1. Which row shows the atomic structure of $^{55}Mn^{2+}$?

	Protons	Neutrons	Electrons
A	25	30	23
B	25	55	23
C	27	30	25
D	30	25	28

Your answer A

from periodic table
atomic no. = 25 = # protons

neutrons:
atomic mass − # protons
= 55 − 25 = 30

e⁻ = 25 − 2 = 23
(as +2 charge)

[1]

2. Which atom is **not** an isotope of iodine?

proton number of I: 53

	Number of neutrons	Mass number
A	72	125
B	74	127
C	75	128
D	77	129

125 - 72 = 53
127 - 74 = 53
128 - 75 = 53
129 - 77 = 52

Your answer D

[1]

3. A sample of boron contains the isotopes ^{10}B and ^{11}B.
The relative atomic mass of the boron sample is 10.8.

What is the percentage of ^{11}B atoms in the sample of boron?

A 8.0%

B 20%

C 80%

D 92%

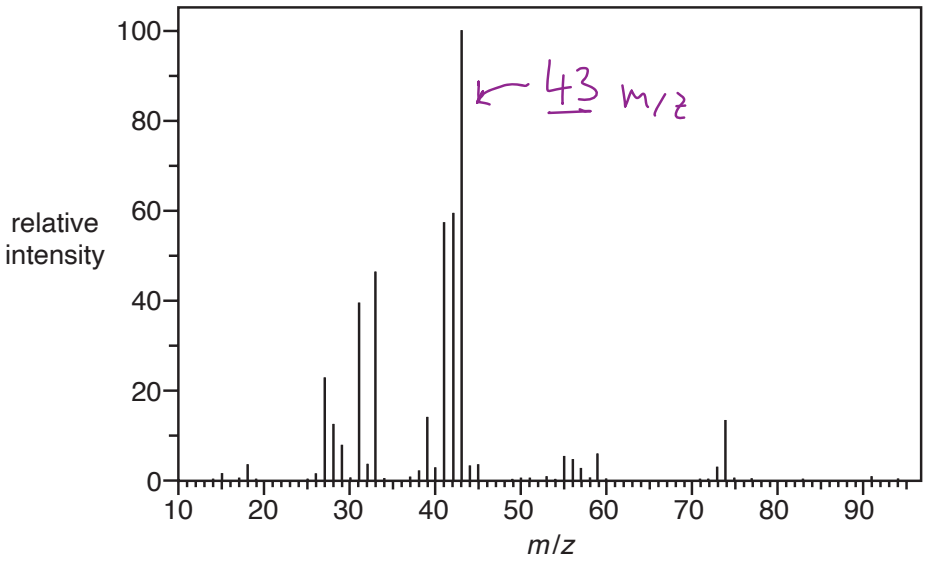
Your answer C

[1]

$\left(\frac{10 \times 20}{100}\right) + \left(\frac{11 \times 80}{100}\right) = 10.8$

relative atomic mass of isotopes $\left(\frac{\text{mass number} \times \%}{100}\right) + (\ldots)$

4. The mass spectrum of $(CH_3)_2CHCH_2OH$ is shown below.



Which ion is responsible for the peak with the greatest relative intensity?

~~A~~ $CHCH_2OH^+$ 44

~~B~~ $CH_3CH_2CH^+$ 42

C $(CH_3)_2CH^+$ 43

~~D~~ CH_3CO^+ 43

Your answer C

not in original molecule

can be formed by breaking one bond

[1]

5. This question is about magnesium, bromine and magnesium bromide.

(a) Relative atomic mass is defined as 'the weighted mean mass compared with 1/12th mass of carbon-12'.

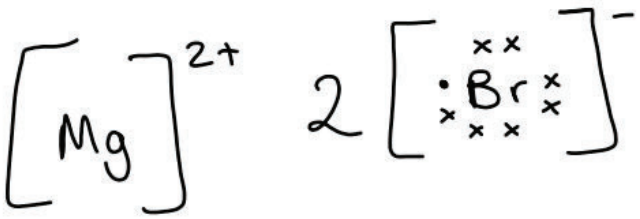
Explain what is meant by the term **weighted mean mass**.

The mean taking into account the relative abundancies of the isotopes

[1]

(b) **(i)** Draw a 'dot-and-cross' diagram for $MgBr_2$. ionic bonding

Show outer electron shells only.



[2]

(ii) Calculate the total number of **ions** in 1.74 g of magnesium bromide, $MgBr_2$.

Give your answer to **3** significant figures.

$\frac{1.74}{24.3 + (2 \times 79.9)} = 9.45 \times 10^{-3}$ mol

3 ions: Mg^{2+}, Br^-, Br^-

$9.45 \times 10^{-3} \times 3 = 0.0283$ mol

$0.0283 \times 6.023 \times 10^{23} = 1.71 \times 10^{22}$ ions

Avogadro's constant

number of ions = 1.71×10^{22} **[3]**

(c)* **Table 16.1** shows some physical properties of magnesium, bromine and magnesium bromide.

Substance	Melting point/°C	Electrical conductivity	
		Solid	Liquid
Magnesium	711	Good	Good
Bromine	−7	Poor	Poor
Magnesium bromide	650	Poor	Good

Table 16.1

Explain the physical properties shown in **Table 16.1** using your knowledge of structure and bonding. **[6]**

Mg: giant lattice, metallic bonding with delocalised electrons so can conduct

Br: simple molecular, london forces (induced dipole dipole interactions between molecules so doesn't conduct

$MgBr_2$: giant lattice, ionic bonding between oppositely charged ions in solid ions can't move in solution ions can move and conduct

Metallic and ionic bonds are stronger than london forces so the melting points of Mg and $MgBr_2$ are greater.

Additional answer space if required

.....

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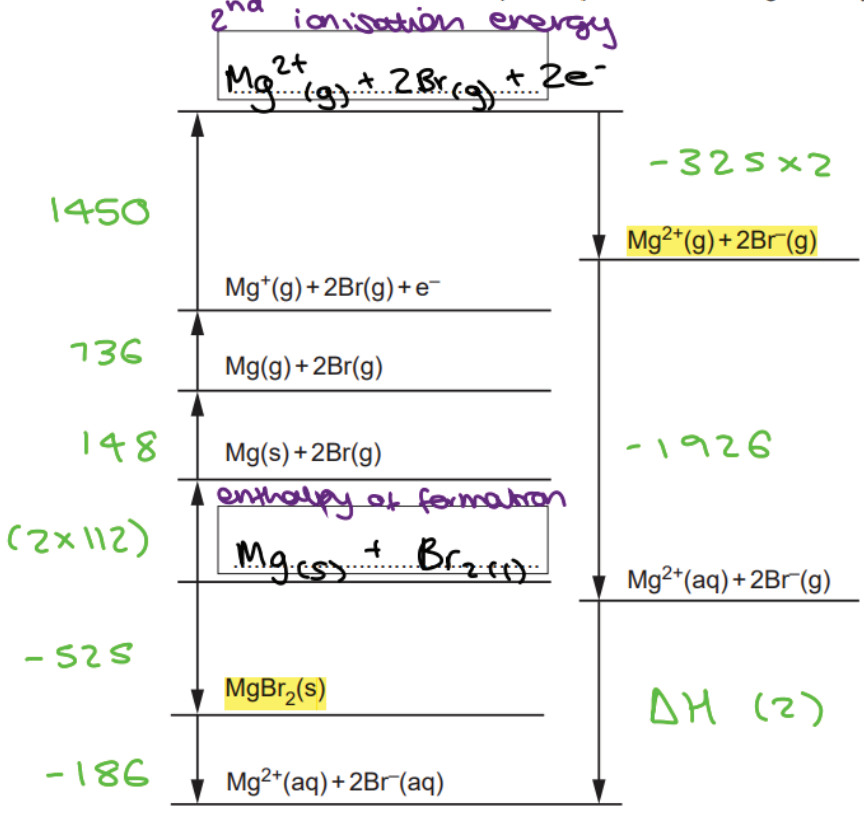
(d) The enthalpy change of hydration of bromide ions can be determined using the enthalpy changes in **Table 16.2**.

Enthalpy change	Energy / kJ mol^{-1}
1st ionisation energy of magnesium	+736
2nd ionisation energy of magnesium	+1450
atomisation of bromine	+112
atomisation of magnesium	+148
electron affinity of bromine	−325
formation of magnesium bromide	−525
hydration of bromide ion	to be calculated
hydration of magnesium ion	−1926
solution of magnesium bromide	−186

Table 16.2

(i) An incomplete energy cycle based on **Table 16.2** is shown below.

On the dotted lines, add the species present, including state symbols.



[2]

(ii) Using your completed energy cycle in **16(d)(i)**, calculate the enthalpy change of hydration of bromide ions.

$1926 + (2 \times 325) - 1450 - 736 - 148$

$- (2 \times 112) - 525 - 186 = -693 \text{ kJmol}^{-1}$

$\frac{-693}{2} = -346.5 \text{ kJmol}^{-1}$

enthalpy change of hydration = ..-346.5.. kJ mol^{-1} **[2]**

(iii) Write the equation for the lattice enthalpy of magnesium bromide and calculate the lattice enthalpy of magnesium bromide.

Equation ..$Mg^{2+}(g) + 2Br^{-}(g) \rightarrow MgBr_2(s)$..

Calculation

$-1926 + (2 \times -346.5) + 186 = -2433 \text{ kJmol}^{-1}$

lattice enthalpy = ..-2433.. kJ mol^{-1} **[3]**