Multiple Choice Answers

Q4: B

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1(a)	**I** The following data are recorded: • two burette readings **AND** titre for the rough titration • initial and final burette 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 FA 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. Examiner selects 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 candidate's mean titre value Calculate the supervisor's mean titre value Calculate the difference (δ) between the candidate's mean titre and the supervisor'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)	Correctly calculates mean titre to 2 dp • 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 dp 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)	All answers to **(c)(ii)**, **(c)(iii)** and **(c)(iv)** to 3 − 4 sf
1(c)(ii)	Correctly calculates amount of manganate(VII) = 0.02 × volume in **(b)** / 1000 mol
1(c)(iii)	Correctly uses **M1** Amount of ethanedioic acid = **(c)(ii)** × 5 / 2 mol **M2** Concentration of **FA 1** = **(c)(ii)** $\times {}^{5}/_{2} \times {}^{1000}/_{25}$ mol dm^{-3}
1(c)(iv)	Correctly uses M_r = 6.2(0) / **(c)(iii)**
1(c)(v)	(M_r – 90) / 18 **AND** correctly calculates answer as integer
1(d)	H^+ needed in the reaction / H^+ used in / appears in the equation

2(a)	**I** Six correct headings with units in results space • (Mass) crucible + lid / g • (Mass) crucible + lid + **FA 4** / g • (Mass) crucible + lid + residue / contents after first heating / g • (Mass) crucible + lid + residue after second heating / g • (Mass) **FA 4** (used) / g • (Mass) residue / g Display of units: / g, (g), in g, in gram(me)s or in (column) heading covering all entries
	II Four readings in space provided • All four weighings recorded to same decimal places (either to two or to three) • Reading after 2nd heating within + 0.02 and − 0.05 of reading after 1st heating
	II Correct subtractions • Correct calculations of mass **FA 4** and residue **AND** • Mass of **FA 4** is between 2.90 and 3.40 g.
	IV and V Accuracy Theoretical value = 1.78 Calculate and record candidate's mass ratio = mass **FA 4** / mass of residue. Award **IV** if 1.51 ⩽ candidate's mass ratio ⩽ 2.05 Award **V** if 1.60 ⩽ candidates mass ratio ⩽ 1.96
2(b)(i)	Correctly uses **M1** Amount $ZnSO_4$ = mass residue / 161.5 mol **AND** answer given to 2 – 4 sf Correctly calculates **M2** Amount H_2O = mass water lost / 18 mol **AND** answer given to 2–4 sf
2(b)(ii)	**M1** y = moles H_2O / moles $ZnSO_4$ **M2** Expression evaluated and y correctly calculated quoted as integer
2(c)	The (anhydrous ethanedioic) acid would decompose (on heating) / is flammable

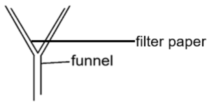
2(a)	**I**	All the following data are recorded • two burette readings **AND** titre for the rough titration • initial and final burette readings for **two** (or more) accurate titrations
	II	Titre values recorded for accurate titrations, **AND** Correct headings and units in the accurate titration table • initial / start **AND** (burette) reading / volume • final / end **AND** (burette) reading / volume • titre **OR** volume used / added / **or FB 5** 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 are recorded to the nearest 0.05 cm^3.
	IV:	The final accurate titre recorded is 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 candidate's mean titre value. Calculate the supervisor's mean titre value. Calculate the difference (δ) between the candidate's mean titre and the supervisor's mean titre.	
	Award accuracy Q marks as follows: **V** award if $\delta \leqslant 0.60\ cm^3$ **VI** award if $\delta \leqslant 0.40\ cm^3$ **VII** award if $\delta \leqslant 0.20\ cm^3$	
2(b)	Correctly calculates mean titre to 2 d.p. • 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 rounded to nearest 0.01 cm^3.	
2(c)(i)	Final answers to both parts **(c)(ii)** and **(c)(iii)** quoted to 3 or 4 sf.	
2(c)(ii)	Correctly calculates amount of $HCl = 0.2 \times$ **(b)** / 1000 (mol) **AND** gives same answer for amount of $NaHCO_3$	
2(c)(iii)	Correctly uses mass of $NaHCO_3$ = **(c)(ii)** $\times$ 40 $\times$ 84(.0) (g)	
	Correctly uses percentage by mass = [(17.20 – mass of $NaHCO_3$) / 17.20] $\times$ 100 **OR** percentage by mass = 100 – [(mass of $NaHCO_3$ / 17.20) $\times$ 100]	
2(d)	**M1:** (ΔH_1) smaller / less positive (for impure $NaHCO_3$)	
	M2: Impurity does not react with the acid / **FB 5**	

1(a)(i)	2.12 g
1(a)(ii)	**M1** add a (small) volume of (distilled) water (to the small beaker) **AND** dissolve the solid / $AgNO_3$ (s) **M2** Transfer the solution and washings (using a funnel) **AND** into a 250 cm^3 volumetric flask. **M3** Make up to the (calibration) mark / line with **distilled** water. **AND** **then** invert the (stoppered) flask (several times)
1(b)(i)	(20(.0) cm^3) pipette.
1(b)(ii)	barium (ions) could react with chromate (ions).
1(b)(iii)	Potassium chromate(VI) / K_2CrO_4(aq) is an irritant / corrosive
1(c)(i)	They are (the only ones that are) concordant.
1(c)(ii)	$\frac{2 \times 0.05}{20.60} \times 100$ = 0.48(54%) Correct working **must** be shown.
1(d)(i)	20.65 $\times$ 0.05 / 1000 = 0.00103(25)
1(d)(ii)	= ((**d)(i)** / 2) *(250 / 20) = **(d)(i)** $\times$ 6.25
1(d)(iii)	**M1** M_r = 1.58 / **(d)(ii)** **M2** x= (M1 – 208.3) / 18 **AND** x must be an integer. Some working must be shown.
1(e)	Heat to drive off water of crystallisation. **M1 Apparatus** 1 Bunsen burner. 2 Crucible (supported by pipeclay triangle) **M2 Measurements** 1 Measure mass of crucible (+ lid) (empty). 2 Measure mass crucible (+ lid) + solid before heating 3 Measure mass of crucible (+ lid) + residue (after heating.) **M3 Key step in method** • Description of heat to constant mass. **OR** Produce a suitable precipitate using a viable reaction. **M1 Apparatus and method** • Chooses suitable reagent. • Filter the precipitate. • Wash and (allow to) dry **M2 Measurements** • Measure mass of hydrated barium chloride used. • Measure mass of precipitate. **M3 Key step in method** • Description of dry to constant mass.

<table>
<tr><td>2(a)(i)</td><td>(25.0 cm^3) volumetric pipette</td></tr>
<tr><td>2(a)(ii)</td><td>(wear) chemically resistant gloves</td></tr>
<tr><td>2(b)(i)</td><td>
<table>
<tr><th>Total volume in beaker / cm^3</th><th>Corrected conductivity / μS cm^{-1}</th></tr>
<tr><td>25.00</td><td>37000</td></tr>
<tr><td>30.00</td><td>27600</td></tr>
<tr><td>35.00</td><td>16800</td></tr>
<tr><td>40.00</td><td>3680</td></tr>
<tr><td>45.00</td><td>9000</td></tr>
<tr><td>50.00</td><td>24000</td></tr>
<tr><td>55.00</td><td>39600</td></tr>
<tr><td>60.00</td><td>50400</td></tr>
<tr><td>65.00</td><td>63700</td></tr>
</table>
M1 Total volume in beaker values
M2 Corrected conductivity values</td></tr>
<tr><td>2(b)(ii)</td><td>volume of 0.100 mol dm^{-3} $Ba(OH)_2$(aq) added to beaker</td></tr>
<tr><td>2(c)</td><td>**M1**: all points 1–4 and 5–9 plotted correctly

M2: two straight lines of best fit line drawn going through most points.
lines must intersect.

Place M2 tick in ‘V’ of graph
Place M1 tick or cross on left hand side of grid
Place cross (or highlight) against mis-plot</td></tr>
</table>

<table>
<tr><td>2(d)(i)</td><td>intersection point volume (read from within grid)</td></tr>
<tr><td>2(d)(ii)</td><td>nSO_4^{2-} =0.100 × ans **(d)(i)** / 1000 = mol
[SO_4^{2-}(aq)] = [0.100 × **(d)(i)** / 1000] / 0.025</td></tr>
<tr><td>2(e)(i)</td><td>diagram showing labelled filter paper in a labelled (filter) funnel

</td></tr>
<tr><td>2(e)(ii)</td><td>wash the residue with distilled water</td></tr>
<tr><td>2(e)(iii)</td><td>heat to constant mass</td></tr>
<tr><td>2(e)(iv)</td><td>higher value
and
(water would cause) (measured) mass / amount (of residue) would be greater</td></tr>
</table>

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• 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
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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.</td></tr>
<tr><td></td><td>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</td></tr>
<tr><td>1(b)</td><td>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.
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• 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).</td></tr>
<tr><td>1(c)(i)</td><td>Final answers for **(c)(ii)**, **(c)(iii)** and **(c)(iv)** to 3 or 4 significant figures.</td></tr>
<tr><td>1(c)(ii)</td><td>Correctly calculates
amount of manganate(VII) = 0.01 × $^{\text{volume in }\mathbf{(b)}}/_{1000}$ mol</td></tr>
<tr><td>1(c)(iii)</td><td>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}</td></tr>
<tr><td>1(c)(iv)</td><td>Correctly uses
concentration of Fe^{2+} = **(c)(iii)** × 55.8 g dm^{-3}</td></tr>
<tr><td>1(c)(v)</td><td>Conclusion
yes / correct (because)
AND $^{\mathbf{(c)(iv)} \times 1000}/_{14}$ (> 150 claimed as present in tablet)</td></tr>
<tr><td>1(d)</td><td>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.</td></tr>
</table>