AQA A-Level Chemistry

Atomic structure mark scheme · goes with “Atomic structure” · whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions

Mark schemes

Atomic structure · 18 questions

Q1 · June 2023 · Paper 3 · Q7 · [1 mark]

Answer: **C**

12

13

10

Q2 · June 2023 · AS Paper 1 · Q9 · [1 mark]

Answer: **C**

^{57}Fe

Q3 · June 2023 · AS Paper 1 · Q1 · [5 marks]

(a) $1s^2 2s^2 2p^6 3s^2 3p^6$

[1 mark]

(b) $Na^+(g) \rightarrow Na^{2+}(g) + e^-$

Ignore state symbol on electron, even if wrong.

Allow

$Na^+(g) + e^- \rightarrow Na^{2+}(g) + 2e^-$

$Na^+(g) - e^- \rightarrow Na^{2+}(g)$

[1 mark]

(c) M1 sulfur / S

M2 large jump after the sixth electron is removed due to the 7th electron being removed / large difference between ionisation energy 6 and 7

M3 electron removed from the (2p) orbital / (second) energy level / (second) shell which is closer to the nucleus / lower in energy / has less shielding

Both ideas needed for mark

[3 marks]

Q4 · June 2024 · Paper 3 · Q7 · [1 mark]

Answer: **B**

Be

Q5 · June 2024 · AS Paper 1 · Q24 · [1 mark]

Answer: **C**

Fe

Q6 · June 2024 · AS Paper 1 · Q6 · [6 marks]

(a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

[1 mark]

(b) $Br_2(g) \rightarrow Br_2^+(g) + e^-$

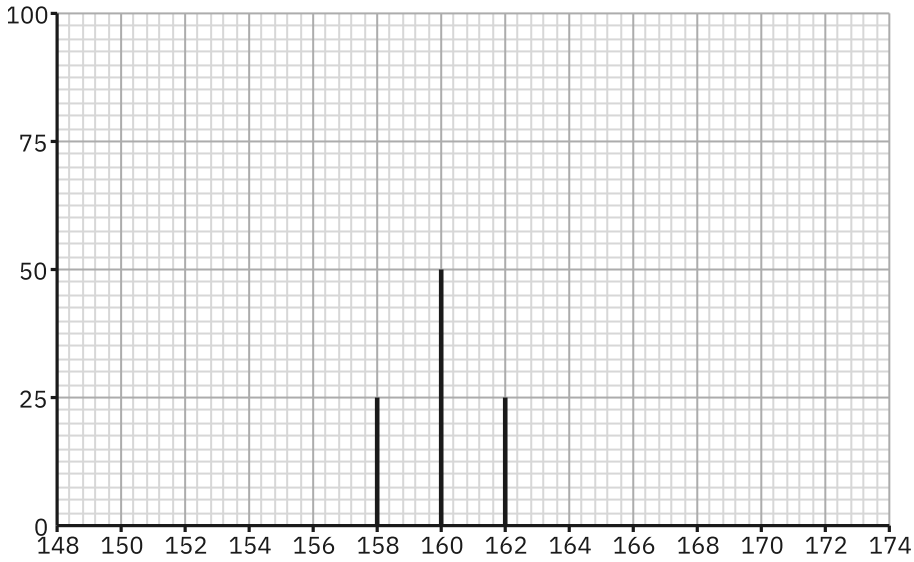
OR

$Br_2(g) + e^- \rightarrow Br_2^+(g) + 2e^-$

Do not penalise the inclusion of a radical dot

[1 mark]

(c)



M1: both axes labelled

y-axis = (relative) abundance or %

x-axis = m/z

M2: two additional peaks at m/z = 160 and 162

M3: peaks at 158,160 and 162 in the relative heights 1:2:1

[3 marks]

(d) The (relative) abundance is proportional to the size of the current.

[1 mark]

Q7 · June 2024 · AS Paper 1 · Q22 · [1 mark]

Answer: **C**

$Mg^{+}(g) \rightarrow Mg^{2+}(g) + e^{-}$

Q8 · June 2024 · AS Paper 1 · Q21 · [1 mark]

Answer: **C**

$$\frac{117}{50}Sn$$

Q9 · June 2024 · AS Paper 1 · Q20 · [1 mark]

Answer: **D**

A sample of CO_2 that is ionised using electron impact ionisation

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Q10 · June 2024 · Paper 3 · Q6 · [1 mark]

Answer: **C**

H_3O^+ and $HF_2{}^+$

Q11 · June 2025 · AS Paper 1 · Q12 · [1 mark]

Answer: **B**

Q12 · June 2025 · AS Paper 1 · Q14 · [1 mark]

Answer: **B**

Si

Q13 · June 2025 · AS Paper 1 · Q16 · [1 mark]

Answer: **C**

nickel

Q14 · June 2025 · AS Paper 1 · Q3 · [13 marks]

03.1

$1s^2\ 2s^2\ 2p^6$

[1 mark]

03.2

Mn

Mn^{2+}

[1 mark]

03.3

$$\frac{\text{Average / mean mass of 1 atom (of an element)}}{\text{1/12 mass of one atom of 12C}}$$

OR

$$\frac{\text{Average / mean mass of atoms of an element}}{\text{1/12 mass of one atom of 12C}}$$

OR

$$\frac{\text{Average / mean mass of atoms of an element} \times 12}{\text{mass of one atom of 12C}}$$

OR

$$\frac{\text{(Average) mass of one mole of atoms}}{\text{1/12 mass of one mole of atoms of 12C}}$$

OR

$$\frac{\text{(Weighted) average mass of all the isotopes (of an element)}}{\text{1/12 mass of one atom of 12C}}$$

OR

Average mass of an atom/isotope compared to/relative to C–12 on a scale in which an atom of C–12 has a mass of 12

This expression = 2 marks

If moles and atoms mixed, max = 1

Mark top and bottom line independently. All key terms must be present for each mark.

[2 marks]

03.4

M1 So it can be accelerated / so it can be detected

M2 Ion (hits negative plate or detector to) gain an electron

M3 Abundance ∝ current flow / idea that abundance is proportional to current.

M2 ion knocks out an electron into electron multiplier

M3 signal from electron multiplier proportional to number of ions

[3 marks]

03.5

54

[1 mark]

03.6

$$\frac{(50 \times 4.3) + (52 \times 82.8) + (53 \times 10.5) + (54 \times 2.4)}{100}$$

52.1 (must be 1 dp)

[2 marks]

03.7

M1: calculation of v

$$v = \frac{d}{t} = \frac{0.850}{6.41 \times 10^{-4}} = 1326 \text{ (m s}^{-1}\text{)}$$

M2: the correct calculation of mass in kg using their M1

$$m = \frac{2KE}{v^2} = \frac{2 \times 7.59 \times 10^{-20}}{(M1)^2}$$

M3: the correct calculation of mass in g using their M2

m = M2 × 1000

M2: calculation of mass in kg

$$m = \frac{2KE}{v^2} = \frac{2 \times 7.59 \times 10^{-20}}{(1326)^2} = 8.63 \times 10^{-26} \text{ (kg)}$$

M3: calculation of mass in g

$m = 8.63 \times 10^{-26} \times 1000 = 8.63 \times 10^{-23}$ (g)

Alternative approach

M1 expression

$$m = \frac{2KEd^2}{t^2}$$

M2 calculation of mass in kg

$$m = \frac{2 \times 7.59 \times 10^{-20} \times (0.850)^2}{(6.41 \times 10^{-4})^2} = 8.63 \times 10^{-26} \text{ (kg)}$$

M3 answer in g

m = M2 × 1000

[3 marks]

Q15 · June 2025 · Paper 1 · Q2 · [8 marks]

02.1

M1 smallest atom/atomic radius

OR

smallest number of shells/energy levels

OR

outer electron is closest to the nucleus

OR

least shielding

M2 strongest attraction between outer/valence electron(s) and nucleus

Allow comparative and superlative only for M1 and M2

Allow correct trends up or down Group 2

[2 marks]

02.2

$Be^{+}(g) \rightarrow Be^{2+}(g) + e^{-}$

OR

$Be^{+}(g) + e^{-} \rightarrow Be^{2+}(g) + 2e^{-}$

[1 mark]

02.3

Mg/Magnesium

[1 mark]

02.4

M1 P

M2 large increase/jump from 5th to 6th ionisation energy/after 5th ionisation energy

M3 the 6th electron is removed from the 2 (principal) energy level/from a lower energy level/from a lower shell/from 2p/from an energy level that is closer to the nucleus

Mark M1, M2 and M3 independently

[3 marks]

02.5

allow answer in range 2500–3200

[1 mark]

Q16 · June 2025 · Paper 3 · Q12 · [1 mark]

Answer: **A**

19

Q17 · June 2025 · Paper 3 · Q21 · [1 mark]

Answer: **C**

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$

Q18 · June 2025 · Paper 3 · Q25 · [1 mark]

Answer: **B**

Radon

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