Question 9 (Answer: **B**)

- Two SO_3^{2-} are needed to build one $S_2O_4^{2-}$, so $a = 2$; balancing oxygen then gives $b = 2$.
- Likewise two SO_3^{2-} make one $S_2O_6^{2-}$, so $w = 2$.
- Balancing charge in the second equation gives $x = 4$.

Question 10 (Answer: **A**)

- An oxidising agent is itself reduced, so hydrogen's oxidation number must *fall*.
- In K^+H^- hydrogen is -1, down from 0 in H_2 – it has been reduced.
- In the other three hydrogen ends up at $+1$, so there it is the reducing agent.

Question 3 (Answer: **B**)

- Balance the electrons: two H_2S half-equations ($4e^-$) match one SO_2 half-equation.
- That gives $2H_2S + SO_2 \rightarrow 3S + 2H_2O$.
- So 3 mol of sulfur needs 2 mol of H_2S, and 1 mol needs $\frac{2}{3}$ mol.

Question 11 (Answer: **D**)

- S_8 is an element, so sulfur is 0.
- $Na_2S_4O_6$: $2(+1) + 4x + 6(-2) = 0$ gives $x = +2.5$; $Na_2S_2O_3$ gives $+2$.
- SO_2Cl_2: $x - 4 - 2 = 0$ gives $x = +6$, the highest of the four.

Question 11 (Answer: **B**)

- One MnO_4^- accepts 5 electrons.
- Each FeC_2O_4 supplies 3: one from $Fe^{2+} \rightarrow Fe^{3+}$ and two from $C_2O_4^{2-} \rightarrow 2CO_2$.
- So $5/3 = 1.67$ mol of iron(II) ethanedioate per mole of manganate(VII).

1(a)(i)	25 protons 30 neutrons 25 electrons
1(a)(ii)	(atoms of an element) with the same number of protons and different number of neutrons
1(a)(iii)	**M1** (relative) isotopic mass. **OR** (relative isotopic) mass of Mn-55 and Mn-53 **M2** (relative) abundance of each isotope
1(b)(i)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ (3d^5\ 4s^2)$
1(b)(ii)	5
1(c)(i)	Mn / MnO_2 **AND** it gains electrons
1(c)(ii)	(+)4
1(c)(iii)	*Due to an issue with question 1(c)(iii), the question has been removed from the question paper.*

1(a)	**I** All the following data recorded. • two burette readings **AND** titre for the rough titration • initial and final readings for **two** (or more) accurate titrations **II** Titre values recorded for accurate titrations, **AND** correct headings and units in the accurate titration table • initial / start **AND** (burette) reading / volume • final / end **AND** (burette) reading / volume • titre **OR** volume used / added **OR FB 2** used / added • unit: / cm^3 **OR** (cm^3) **OR** in cm^3 (for each heading) **OR** cm^3 unit given for each volume recorded. **III** All accurate burette readings recorded to 0.05 cm^3. **IV** The final accurate titre recorded must be within 0.10 cm^3 of any other accurate titre.
	Accuracy (Q) marks Round burette readings to the nearest 0.05 cm^3. Check and correct titre subtractions where necessary. Select the best mean titre, using the following hierarchy: • two (or more) accurate identical titres (ignoring any that are labelled "rough"), *then* • two (or more) accurate titres within 0.05 cm^3, *then* • two(or more) accurate titres within 0.10 cm^3, *etc.* Calculate the Supervisor's mean titre to two decimal places. Calculate the Candidate's mean titre to two decimal places. Calculate the difference (δ) between the Supervisor's and Candidate's mean titre.
	Award accuracy Q marks as follows: **V** award if $\delta \leqslant 0.50$ cm^3 **VI** award if $\delta \leqslant 0.30$ cm^3 **VII** award if $\delta \leqslant 0.20$ cm^3
1(b)	Correct calculation of the mean titre • Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. • Working/explanation must be shown **OR** ticks must be put next to the two (or more) accurate readings selected. • The mean should be quoted to 2 d.p. and be rounded to nearest 0.01 cm^3 (e.g. 26.675 cm^3 must be rounded to 26.68 cm^3).
1(c)(i)	Final answers for **(c)(ii)**, **(c)(iii)** and **(c)(iv)** to 3 or 4 significant figures.
1(c)(ii)	Correctly calculates amount of manganate(VII) = $0.01 \times {}^{\text{volume in (b)}}/_{1000}$ mol
1(c)(iii)	Correctly uses amount of Fe^{2+} reacting with **FB 2** = **(c)(ii)** × 5 mol **AND** concentration of Fe^{2+} = (**(c)(ii)** × 5) × 40 mol dm^{-3}
1(c)(iv)	Correctly uses concentration of Fe^{2+} = **(c)(iii)** × 55.8 g dm^{-3}
1(c)(v)	Conclusion yes / correct (because) **AND** ${}^{\text{(c)(iv)} \times 1000}/_{14}$ (> 150 claimed as present in tablet)
1(d)	no because chloride (ions) are oxidised by manganate(VII) / $KMnO_4$. **OR** no because hydrochloric acid is monoprotic **AND** might not produce enough H^+. **OR** yes because hydrochloric acid is a strong acid.