, 17, 18, 20–22
Definitions	Short exact responses referenced to one-twelfth of carbon-12; correct use of relative formula mass for ionic substances.	Missing the comparison standard or the weighted-mean idea.	9

Research basis

Design analysis used relevant AQA 7404/7405 question papers and mark schemes from 2016, 2017, 2018, 2019, 2022, 2023 and 2024, checked against the current AQA Chemistry 7405 specification. No past-paper question has been reproduced.

SECTION A

TEST IT answers

Specification-point checks with concise marking guidance

TEST IT 1

[6 marks]

- Proton: relative charge +1; relative mass 1. [2]
- Neutron: relative charge 0; relative mass 1. [2]
- Electron: relative charge -1; relative mass approximately 1/1840. [2]

Common trap: Do not give the electron a relative mass of zero. It is very small, not zero.

TEST IT 2

[4 marks]

- Protons are in the nucleus. [1]
- Neutrons are in the nucleus. [1]
- Electrons occupy regions around the nucleus. [1]
- Almost all of the mass is concentrated in the nucleus. [1]

TEST IT 3

[3 marks]

- Protons = 16. [1]
- Neutrons = $34 - 16 = 18$. [1]
- Electrons = $16 + 2 = 18$. [1]

Common trap: A 2- charge means that two electrons have been gained.

TEST IT 4

[3 marks]

- (a) Atoms with the same number of protons but different numbers of neutrons. [2]
- (b) They have the same electron configuration. [1]

AQA habit: For chemical properties, the scoring idea is electron configuration. Repeating that the isotopes have the same proton number does not explain their chemistry.

TEST IT 5

[5 marks]

- (a) Ionisation → acceleration → drift → detection → data analysis. [2]
- (b) The ions are accelerated by an electric field. [1]
- They are given the same kinetic energy. [1]
- (c) Evacuating the drift region prevents ions colliding with gas particles. [1]

TEST IT 6

[3 marks]

- The ions have the same kinetic energy. [1]
- From $KE = \frac{1}{2}mv^2$, the heavier ion must have a lower speed. [1]
- It therefore takes longer to travel the same distance. [1]

TEST IT 7

[2 marks]

- The positive ion gains an electron at the detector, producing a current. [1]
- The size of the current is proportional to the abundance of that ion. [1]

TEST IT 8

[6 marks]

- (a) Horizontal axis: m/z . Vertical axis: relative abundance or relative intensity. [2]

(b) $A_r = [(19.9924 \times 90.48) + (20.9938 \times 0.27) + (21.9914 \times 9.25)] / 100$

$A_r = 20.18001128$

$A_r = 20.18$ to four significant figures

- Correct weighted sum. [1]
- Divide by 100. [1]
- 20.18 to four significant figures. [1]
- (c) The element is neon. [1]

Common trap: Relative atomic mass has no unit.

TEST IT 9

[5 marks]

- (a) The weighted mean mass of an atom of an element compared with one-twelfth of the mass of a carbon-12 atom. [2]
- (b) The average mass of a molecule compared with one-twelfth of the mass of a carbon-12 atom. [2]
- (c) Relative formula mass. [1]

Common trap: Include both the carbon-12 reference and the idea of a weighted mean or average, as appropriate.

SECTION B

EXAM STYLE answers

Method marks are separated so students can diagnose the exact lost step

EXAM STYLE 10

[4 marks]

- Most particles pass through, so most of the atom is empty space. [1]
- Large deflections require the positive charge to be concentrated in a very small central nucleus. [1]
- Most of the mass is also concentrated in that nucleus. [1]
- A diffuse positive charge would cause only small deflections, so it cannot account for the rare large deflections. [1]

AQA habit: Link each observation to a conclusion. Listing facts about the modern atom without using the evidence does not fully answer the question.

EXAM STYLE 11

[4 marks]

Let the abundances be 4.35 parts and 1.00 part.

$$A_r = [(78.918 \times 4.35) + (80.916 \times 1.00)] / (4.35 + 1.00)$$

$$A_r = 79.2914579...$$

$$A_r = 79.291 \text{ to three decimal places}$$

- Uses the ratio as weighting factors. [1]
- Correct weighted mean expression. [1]
- Correct unrounded value. [1]
- 79.291 to three decimal places. [1]

EXAM STYLE 12

[4 marks]

- (a) $Y(g) \rightarrow Y^+(g) + e^-$ [1]
- (b) The ion gains an electron at the detector. [1]
- The electron movement produces a current. [1]
- A larger current means a greater relative abundance. [1]

Common trap: The detector does not measure mass directly. The flight time is converted into m/z during data analysis.

EXAM STYLE 13

[6 marks]

- (a) Dissolve M in a volatile solvent. [1]
- Inject the solution through a fine needle at high pressure. [1]
- Apply a high voltage to produce a fine spray of charged droplets. [1]
- M gains a proton to form $[MH]^+$ ions. [1]
- (b) $M + H^+ \rightarrow [MH]^+$ [1]
- (c) $M_r = 587.4 - 1.0 = 586.4$. [1]

Common trap: A singly charged $[MH]^+$ peak includes the added proton, so subtract 1.0 to obtain the relative molecular mass of M.

EXAM STYLE 14

[5 marks]

Target: time. Start with $t = d/v$. The unknown speed must be found first.

$$\text{Mass of one ion} = (72.0 \times 10^{-3}) / (6.022 \times 10^{23}) = 1.1956 \times 10^{-25} \text{ kg}$$

$$v^2 = 2KE/m$$

$$v = [(2 \times 8.25 \times 10^{-16}) / (1.1956 \times 10^{-25})]^{0.5} = 1.1748 \times 10^5 \text{ m s}^{-1}$$

$$t = d/v = 1.40 / (1.1748 \times 10^5) = 1.1917 \times 10^{-5} \text{ s}$$

$t = 11.9 \mu\text{s}$ to three significant figures

- Converts molar mass to the mass of one ion in kg. [1]
- Correct rearrangement of KE equation. [1]
- Correct speed. [1]
- Uses $t = d/v$. [1]
- $11.9 \mu\text{s}$ to three significant figures. [1]

Method: Scan for the target, choose an equation containing it, then chase any remaining unknown through the other equation.

EXAM STYLE 15

[5 marks]

Target: mass number. $KE = \frac{1}{2}mv^2$ contains mass, but speed is also unknown.

$$v = d/t = 1.12 / (11.4 \times 10^{-6}) = 9.8246 \times 10^4 \text{ m s}^{-1}$$

$$m = 2KE/v^2$$

$$m = (2 \times 6.75 \times 10^{-16}) / (9.8246 \times 10^4)^2 = 1.3986 \times 10^{-25} \text{ kg}$$

$$\text{Mass of one mole} = 1.3986 \times 10^{-25} \times 6.022 \times 10^{23} \times 1000 = 84.23 \text{ g mol}^{-1}$$

Mass number = 84

- Converts μs to s and calculates speed. [1]
- Rearranges to $m = 2KE/v^2$. [1]
- Correct mass of one ion in kg. [1]
- Converts to mass of one mole in g mol^{-1} . [1]
- Gives the integer mass number 84. [1]

Common trap: The mass number is a whole number. Do not report 84.23 as the final mass number.

EXAM STYLE 16

[5 marks]

Target: distance. Use $d = vt$. Speed must be found first.

$$\text{Mass of one ion} = (96.0 \times 10^{-3}) / (6.022 \times 10^{23}) = 1.5942 \times 10^{-25} \text{ kg}$$

$$v^2 = 2KE/m$$

$$v = [(2 \times 7.40 \times 10^{-16}) / (1.5942 \times 10^{-25})]^{0.5} = 9.6353 \times 10^4 \text{ m s}^{-1}$$

$$d = vt = (9.6353 \times 10^4)(18.5 \times 10^{-6})$$

$d = 1.78 \text{ m}$ to three significant figures

- Mass of one ion in kg. [1]
- Correct KE rearrangement. [1]
- Correct speed. [1]
- Converts μs to s and uses $d = vt$. [1]
- 1.78 m to three significant figures. [1]

EXAM STYLE 17

[4 marks]

(a) $58.573 = (57.935 \times 0.680) + (x \times 0.320)$
 $x = [58.573 - (57.935 \times 0.680)] / 0.320$
 $x = 59.92875 = 59.929$ to three decimal places
(b) Mass number = 60

- Correct weighted-mean equation. [1]
- Correct rearrangement. [1]
- 59.929 to three decimal places. [1]
- Integer mass number 60. [1]

Common trap: Accurate relative isotopic mass is not exactly the same as mass number. Round to the nearest whole number only when the question asks for mass number.

EXAM STYLE 18

[3 marks]

- (a) $M_r = 70$. [1]
- (b) The base peak is the most intense peak and is assigned a relative intensity of 100. [1]
- It can be due to a fragment ion, so the molecular ion peak at $m/z = 70$ is used for M_r . [1]

SECTION C

HARDER MIXED answers

Full routes, cancellation logic and common traps

HARDER MIXED 19

[7 marks]

- (a) For ion B, both its mass and its speed are unknown, so one KE equation contains more than one unknown. [1]
- (b) Same kinetic energy: $\frac{1}{2}m_a v_a^2 = \frac{1}{2}m_b v_b^2$
 Multiply both sides by 2: $m_a v_a^2 = m_b v_b^2$
 Substitute $v = d/t$ separately for each ion:
 $m_a(d/t_a)^2 = m_b(d/t_b)^2$
 The ions travel the same distance, so the identical factor d^2 cancels:
 $m_a/t_a^2 = m_b/t_b^2$
 $m_b = m_a(t_b/t_a)^2 = 64.0(15.3/13.6)^2 = 81.0$

- Sets the kinetic energies equal. [1]
- Multiplies both sides by 2 to remove both halves. [1]
- Substitutes $v = d/t$ for each ion. [1]
- Cancels d^2 because the distance is identical. [1]
- Relative isotopic mass of B = 81.0. [1]
- (c) The ions have different masses and different speeds, so those quantities are not identical factors and cannot be cancelled. [1]

Top tip: If the direct route leaves more than one unknown, look for a condition that links the two ions. Here it is equal kinetic energy. Only identical quantities can cancel: the distances are the same; the masses and speeds are different.

STRETCH / SYNOPTIC 20

[6 marks]

- (a) $^{24}\text{X}-^{24}\text{X}$ gives $m/z = 48$; $^{24}\text{X}-^{26}\text{X}$ gives $m/z = 50$; $^{26}\text{X}-^{26}\text{X}$ gives $m/z = 52$. [2]
- (b) $P(48) = 0.790^2 = 0.6241 = 62.41\%$
 $P(50) = 2(0.790)(0.210) = 0.3318 = 33.18\%$
 $P(52) = 0.210^2 = 0.0441 = 4.41\%$
 Expected percentage ratio = $62.4 : 33.2 : 4.41$

- Correct probability for 48. [1]
- Correct doubled probability for 50. [1]
- Correct probability for 52 and consistent ratio. [1]
- (c) The middle ion can be $^{24}\text{X}-^{26}\text{X}$ or $^{26}\text{X}-^{24}\text{X}$, so the mixed-isotope probability is doubled. [1]

Common trap: Do not use 0.790×0.210 only once for the middle peak.

HARDER MIXED 21

[10 marks]

- (a) $v = d/t = 1.25 / (10.92 \times 10^{-6}) = 1.1447 \times 10^5 \text{ m s}^{-1}$
 $m = 2KE/v^2$
 $m = (2 \times 7.50 \times 10^{-16}) / (1.1447 \times 10^5)^2 = 1.1447 \times 10^{-25} \text{ kg}$
 Mass of one mole = $1.1447 \times 10^{-25} \times 6.022 \times 10^{23} \times 1000 = 68.94 \text{ g mol}^{-1}$
 Mass number = 69
- (b) Total current = $3.20 + 1.10 = 4.30 \text{ nA}$
 Abundance of isotope 69 = $(3.20/4.30) \times 100 = 74.4\%$
 Abundance of isotope 71 = $(1.10/4.30) \times 100 = 25.6\%$
- (c) $A_r = [(69 \times 3.20) + (71 \times 1.10)] / 4.30 = 69.512$

- Speed with μs converted to s. [1]
- Correct KE rearrangement. [1]
- Mass of one ion in kg. [1]
- Converts to mass of one mole. [1]
- Integer mass number 69. [1]
- Each percentage abundance correct. [2]
- Correct weighted mean. [1]
- 69.512 to three decimal places. [1]
- (d) The current is smaller because the heavier isotope is less abundant, not simply because it is heavier. [1]

Common trap: Detector current measures abundance. Flight time distinguishes m/z .

HARDER MIXED 22

[8 marks]

- (a) Equal KE and equal distance give $m/t^2 = \text{constant}$.
 $m_2/m_1 = (t_2/t_1)^2$
 $m_2 = 125.0(23.3/18.6)^2 = 196.153\dots$
 Mass of $[\text{MH}]^+$ relative to carbon-12 = 196 to three significant figures
 (b) M_r of M = $196 - 1 = 195$

- Uses the equal-KE time relationship. [1]
- Correct squared time ratio. [1]
- Correct substitution. [1]
- Mass of $[\text{MH}]^+ = 196$ to three significant figures. [1]
- $M_r = 195$. [1]
- (c) Electrospray causes less fragmentation, so the large molecule is more likely to remain intact. [1]
- (d) Use the molecular ion peak at $m/z = 195$ because it represents the intact molecule. [1]
- The base peak at $m/z = 43$ is the most intense fragment peak and does not give the relative molecular mass. [1]

Final review

A correct final number is not enough preparation. Check that the route, units, equation choice and chemical explanation would each earn the intended mark.