

Question Number	Acceptable Answers	Reject	Mark
1 (a)	<p>Atoms (of an element) with the same number of protons (1)</p> <p>But with different number of neutrons (1)</p> <p>Same atomic number but different mass number only = (1)</p> <p>Element(s) with same number of protons but different number of neutrons = (1) max</p> <p>Ignore comments on electrons unless incorrect in which case award max 1</p>		2

Question Number	Acceptable Answers	Reject	Mark
1 (b)(i)	(Electric field) accelerates ions		1

Question Number	Acceptable Answers	Reject	Mark
1 (b) (ii)	<p>(Magnetic field) deflects / changes direction of / bends the beam of ions</p> <p>if the term 'ions' is missing or an incorrect term is used e.g. 'atoms', penalise only once in parts b (i) and b (ii)</p>	just bends ions	1

Question Number	Acceptable Answers	Reject	Mark
1 (c)	<p>% abundance = $(135 \times 9.01 + 136 \times 10.81 + 137 \times 12.32 + 138 \times 67.86) / 100$ (1)</p> <p>= 137.4 (1)</p> <p>ignore units</p> <p>Allow TE for one slip in transfer of data from question</p> <p>Correct answer scores (2)</p>	<p>Just 137 as final answer</p> <p>137.39</p> <p>137.3903</p> <p>137.390</p>	2

Question Number	Acceptable Answers	Reject	Mark
1 (d)	<p>three peaks (caused by Br_2^+ ions) (1)</p> <p>because ions $(^{79}\text{Br}-^{79}\text{Br})^{(+)}$ and $(^{81}\text{Br}-^{79}\text{Br})^{(+)}$ / $(^{79}\text{Br}-^{81}\text{Br})^{(+)}$ and $(^{81}\text{Br}-^{81}\text{Br})^{(+)}$ (1)</p> <p>Mark independently</p>		2

Question Number	Acceptable Answers	Reject	Mark
1 (e)	<p>Any one</p> <p>analysis of material from space / drug testing in sport / identify breakdown products from drugs in body / quality control in pharmaceutical industry / identify molecules from sample with potential biological activity / radioactive dating with context e.g determine age of fossils / human remains</p> <p>The uses above must have a context</p> <p>/ determining M_r of a molecule / evidence for structure from fragmentation pattern</p>		1

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	<p>The mark is for the idea of impact by high energy electrons</p> <p>Any ONE of: High-energy electrons Bombard with electrons Fast electrons (fired at sample) Accelerated electrons (fired at sample) (High-energy) electrons fired (at sample) (Sample) blasted with electrons Electron gun</p> <p>ALLOW "beam of electrons"</p> <p>IGNORE any comments (correct or incorrect) re subsequent ionization of the sample</p>	High- density electrons	1

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	Electric field /electrostatic field / charged plates /voltage plates	Positively-charged plates /electronic field /electric current /(electro) magnetic field / electric coil	1

Question Number	Acceptable Answers	Reject	Mark
2(a)(iii)	Magnetic field/magnet / electromagnet /magnetic plates/ electromagnetic field	"Negative magnetic field"/ negatively-charged magnet	1

Question Number	Acceptable Answers	Reject	Mark
2(b)	(Molecular mass of a substance is) that of the molecular ion/parent ion OR (m/e value for) peak/ion of largest mass OR (m/e value for) peak/ion furthest to the right ALLOW "last peak"/"peak at the end"	Highest peak/ tallest peak/ comments about determination of relative atomic mass	1

Question Number	Acceptable Answers	Reject	Mark
2(c)	Mark independently: First mark: Any mention of (determination of) amount /mass/abundance of ^{14}C (in cloth) ALLOW Any mention of (determination of) concentration/content/percentage of ^{14}C (in cloth) OR find proportion of $^{12}\text{C} : ^{14}\text{C}$ (in cloth) (1) Second mark: Any mention of any one of the following:- (Use) half-life of ^{14}C / mention that amount of ^{14}C (in cloth) decreases (over time) / ^{14}C decays over time / comparison of amount of ^{14}C in living systems / comparison of amount of ^{14}C in modern materials / compare with $^{12}\text{C} : ^{14}\text{C}$ in living systems (1)	amount of ^{14}C (in cloth) increases (over time)	2

Question Number	Acceptable Answers	Reject	Mark
3 (a)	<p><u>Average/mean mass of an atom/isotopes (1)</u> (1/12 mass of an atom of) carbon-12 (1)</p> <p>First mark: mention of mean or average mass of either an atom/isotopes <i>IGNORE</i> "weighted" before average or mean <i>IGNORE</i> any mention of "moles" in definition</p> <p>Second mark: any mention of carbon-12</p> <p><i>IGNORE</i> any reference to "moles" or "1 mole" at any stage</p> <p><i>IGNORE</i> 12 g with reference to carbon-12</p> <p>Mark the two points independently</p>	<p>"weight" instead of mass</p> <p>mean or average mass of an element... without prior mention of either an atom or isotopes</p>	2

Question Number	Acceptable Answers	Reject	Mark
3 (b) (i)	<p>(Rubidium/it has) two isotopes</p> <p><i>ALLOW</i> (Rubidium/it has) "different isotopes"</p> <p><i>ALLOW</i> abbreviations such as formulae of rubidium atoms or cations with isotopic masses</p>		1

Question Number	Acceptable Answers	Reject	Mark
3 (b) (ii)	<p>$\frac{85 \times 72 + 87 \times 28}{100}$ $= 85.56 \text{ or } 85.6 \text{ (1)}$ Correct answer with no working (2)</p> <p>NOTE: Rounding error giving answer 85.5 scores (1)</p> <p><i>IGNORE</i> any units (for example, g/g mol⁻¹/%)</p> <p>NOTE: If 71% abundance used for ⁸⁵Rb and 29% for ⁸⁷Rb, answer = 85.58 or 85.6 scores (1)</p> <p>Second mark awarded if answer CQ correct on wrong abundances and /or wrong isotopic masses.</p>	<p>Calculation of simple arithmetic mean of 85 + 87 = 86 scores zero</p>	2

Question Number	Acceptable Answers	Reject	Mark
4 (a)	<p>Q: O-H</p> <p>ALLOW OH - O - H (1)</p> <p>R: C=O</p> <p>ALLOW - C = O </p> <p>- C = O (1)</p> <p>IGNORE names ACCEPT answers written on spectrum</p>	<p>Just 'alcohol' - OH</p> <p>Just 'carbonyl' - C O </p> <p>C-O</p>	2

Question Number	Acceptable Answers	Reject	Mark
4 (b) (i)	<p>Y = methanol / CH₃OH (1)</p> <p>Any two of the following: Molecular ion / M⁺ / M_r / CH₃OH⁺ / methanol = 32 CH₃⁺ = 15 CH₃O⁺ / CH₂OH⁺ = 31 CHOH⁺ / CH₂O⁺ = 30 COH⁺ = 29 CO⁺ = 28 (1)</p> <p>Charges not required</p> <p>TE in second mark for two correct possible peaks from an incorrect compound.</p>		2

Question Number	Acceptable Answers	Reject	Mark
4 (b) (ii)	<p>Two (1) This mark may be scored if two shifts are given.</p> <p>Any two shifts correctly identified: -OH at 2.0-4.0 / any value in this range H-C-O at 3.0- 4.2 / any value in this range H in CH₃ OH at 3.39 (ppm) (1)</p> <p>Allow TE for ethanol with three peaks (1) and three correct shift values: -OH at 2.0-4.0 / any value in this range H-C-O at 3.0- 4.2 / any value in this range CH in an alkane at 0.1-1.9 (1)</p>	<p>CH in an alkane at 0.1-1.9</p> <p>Just CH₃ OH at 3.39</p>	2

Question Number	Acceptable Answers	Reject	Mark
4 (c) (i)	<p>Z contains two -OH/ one alcohol + one acid</p> <p>ALLOW two alcohol groups / is a diol</p>		1

Question Number	Acceptable Answers	Reject	Mark
4 (c) (ii)	<p>Z is an acid / contains -COOH / contains -CO₂H/ contains a carboxylic acid group / contains H⁺</p>		1

Question Number	Acceptable Answers	Reject	Mark
4 (c) (iii)	<p>Z is a secondary alcohol/ a ketone is formed from Z /</p> <p>Z contains $\begin{array}{c} \\ -\text{C}-\text{OH} \\ \\ \text{H} \end{array}$ (1)</p>	Z is a ketone	1

Question Number	Acceptable Answers	Reject	Mark
4 (c) (iv)	<p>(Iodoform produced) so Z contains CH₃ CH(OH)-</p> <p>TE if Z is identified as a ketone in (iii): Z contains CH₃ C=O / Z is a methyl ketone</p>		1

Question Number	Acceptable Answers	Reject	Mark
4 (d)	<p>Answers will be based on several pieces of information (molecular formula, products of ester hydrolysis, answers to (c)) which may be contradictory if errors have been made.</p> <p>ALLOW TE marks for formulae which are chemically possible (ie no 5 bonded carbons etc) and based on most of the deductions but not necessarily all.</p> <p>Z is $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{COOH}$ (1) Stand alone mark</p> <p>ALLOW TE for an acid with OH in wrong position in Z if oxidation product identified as aldehyde</p> <p>TE for Z = $\text{CH}_3\text{COCH}_2\text{COOH}$ if identified as ketone in (iii)</p> <p>X is $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{COOCH}_3$ (1) Stand alone mark TE for a methyl ester of Z</p>		2