

Question	Answer	Marks	Guidance
1	C	1	ALLOW +6 in the box

Question	Answer	Marks	Guidance
2	B	1	ALLOW 20 in the box

Question	Answer	Marks	Guidance
3	A	1	

Question	Answer	Marks	Guidance
4	C	1	ALLOW 4.1 in the box

Question	Answer	Marks	AO element	Guidance
5	C	1	AO2.2	

Question	Answer	Marks	AO element	Guidance
6	D	1	AO2.4	

Question	Answer	Marks	AO element	Guidance
7	B	1	AO2.8	

Question	Answer	Marks	AO element	Guidance
8	B	1	AO1.2	

Question	Answer	Marks	AO element	Guidance
9	D	1	AO1.2	

Question	Answer	Marks	AO element	Guidance
10	B	1	AO2.6	

Question	Answer	Marks	AO element	Guidance
11	D	1	2.7	

Question	Answer	Marks	AO element	Guidance
12	C	1	2.2	

Question	Answer	Marks	AO element	Guidance
13	C	1	2.6	

Question	Answer	Marks	AO element	Guidance
14	B	1	AO1.2	

Question	Answer	Marks	AO element	Guidance
15	D	1	AO2.6	

Question	Answer	Marks	AO element	Guidance
16	D	1	AO2.6	

Question	Answer	Marks	AO element	Guidance
17	C	1	AO2.6	

Question	Answer	Marks	AO element	Guidance
18	C	1	1.2	

Question	Answer	Marks	AO element	Guidance
19	C	1	2.8	

Question	Answer	Marks	AO element	Guidance
20	B	1	1.2	

Question	Answer	Marks	AO element	Guidance
21	C	1	AO2.2	

Question	Answer	Marks	Guidance
22	C	1	

Question	Answer	Marks	Guidance
23	B	1	

Question	Answer	Marks	Guidance
24	D	1	

Question	Answer	Marks	Guidance
25	C	1	

Question	Answer	Marks	Guidance
26	A	1	

Question	Answer	Marks	Guidance
27	D	1	

Question	Answer	Marks	Guidance
28	C	1	

Question			Answer	Marks	Guidance
29	(a)		$\text{Ba}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{BaCl}_2 + 2\text{H}_2\text{O}$ ✓	1	ALLOW multiples IGNORE state symbols (even if wrong)

Question			Answer	Marks	Guidance
30	(a)	(i)	<i>Disproportionation:</i> oxidation and reduction of the same element ✓ <i>Redox:</i> Cl is oxidised from +5 (in KClO_3) to +7 (in KClO_4) ✓ Cl is reduced from +5 (in KClO_3) to -1 (in KCl) ✓	3	ALLOW 'chlorine' OR 'Cl' for same element IGNORE 'species' for 'element' ALLOW after number, e.g. 5+ IGNORE ionic charges, e.g. Cl^{5+} IGNORE '5' (signs required) IGNORE any reference to electron loss/gain (even if wrong) ALLOW one redox mark if oxidation numbers are correct but reduction/oxidation is incorrectly assigned
		(ii)	potassium chlorate(VII) ✓	1	Brackets required

Question			Answer	Marks	Guidance
31	(a)		$n(\text{H}_2\text{O}_2) = 2.30 \times \frac{25.0}{1000}$ OR $= 0.0575 \text{ (mol)}$ ✓ $\text{vol O}_2 = \frac{0.0575}{2} \times 24000 = 690 \text{ cm}^3$ ✓ Collect in $1000 \text{ cm}^3/1 \text{ dm}^3$ measuring cylinder ✓	3	ALLOW $0.69(0) \text{ dm}^3$ 2 nd mark subsumes 1 st mark ALLOW $1000 \text{ cm}^3/1 \text{ dm}^3$ syringe Needs a name of actual apparatus, not just 'container' 'measuring cylinder' without volume is insufficient

Question			Answer	Marks	Guidance
32	(a)	(i)	Titres correct and ALL recorded to 2 decimal places Titre: 24.00 23.40 23.75 23.85 ✓ mean titre = 23.80 (cm ³) ✓	2	ALLOW 23.8 cm ³
	(d)	(ii)	Percentage uncertainty = $\frac{0.05 \times 2}{23.40} \times 100 = 0.43 \text{ (\%)} \checkmark$	1	ALLOW ECF from incorrect subtraction in (i) or incorrect mean ALLOW 0.42% from titre values 2, 3 or 4 or mean titre or trial titre. 2 DP required
	(d)	(iii)	Add starch (near the end point) ✓ Blue to colourless ✓	2	ALLOW blue/black OR black OR purple for colour of mixture ALLOW blue colour disappears (to colourless)

Question			Answer	Marks	Guidance
	(d)	(iv)	FIRST CHECK THE ANSWER ON THE ANSWER LINE IF B = RbIO₃ AND relative formula mass = 260.5 award 5 marks IF relative formula mass = 260.5 award 4 marks ----- $n(\text{S}_2\text{O}_3^{2-})$ in titration $= \frac{0.150 \times 23.80}{1000} = 3.57 \times 10^{-3} \text{ (mol) } \checkmark$ $n(\text{IO}_3^-)$ in titration $= \frac{3.57 \times 10^{-3}}{6} = 5.95 \times 10^{-4} \text{ (mol) } \checkmark$ $n(\text{IO}_3^-)$ in original 250 cm³ $= 10 \times 5.95 \times 10^{-4} = 5.95 \times 10^{-3} \text{ (mol) } \checkmark$ Relative formula mass of B $= \frac{1.55}{5.95 \times 10^{-3}} = 260.5 \text{ (g mol}^{-1}\text{) } \checkmark$ Formula of B (must be derived from relative formula mass) Iodate of Group 1 metal that most closely matches calculated molar mass of B Formula from 260.5 = RbIO₃ $\checkmark$	5	ALLOW ECF from incorrect mean titre in (a)(i) ECF from $n(\text{S}_2\text{O}_3^{2-})$ in titration ALLOW a two-step calculation $n(\text{I}_2) = n(\text{S}_2\text{O}_3^{2-}) \div 2$ and $n(\text{IO}_3^-) = n(\text{I}_2) \div 3$ ECF from $n(\text{IO}_3^-)$ in titration ECF from $n(\text{IO}_3^-)$ in original 250 cm³ IF scaling $\times 10$ is omitted, ALLOW ECF from $n(\text{IO}_3^-)$ in titration ALLOW ECF from incorrect RFM of B provided metal is from Group 1 ALLOW RbIO₃⁻ DO NOT ALLOW RbIO₃ without relative formula mass value. DO NOT ALLOW 260.4 (without working) and RbIO₃ IF B = RbIO₃ AND relative formula mass = 261 award 5 marks
			Total	20	

Question			Answer	Marks	AO element	Guidance
33	(a)	(i)	(0.00200 mol dm ⁻³ solution gives) a large titre which leads to a small (percentage) error / uncertainty ✓	1	3.4	ALLOW (0.0200 mol dm ⁻³ solution gives) a small titre which leads to a large (percentage) error / uncertainty Assume 'it' means dilute solution ALLOW 13.50 cm ³ gives a lower percentage error than 1.35 cm ³
33	(a)	(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 301 mg award 5 marks	5	2.8 x5	ALLOW ECF throughout ALLOW working to 3SF minimum throughout

Question			Answer	Marks	AO element	Guidance
			$n(\text{MnO}_4^-) = \frac{13.50}{1000} \times 0.00200 = 2.7(0) \times 10^{-5} \text{ (mol)} \checkmark$ $n(\text{Fe}^{2+}) \text{ (in } 25.0 \text{ cm}^3) = 2.7(0) \times 10^{-5} \times 5 = 1.35 \times 10^{-4} \text{ (mol)} \checkmark$ $n(\text{Fe}^{2+}) \text{ (in } 250 \text{ cm}^3) = 1.35 \times 10^{-4} \times 10 = 1.35 \times 10^{-3} \checkmark$ Mass $\text{C}_{12}\text{H}_{22}\text{FeO}_{14}$ in 2 tablets $= 1.35 \times 10^{-3} \times 445.8 = 0.6018 \text{ (g)} \checkmark$ Mass $\text{C}_{12}\text{H}_{22}\text{FeO}_{14}$ in 1 tablet = 301 (mg) AND to 3 SF $\checkmark$			Common errors 602 (mg) (not dividing by 2) = 4 marks 37.7 (using 55.8 instead of 445.8) = 4 marks Last mark involves dividing by two and converting g to mg. These steps may be seen earlier
		(iii)	A: Mass Fe = $\frac{180 \times 55.8}{151.8} = 66 \text{ mg}$ B: Mass Fe = $\frac{210 \times 55.8}{169.8} = 69 \text{ mg}$ Iron supplement: B provides more Fe per tablet $\checkmark$	1	3.1 x1	ALLOW correct working if iron supplement is not named ALLOW iron(II) fumarate or $\text{C}_4\text{H}_2\text{FeO}_4$
				18		

Question			Answer	Marks	AO element	Guidance
	34	(a)	$n(\text{C}_2\text{H}_5\text{COOH}) = (0.0800 \times \frac{25.0}{1000}) = 0.002 \text{ (mol)}$ AND $V(\text{NaOH}) = \frac{0.002}{0.100} \times 1000 = (= 20(.0) \text{ cm}^3) \checkmark$	1	2.5	<i>incorrect K_a values</i> ALLOW 0.02 dm³ if unit given Mark is for WORKING which could all be shown as 1 step ALLOW method showing 20cm³ NaOH contains

Question			Answer	Marks	AO element	Guidance
35	(a)		Equation: $\text{Mg} + 2\text{CH}_3\text{COOH} \rightarrow (\text{CH}_3\text{COO})_2\text{Mg} + \text{H}_2$ ✓	3	2.6	ALLOW $\text{Mg}(\text{CH}_3\text{COO})_2$ ALLOW multiples IGNORE Oxidation numbers in formulae IGNORE state symbols
			Oxidation: Mg from 0 to +2 ✓		1.2	Mark independently from equation
			Reduction: H from +1 to 0 ✓		1.2	ALLOW 1 mark for correct oxidation numbers but

Question		Answer	Marks	AO element	Guidance
	(ii)	+2 ✓	1	2.1	+ required ALLOW 2+
36	(a)	$n(\text{MnO}_4^-)$ in titration $= 0.01 \times \frac{12.6}{1000} = 1.26 \times 10^{-4}$ ✓ $n(\text{SO}_3^{2-})$ in 25.0 cm ³ $= 1.26 \times 10^{-4} \times 2.5 = 3.15 \times 10^{-4}$ (mol) ✓ $n(\text{SO}_3^{2-})$ in 250 cm ³ $= 10 \times 3.15 \times 10^{-4} = 3.15 \times 10^{-3}$ (mol) ✓ mass Na ₂ SO ₃ in 525 g meat $= 3.15 \times 10^{-3} \times 126.1 = 0.397$ (g) ✓ mass Na ₂ SO ₃ in 1 kg of meat $= 0.397215 \times \frac{1000}{525} = 0.7566$ g OR 756.6 mg AND less than the maximum permitted level OR AW ✓	5	1.2×1 2.8×3 3.2×1	ALLOW 3 SF or more throughout ALLOW ECF throughout Calculator = 0.397215 g ALLOW within range: 756 to 757 mg ALLOW 0.397 g < 0.446 g per 525 g meat.
		Total	15		

Question			Answer	Marks	AO element	Guidance
37	(a)		Formula: CuCO_3 ✓ $\text{CuCO}_3 + 2\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O}$ ✓	2	AO1.2 AO2.6	IGNORE state symbols ALLOW formula within equation. ALLOW other copper(II) compounds which can react with nitric acid to form a gas e.g. CuS , CuSO_3 for mark 1, with correct equation for mark 2. e.g. $\text{CuSO}_3 + 2\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{SO}_2 + \text{H}_2\text{O}$
	(b)		$2\text{Cu}^{2+}(\text{aq}) + 4\text{I}^{-}(\text{aq}) \rightarrow 2\text{CuI}(\text{s}) + \text{I}_2(\text{aq})$ ✓	1	AO2.6	ALLOW multiples State symbols are required
	(c)		starch (solution) AND blue-black to colourless ✓	1	AO1.2	ALLOW blue OR black OR purple for colour of mixture ALLOW blue colour disappears (to colourless) IGNORE 'clear' IGNORE 'colorimetry'
	(d)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.35 award 4 marks ----- $n(\text{S}_2\text{O}_3^{2-}) = 0.0200 \times \frac{26.55}{1000}$ $= 5.31 \times 10^{-4} \text{ (mol) } \checkmark$ $n(\text{I}_2) = 2.655 \times 10^{-4} \text{ OR}$ $n(\text{Cu}^{2+}) = 5.31 \times 10^{-4} \text{ (mol) } \checkmark$ $m(\text{Cu}/\text{Cu}^{2+}) \text{ in ore} = 63.5 \times 5.31 \times 10^{-4}$ $= 0.0337 \dots \text{ (g) } \checkmark$ $\text{percentage} = \frac{0.0337 \dots}{2.50} \times 100$ $= 1.35 \text{ (\%)} \checkmark \text{ (3SF required)}$	4	AO2.8 ×5	FULL ANNOTATIONS MUST BE USED ----- ALLOW ECF throughout If 1:2 ratio for $\text{I}_2:\text{Cu}^{2+}$ not used check ratio in b) and allow ECF IGNORE rounding errors after 3 SF Calculator: 0.0337185 ALLOW 3 SF (0.0337) up to calculator value ECF dependent on the use of a calculated mass of Cu/Cu^{2+}

Question			Answer	Marks	AO element	Guidance
	(e)	(i)	Lower AND smaller titre ✓	1	AO3.4	ALLOW less I ₂ produced / less Cu ²⁺ reacts
		(ii)	The same AND burette measures by difference ✓	1	AO3.4	ALLOW AW
	(f)		Any two of the following: Make up a (standard solution) from Step 2 to a stated volume (e.g. 250 cm³) OR Repeat titrations AND Take mean of concordant/closest titres/ identify anomalies OR lower [S₂O₃]²⁻ to increase titre volume (to reduce the percentage error). OR higher [S₂O₃]²⁻ so not to refill the burette. OR Use a 3 dec place balance (to reduce the percentage error).	2	AO3.4 x 2	
			Total	12		

Question			Answer	Marks	AO element	Guidance
	38	(a)	$n(\text{H}_2\text{SO}_4) = 1.60 \times \frac{25.0}{1000} = 0.04(00) \text{ (mol)}$ AND $n(\text{NaOH}) = 1.50 \times \frac{55.0}{1000} = 0.0825 \text{ (mol) } \checkmark$ 0.04(00) mol H_2SO_4 reacts with 0.08(00) mol NaOH OR 1 mol H_2SO_4 reacts with 2 mol NaOH $\checkmark$	2	AO2.2 ×2	ALLOW 0.0825>0.08

Question			Answer	Marks	AO element	Guidance				
39	(a)	(i)	Titres <table border="1"><tr><td>22.75</td><td>22.45</td><td>22.70</td><td>22.55</td></tr></table> ✓ Mean titre $\frac{22.45 + 22.55}{2} = 22.5(0) \text{ (cm}^3\text{)} \checkmark$	22.75	22.45	22.70	22.55	2	AO1.2 x2	2 DP essential i.e. last 0 for 22.70 DO NOT ALLOW use of trial titre.
22.75	22.45	22.70	22.55							
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 498 mg award 5 marks ----- Number of moles of KOH in titre $= 0.0600 \times \frac{22.50}{1000}$ OR $1.35 \times 10^{-3} \text{ (mol)} \checkmark$ Number of moles of acid in 10 cm³ $= \frac{1.35 \times 10^{-3}}{2}$ OR $6.75 \times 10^{-4} \text{ (mol)} \checkmark$ Number of moles of acid in 250 cm³ $= 6.75 \times 10^{-4} \times 25$ OR $0.016875 \text{ (mol)} \checkmark$ Mass of acid in 4 tablets $= 0.016875 \times 118$ OR $1.99125 \text{ (g)} \checkmark$ Mass in one tablet AND mg conversion (i.e. divide by 4 AND x 1000) $= \frac{1.99 \times 10^3}{4} = 498 \text{ (mg)} \checkmark$ Answer must be to 3SF	5	AO2.8 x3 <					

Question			Answer	Marks	AO element	Guidance
40		(a)	Oxidation $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$ ✓ Reduction $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ OR $\text{H}^+ + \text{e}^- \rightarrow \frac{1}{2}\text{H}_2$ ✓	2	AO2.6 x2	IGNORE exothermic In half equations, ALLOW the use of e for e^- ALLOW $\text{Mg} - 2\text{e}^- \rightarrow \text{Mg}^{2+}$ IGNORE state symbols even is wrong BUT half equations MUST only have species that change. For charges on half equations, ALLOW Mg^{+2} for Mg^{2+} OR H^{+1} for H^+ If BOTH half equations are correct but shown with oxidation and reduction the wrong way around, award 1 mark from the 2 marks for half equations

Question			Answer	Marks	AO element	Guidance
41		(a)	$\text{Ba}^{2+}(\text{aq}) + 2\text{H}^{+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$ ✓	1	AO3.2	ALLOW multiples ALLOW $\text{H}^{+}(\text{aq}) + \text{OH}^{-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$ OR $\text{H}^{+}(\text{aq}) + \text{OH}^{-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$

Question		Answer	Marks	AO element	Guidance
42	(a)	(i) FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 731(g) award 3 marks ----- <i>n</i>(Z) $n(\text{Ca}_5\text{NH}_4(\text{NO}_3)_{11} \cdot 10\text{H}_2\text{O}) = \frac{1500}{1080.5}$ OR 1.388246... ✓ Mass of limestone $n(\text{CaCO}_3) = 1.388246... \times 5$ OR 6.94123... AND mass $\text{CaCO}_3 = 6.94123... \times 100.1$ OR 694.8 g ✓ mass limestone = $\frac{694.8 \times 100}{95.0} = 731 \text{ g (3SF)}$ ✓	3	AO2.6 ×3	ALLOW ECF throughout ALLOW calculation process in any order. IGNORE rounding errors past 3SF DO NOT ALLOW 100 for M_r of CaCO_3 Common errors 2 marks 146g no × 5 for moles of CaCO_3 660g use of 95.0/100 29.3g divide by 5 rather than ×5

		(ii)	$\text{Mg}_3\text{Ca}(\text{CO}_3)_4(\text{s}) + 8\text{HCl}(\text{aq}) \rightarrow$ $3\text{MgCl}_2(\text{aq}) + \text{CaCl}_2(\text{aq}) + 4\text{H}_2\text{O}(\text{l}) + 4\text{CO}_2(\text{g})$ Correct formulae ✓ Balanced AND state symbols ✓	2	AO2.6 ×2	ALLOW multiples M2 dependent on M1 IGNORE incorrect state symbol for $\text{Mg}_3\text{Ca}(\text{CO}_3)_4$
			TOTAL	13		

43	(a)	(i)	$\text{SrCO}_3 + 2\text{HNO}_3 \rightarrow \text{Sr}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$ ✓	1	AO2.6	IGNORE state symbols DO NOT ALLOW H_2CO_3 for $\text{H}_2\text{O} + \text{CO}_2$ (question states that a gas was produced) ALLOW multiples
		(ii)	M_r of SrCO_3 is different to M_r CaCO_3 / moles SrCO_3 are different to moles CaCO_3 ✓ M_r of $\text{SrCO}_3 > M_r$ CaCO_3 / moles $\text{SrCO}_3 <$ moles CaCO_3 AND More moles/volume gas (from CaCO_3) ✓	2	AO3.1 ×1 AO3.2 ×1	ALLOW ORA ALLOW $n(\text{SrCO}_3) = (1.00 \div 147.6) = 6.78 \times 10^{-3}$ (mol) AND $n(\text{CaCO}_3) = (1.00 \div 100.1) = 9.99 \times 10^{-3}$ (mol) For the 2nd mark, we are assessing the idea of the greater moles of carbonate produces more gas.

	44	(a)	$\text{Mg} + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2$ ✓	1	AO2.6	ALLOW multiples ALLOW Mg^{+2} IGNORE state symbols
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Question			Answer	Marks	AO element	Guidance			
45	(a)	(i)	Colourless to (pale) pink	1	AO1.1	ALLOW <u>Pale</u> purple DO NOT ALLOW purple			
		(ii)	<table border="1"><tr><td>12.65</td><td>12.95</td><td>12.75</td></tr></table> ✓ $\frac{12.65+12.75}{2} = 12.7(0) \text{ cm}^3 \checkmark$	12.65	12.95	12.75	2	AO2.8 x2	
12.65	12.95	12.75							
		(iii)	FIRST CHECK THE ANSWER ON ANSWER LINE if answer = 6.35×10^{-3} award 3 marks ----- $n(\text{MnO}_4^-)$ in titration = $(0.00250 \times \frac{12.7}{1000})$ = $3.175 \times 10^{-5} \checkmark$ $n(\text{Fe}^{2+})$ in 25.0 cm³ = $(3.175 \times 10^{-5} \times 5)$ = $1.5875 \times 10^{-4} \text{ (mol)} \checkmark$ $[\text{Fe}^{2+}] = (1.5875 \times 10^{-4} \div 0.025)$ OR $(1.5875 \times 10^{-4} \times 40)$ = $6.35 \times 10^{-3} \text{ (mol dm}^{-3}\text{)} \checkmark$	3	AO2.8 x3	ALLOW ECF from incorrect titre in 21 a ii) for 3 marks e.g. Titre of 12.78 cm³ gives 6.39×10^{-3} ----- ALLOW 3 SF or more throughout ALLOW ECF throughout ALLOW $n(\text{Fe}^{2+})$ in 250 cm³ = $1.5875 \times 10^{-3} \text{ (mol)}$ so $[\text{Fe}^{2+}]$ in 25 cm³ = $1.5875 \times 10^{-3} \div 0.25 = 6.35 \times 10^{-3}$ Common errors for 2 marks 2.46×10^{-2} (volumes transposed) 1.25×10^{-2} (same volume used twice) 1.27×10^{-3} (no x 5) 2.54×10^{-4} ($\div 5$)			

Question			Answer	Marks	AO element	Guidance
46	(a)		$3\text{V}^{3+} + \text{Cr}_2\text{O}_7^{2-} + 2\text{H}^+ \rightarrow 3\text{VO}_2^+ + 2\text{Cr}^{3+} + \text{H}_2\text{O}$ ALL reactant and product species correct ✓ Correct balancing (of correct equation) AND cancelling of species ✓	2	AO2.5 AO2.6	IGNORE Balancing and electrons for first mark DO NOT ALLOW electrons in final answer

Question			Answer	Marks	Guidance
					Common error: 2 marks 0.90 (not using $[H^+]^2$)
47	(a)	(i)	Smooth s-shaped curve using a best fit line that goes through the majority of points. ✓ Reading off x-axis at 12.5 cm³ ✓ $n(\text{Ba}(\text{OH})_2) = 0.0560 \times \frac{12.5}{1000}$ $= 7.00 \times 10^{-4} \text{ ✓}$ $n(\text{CH}_3\text{COOH}) = 2 \times (\text{moles Ba}(\text{OH})_2)$ $= 1.40 \times 10^{-3} \text{ ✓}$ $(\text{concentration}) = \frac{1.4 \times 10^{-3}}{(10/1000)}$ $= 0.14(0) \text{ (mol dm}^{-3}\text{) ✓}$	5	DO NOT ALLOW point to point DO NOT ALLOW tram/feather lines. ALLOW Reading off x-axis from 12.4 – 12.6 cm ³ ALLOW ECF throughout ALLOW 3SF or more unless there is a trailing zero <u>Alternative answers:</u> 0.139 (mol dm ⁻³) (from reading off x-axis at 12.4 cm ³) 0.141 (mol dm ⁻³) (from reading off x-axis at 12.6 cm ³) Common errors: 3 Marks 0.134 (Use of 12 cm ³) 0.202 (use of 18 cm ³)

		(ii)	Phenol red OR Phenolphthalein✓	1	Both indicators can change colour on the sharp vertical section of the candidates curve.
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Question		Answer	Marks	Guidance
21	(a)		3	ALLOW multiples
48	(a)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 84 award 4 marks ----- $n(\text{I}^-) = \frac{26.2 \times 0.150}{1000} = 3.93 \times 10^{-3} \checkmark$ $n(\text{IO}_3^-) = \frac{3.93 \times 10^{-3}}{5} = 7.86 \times 10^{-4} \checkmark$ mass KIO₃ in 2 tablets = $7.86 \times 10^{-4} \times 214 = 0.168204 \text{ g}$ $\checkmark$ mass KIO₃ in 1 tablet = $0.084102 \text{ g} = 84 \text{ mg}$ (nearest whole number)$\checkmark$	4	ALLOW 3 SF or more throughout ALLOW ECF throughout Care – other sequence of calculations can be valid. <u>Alternative route</u> M3 mol (IO₃⁻) in one tablet = $\frac{7.86 \times 10^{-4}}{2} = 3.93 \times 10^{-4}$ M4 Mass (KIO₃) in one tablet = $3.93 \times 10^{-4} \times 214 = 84$ Final answer must be a whole number Common Errors 3 marks: 69 mg (using M_r of IO₃⁻) 421mg (not divided by 5)

Question			Answer	Mark	Guidance
49		(a)	(Simultaneous) oxidation and reduction of (the same) <u>element</u> ✓ N from +3 (in HNO_2) to +5 (in HNO_3) AND N from +3 (in HNO_2) to +2 (in NO) ✓ N is oxidised to HNO_3 AND N is reduced to NO ✓	3	ALLOW N / nitrogen for element IGNORE species for element + required ALLOW 3+, 5+, and 2+ DO NOT ALLOW N^{3+} , N^{5+} and N^{2+} ALLOW clearly assigned oxidation numbers above the equation if not quoted on the answer line

Question			Answer	Mark	Guidance
5	(a)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 65.4% award 5 marks $n(\text{S}_2\text{O}_3^{2-}) = \frac{31.15 \times 0.0800}{1000} = 2.492 \times 10^{-3} \checkmark$ $n(\text{Cu}^{2+}) \text{ in } 25 \text{ cm}^3 = 2.492 \times 10^{-3}$ OR $n(\text{I}_2) = 1.246 \times 10^{-3} \checkmark$ $n(\text{Cu}^{2+}) \text{ in } 250 \text{ cm}^3 = 2.492 \times 10^{-2} \checkmark$ Mass $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in mixture A = $2.492 \times 10^{-2} \times 249.6$ $= 6.22(0032) \text{ g} \checkmark$ $\% = \frac{6.22 \times 100}{9.51} = 65.4 \% \text{ (3 SF required)} \checkmark$	5	ALLOW ECF throughout ALLOW 3 SF up to calculated value IGNORE rounding errors after 3 SF Common Errors 4 marks 65.2% (use of 249 rather than 249.6) 41.8% (use of 159.6 (CuSO_4)) 32.7% (no use of second ratio) 6.54% (no x 10)
		(ii)	Iron(III) / Fe^{3+} reacts with iodide ions (I^-) to form <u>iodine</u> (I_2) OR Iron(III) / Fe^{3+} oxidises $\text{I}^- \checkmark$	1	ALLOW ORA ALLOW (because) Iron(III) is reduced by /reacts with thiosulfate