Isotopes, Mass Spec & RAM/ RMM

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	The Core Principles of Chemistry
Sub Topic	Isotopes, Mass Spec & RAM/RMM
Booklet	Mark Scheme

Time Allowed: **59 minutes**

Score: **/49**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Correct Answer	Reject	Mark
1	D		**1**

Question Number	Correct Answer	Reject	Mark
2	B		**1**

Question Number	Correct Answer	Mark
3	B	**1**

Question Number	Correct Answer	Mark
4	C	**1**

Question Number	Correct Answer	Mark
5	C	**1**

Question Number	Correct Answer	Mark
6	D	**1**

Question Number	Correct Answer	Mark
7	B	**1**

Question Number	Correct Answer	Reject	Mark
8	C		1

Question Number	Correct Answer	Reject	Mark
9	B		1

Question Number	Correct Answer	Reject	Mark
10	C		1

Question Number	Acceptable Answers	Reject	Mark
11(a)(i)	(RAM = $\frac{(13.9 \times 10) + (86.1 \times 11)}{100}$) = 10.861 (1) = 10.9 IGNORE amu / g mol^{-1} (1) Correct answer without working scores (2)	g/% answers not to 3sf	2

Question Number	Acceptable Answers	Reject	Mark
11(a)(ii)	compared to one twelfth the mass of a carbon-12 (atom/isotope) ALLOW where (one atom of) carbon-12 has a mass of exactly 12		1

Question Number	Acceptable Answers	Reject	Mark
11(a)(iii)	5 protons and 5 electrons (1) 7 neutrons (1) ALLOW use of letters p, e and n for sub-atomic particles		2

Question Number	Acceptable Answers	Reject	Mark
11(b)(i)	Any one from • deflect the ions from their normal path • additional/false peaks from particles in the air • ions would collide with particles in the air IGNORE Reference to chemical reactions/anomalous results/decreased speed of ions/ wrong percentage abundance given	Air molecules	1

Question Number	Acceptable Answers	Reject	Mark
11(b)(ii)	No effect / unaffected / they would not be accelerated/Only affects charged particles IGNORE Reference to detection/deflection/magnetic field		1

Question Number	Acceptable Answers	Reject	Mark
11(b)(iii)	Any one correct statement scores (1) Three correct statements scores (2) both oxygen atoms from the manganate(VII) ion gives a (molecular / parent ion) peak at **66** one oxygen atom from the manganate(VII) ion / one from water gives a (molecular / parent ion) peak at **64** both oxygen atoms from the water gives a (molecular / parent ion) peak at **62** IGNORE ^{18}O peak ALLOW Both oxygen atoms from the magnagate(VII) ion gives a (molecular/parent ion) peak **four** more	Reference to peaks at 32,34,36 or 63 or 65	2

Question Number	Acceptable Answers	Reject	Mark
11(c)(i)	(Error 1) peaks at 35 and 37 should be in 3:1 ratio/the peak at 35 should be three times the height of the peak at 37 ALLOW Reference to the height of the peak at 35 being at 75% compared to the height of the peak at 37 being at 25% (1) (Error 2) there should be a peak at 72 IGNORE Reference to the height/intensity of the peak at 72 (1)	Just 'greater'	2

Question Number	Acceptable Answers	Reject	Mark
11(c)(ii)	$(^{37}Cl—^{37}Cl)^+$ OR $[^{37}Cl—^{37}Cl]^+$ OR $(^{37}Cl^{37}Cl)^+$ OR $^{37}Cl—^{37}Cl^+$ OR $^{37}Cl_2{}^+$	$(^{37}Cl+^{37}Cl)^+$ 2 $^{37}Cl^+$	1

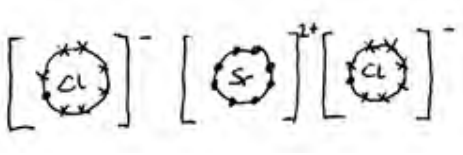
(Total for Question 11 = 12 marks)

Question Number	Acceptable Answers	Reject	Mark
12(a)(i)	**t mark** Weighted mean mass ALLOW (Weighted) average (atomic) mass **(1)** **Second mark** (Mass) of atom(s) (of an element) ALLOW (Mass of all) the isotopes (of an element) **(1)** **Third mark** Divided by / compared with 1/12th the **mass** of (an atom of) ^{12}C / C-12 OR On a scale in which ^{12}C / C-12 = 12 (g) **(1)**	average weight atom of an isotope Mole(s) of atoms	**3**

Question Number	Acceptable Answers	Reject	Mark
12(a)(ii)	(Beam of) high energy electrons / accelerated electrons / electrons from electron gun / high speed electrons / ALLOW Electron beam OR Electrons bombard / hit / blast the (gaseous) atoms OR Electrons are fired at the (gaseous) atoms **(1)** Knock off / liberates an electron(s) / leads to loss/removal of electron(s) (from the gaseous atoms) **(1)** IGNORE References to ionising / forming (positive) ions / just an equation e.g. $M(g) \rightarrow M^+(g) + e$	Just 'electron gun' / 'electron(s)' highly charged electrons Just 'takes an electron(s)'	**2**

Question Number	Acceptable Answers	Reject	Mark
12(a)(iii)	Correct answer with or without working scores both marks ((84.0 x 0.56) + (86.0 x 9.86) + (87.0 x 7.02) +(88.0 x 82.56))/100 **(1)** = 87.7 (must be to 3 SF) **(1)** NOTE 87.71/ 87.710/87.7102 score **(1)** with or without working IGNORE g or g mol^{-1}, but wrong units, eg %, lose the second mark		**2**

Question Number	Acceptable Answers	Reject	Mark
12(b)	s (block) ALLOW S (block) IGNORE group 2 / period 5	Any number in front of the s e.g. 4s Any other group number / period number	**1**

Question Number	Acceptable Answers	Reject	Mark
12(c)	 **First mark** Correct dot and cross diagrams with 2+ charge on Sr and – charge on Cl **(1)** ALLOW no electrons or 8 electrons on outer shell of Sr ALLOW dots or crosses for electrons ALLOW diagrams without square brackets **Second mark** Ratio of 1 strontium and 2 chloride (ions) ALLOW this shown as 2 in front of a chloride ion or subscript 2 after the ion **(1)** IGNORE any inner shell electrons ALLOW max 1 for incorrect symbol(s)	covalent bonding **(0)**	**2**

Question Number	Acceptable Answers	Reject	Mark
12(d)	$SrO(s) + 2HNO_3(aq) \rightarrow Sr(NO_3)_2(aq) + H_2O(l)$ **OR** $SrO(s) + 2H^+(aq) \rightarrow Sr^{2+}(aq) + H_2O(l)$ Correct formulae and balancing ALLOW multiples **(1)** State symbols **(1)** If no other mark awarded, ALLOW Ionic equation given as $O^{2-}(s) + 2H^+(aq) \rightarrow H_2O(l)$ **(1)**	H_2 scores **(0)**	**2**

Question Number	Acceptable Answers	Reject	Mark
12(e)	SrC_2O_4 with or without working scores 3 marks Sr C O % 49.9 13.7 36.4 **(1)** A_r 87.6 12.0 16.0 divide by smaller 0.57 1.14 2.28 0.57 0.57 0.57 ratio 1 2(.004) 4/3.993 **(1)** empirical formula SrC_2O_4 **(1)** ALLOW symbols in any order ALLOW use of 87.7 instead of 87.6 ALLOW TE for MP2 and 3, if one slip in MP1 or MP2	If all A_r/%, scores **(0)** overall If all %/atomic number, scores **(0)** overall Incorrect symbol(s)	**3**

(Total for Question 12 = 15 marks)

<table>
<tr><th>Question Number</th><th>Acceptable Answers</th><th>Reject</th><th>Mark</th></tr>
<tr><td>13(a)</td><td>
<table>
<tr><th>(Sub-atomic particle)</th><th>(Relative mass)</th><th>(Relative charge)</th></tr>
<tr><td>(proton)</td><td>1</td><td>+1/1+</td></tr>
<tr><td>(neutron)</td><td>1</td><td>0</td></tr>
<tr><td>(electron)</td><td>1/2000 to 1/1800
or
‘negligible’
or 0.0005 to 0.00056</td><td>—1/1—</td></tr>
</table>
(1) for each correct row

MAX (1) if only one COLUMN correct
IGNORE any masses in g or kg
IGNORE any charges in coulombs</td><td>Just “+” for proton charge

Just “neutral” for neutron charge

Just “—” for electron charge

“Zero” /”0” for mass of an electron</td><td>3</td></tr>
</table>

Question Number	Acceptable Answers	Reject	Mark
13(b)	**Atoms** with the same number of protons **(1)** IGNORE same number of electrons (but) different numbers of neutrons **(1)** IGNORE References to atomic number / mass number / ‘nucleons’ / **JUST** ‘atoms of the same element’	“**Element(s)** with the same number of protons”	**2**

Question Number	Acceptable Answers	Reject	Mark
13(c)(i)	Electron gun / high-speed electrons / high-energy electrons / fast-moving electrons / bombardment with electrons **(1)** Knock-out / remove electron(s) **(1)** IGNORE References to ionizing / forming ions / **just** equations such as $Rb(g) \rightarrow Rb^{+}(g) + e^{-}$ / other stages in the process of mass spectrometry	**Just** ‘electrons’ / ‘Highly-charged’ electrons	**2**

Question Number	Acceptable Answers	Reject	Mark
13(c)(ii)	[FIRST, check the answer on the answer line IF answer = 85.6 award **(3)** marks] **1st mark:** 85 x 2.5 + 87 x 1 OR 85 x 71.4 + 87 x 28.6 **(1)** **2nd mark:** ÷3.5 (can ÷7 if ratio given as 5:2) OR ÷100 ALLOW TE using incorrect % abundances or ratios **(1)** **3rd mark – stand alone for correct rounding (TE only if value calculated is between 85 and 87)** (= 85.57, but 'accurate' answer depends on rounding) Final answer rounded to **85.6** (ie 1 dp) Ignore units even if incorrect. **(1)** **NOTE** 85.5 without working scores **(0)**		**3**

Question Number	Acceptable Answers	Reject	Mark
13(d)	(Left-hand box) Delocalised electron(s) **BOTH these words needed** **(1)** (Right-hand box) Positive ion(s) / cation(s) / Rb^+ **ALLOW** metal ion(s) **(1)**	**Just** 'electrons' 'Negatively-charged ions' 'nuclei' / 'nucleus' / 'positive atoms' 'positively-charged lattice'	**2**

(Total for Question 13 = 12 marks)