

**M1.** (a) Proton mass = 1 charge = +1  
 Electron mass  $\leq 1/1800$  Or  $\leq 5.6 \times 10^{-4}$  charge = -1  
*(Do not accept +1 for proton mass or 'g' units)* 2

(b) (i) 13 1

(ii) Si 1

Mass number = 28 **and** atomic number = 14  
*(Do not accept 28.1 or 28.0 or 'Silicon')* 5

(c) Mean (average) mass of an atom / all the isotopes  
 $1/12^{\text{th}}$  mass of atom of  $^{12}\text{C}$   
 Or Mass of 1 mole of atoms of an element (1)  
 $1/12^{\text{th}}$  mass of 1 mole of  $^{12}\text{C}$  (1)  
 Or Average mass of an atom / all the isotopes (1)  
 relative to the mass of a  $^{12}\text{C}$  atom taken as exactly 12 / 12.000 (1)  
*(Penalise 'weight' once only) (Ignore 'average' mass of  $^{12}\text{C}$ )*  
*(Do not allow 'mass of average atom')* 2

(d)  $A_r = (24 \times 0.735) + (25 \times 0.101) + (26 \times 0.164) = 24.41$   
*(mark M2 conseq on transcription error or incorrect addition of %)*

(e)  $M_r =$  highest m/z value 1  
*(NOT 'highest/largest/right-hand' peak)* 3

[10]

**M2.** (a)

Particle	Relative charge	Relative mass	
Proton	+1 <b>or</b> 1+	1	<b>(1)</b>
Neutron	0 <b>or</b> no charge/neutral/zero	1 ( <u>not</u> – 1)	<b>(1)</b>
Electron	–1 or 1–	1/1800 to 1/2000	<b>(1)</b>

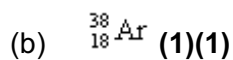
**or** negligible

**or** zero

**or**  $5.0 \times 10^{-4}$  to  $5.6 \times 10^{-4}$

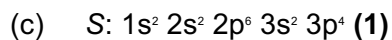
*if 'g' in mass column - wrong  
penalise once*

3

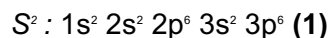


*Allow numbers before or after Ar*

2



*Allow upper case letters*



*If use subscript penalise once*

2

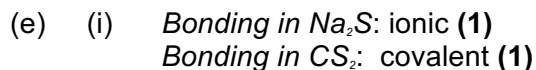


*Explanation:* Highest energy or outer orbital is (3) p

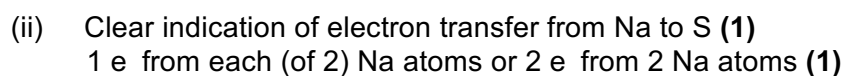
*OR outer electron, valency electron in (3) p*

*NOT 2p etc.*

2

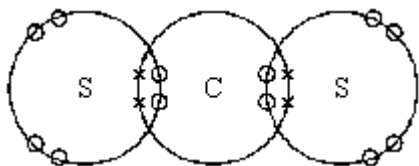


*ignore other words such as dative / polar / co-ordinate*



*QoL correct English*

(iii)



Correct covalent bonds (1)  
All correct including lone pairs (1)

*Allow all •s or all ×s*

*M2 tied to M1*

*NOT separate e s in S•- 2 l p*

(iv)  $\text{CS}_2 + 2\text{H}_2\text{O} \rightarrow \text{CO}_2 + 2\text{H}_2\text{S}$  (1)

*Ignore state symbols even if wrong*

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[16]

**M3.** (a) Proton: mass 1, charge + 1 (1)

Neutron: mass 1, charge 0 (1)

Electron mass 1/1840, charge -1 (1)

*Allow mass = 0, or negligible, or 1/1800 to 1/2000*

Isotopes have the same number of protons (1)

*OR atomic number*

different number of neutrons (1)

Isotopes have the same electronic configuration (1)

*OR same number of electrons*

Chemical properties depend on electrons (1)

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(b) 
$$\frac{\text{average(1) mass of an atom/isotopes}}{\text{mass of 1 atom of } ^{12}\text{C}} \times 12$$
 (1)

$\frac{\text{mass of 1 mol of atoms}}{\text{OR mass of 1 atom of } ^{12}\text{C}} \times 12 \text{ or in words}$

Spectrum gives (relative) abundance **(1)**

*OR % or amount*

And  $m/z$  **(1)**

Multiply  $m/z$  by relative abundance for each isotope **(1)**

*Allow instead of  $m/z$  mass no,  $A_r$  or actual value from example*

Sum these values **(1)**

Divide by the sum of the relative abundances **(1)**

*only award this mark if previous 2 given*

*Max 2 if e.g. has only 2 isotopes*

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**[14]**

**M4.C**

**[1]**