

Markscheme

May 2025

Chemistry

Higher level

Paper 1B

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Subject Details: Chemistry Higher Level Paper 1B Markscheme

Candidates are required to answer **ALL** questions. Maximum total = **[35 marks]**.

1. Each row in the “Question” column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the “Total” column.
3. Each marking point in the “Answers” column is shown by means of a tick (✓) at the end of the marking point.
4. A question subpart may have more marking points than the total allows. This will be indicated by “**max**” written after the mark in the “Total” column. The related rubric, if necessary, will be outlined in the “Notes” column.
5. An alternative word is indicated in the “Answers” column by a slash (/). Either word can be accepted.
6. An alternative answer is indicated in the “Answers” column by “**OR**”. Either answer can be accepted.
7. An alternative markscheme is indicated in the “Answers” column under heading **ALTERNATIVE 1** etc. Either alternative can be accepted.
8. Words inside chevrons « » in the “Answers” column are not necessary to gain the mark.
9. Words that are underlined are essential for the mark.
10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
11. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect) in the “Notes” column.
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.
15. If a question specifically asks for the name of a substance, do not award a mark for a correct formula unless directed otherwise in the “Notes” column. Similarly, if the formula is specifically asked for, do not award a mark for a correct name unless directed otherwise in the “Notes” column.
16. If a question asks for an equation for a reaction, a balanced symbol equation is usually expected, do not award a mark for a word equation or an unbalanced equation unless directed otherwise in the “Notes” column.

Ignore missing or incorrect state symbols in an equation unless directed otherwise in the “Notes” column.

Question			Answers	Notes	Total
1	(a)	(i)	«250.0 cm ³ » volumetric flask ✓		1
1	(a)	(ii)	<p>Alternative 1</p> <p><i>Any two of:</i></p> <p>use funnel «to transfer solution to volumetric flask and avoid loss of solution» ✓</p> <p>rinse «beaker and funnel» and transfer washings «to volumetric flask» ✓</p> <p>fill up to line/mark with deionized/distilled water ✓</p> <p>« stopper the flask and » turn flask over «several times»/shake/homogenize « the solution » ✓</p> <p>Alternative 2</p> <p><i>Any two of:</i></p> <p>determine volume of concentrated solution needed/ $c_1V_1=c_2V_2$ ✓</p> <p>use a volumetric pipette « to remove the determined volume and transfer to a volumetric flask»</p> <p>OR</p> <p>burette « to transfer the determined volume to a volumetric flask » ✓</p> <p>fill up to line/mark with deionized/distilled water ✓</p> <p>« stopper the flask and » turn flask over «several times»/shake/homogenize « the solution » ✓</p>		2 max

Question			Answers	Notes	Total
1	(b)		«heat» to constant mass/same mass twice ✓ cool /store «solid» in desiccator/vacuum ✓		2
1	(c)	(i)	Any two of: liquid not at end of burette tip «for initial reading» ✓ first titration done quickly «to get estimate of volume needed for each titre»/ overshoot the end point by adding excess titrant ✓ burette wasn't shut correctly/leaking ✓ «conical/titration» flask/burette contaminated/not rinsed with EDTA OR «conical/titration» flask not rinsed with deionized water/rinsed with analyte solution ✓ «extra titrant added» to confirm colour change complete ✓	<i>Apply list principle (LP).</i>	2 max
1	(c)	(ii)	outlier ✓	Accept 'mistake', OR 'anomaly/anomalous value', OR 'not concordant' OR 'rogue value'.	1

Question			Answers	Notes	Total
1	(c)	(iii)	<p>mean/average/calculated concentration too high</p> <p>OR</p> <p>value not concordant «with other three»</p> <p>OR</p> <p>systematic error would occur ✓</p>	<p><i>Accept answers which calculate means with and without trial 1, showing variation to be outside random error OR 'trial 1 does not agree with the other trials when random error/uncertainty /standard deviation is considered' OR 'differs in more than 0.10 cm³ from other trials' for M2. OR 'mean/average volume would be too high'.</i></p>	1
1	(c)	(iv)	<p>$\ll \frac{0.1}{24.25} \times 100 = \gg$</p> <p>0.41/0.4 «%» ✓</p>		1
1	(c)	(v)	<p>X/red «complex» absorbs green light /at 491-575nm/ its complementary colour</p> <p>AND</p> <p>Y/blue «ion» absorbs orange light/at 585-647nm/its complementary colour ✓</p> <p>green light is higher energy/ higher frequency /shorter wavelength/«than orange light» ✓</p>	<p><i>Accept converse argument for M2.</i></p>	2

Question			Answers	Notes	Total
1	(d)	(i)	<p>Absorbance vs Concentration of Ca²⁺ / ppm</p> <p>Reasonable line of best fit with equal spacing of points above and below the line ✓</p>	<p><i>Accept lines that are not extrapolated.</i></p>	1
1	(d)	(ii)	<p>9.2 «ppm» ✓</p>	<p><i>Mark can be scored based on part d (i) of this question.</i></p>	1

Question			Answers	Notes	Total
1	(d)	(iii)	<p>Alternative 1: $\left\langle \frac{I_0}{I} = 10^{0.090} \right\rangle 1.23 \checkmark$</p> <p>$\left\langle I = \frac{I_0}{1.23} \right\rangle$ $\left\langle I = 0.813 I_0 = 81.3\% I_0 \right\rangle$</p> <p>$\left\langle \% \text{ absorbed} = 100 - 81.3 = \right\rangle 18.7 \left\langle \% \right\rangle \checkmark$</p> <p>Alternative 2: $\left\langle \frac{I}{I_0} = 10^{-0.090} = \right\rangle 0.813 \checkmark$</p> <p>$\left\langle I = 81.3\% I_0 \right\rangle$</p> <p>$\left\langle \% \text{ absorbed} = 100 - 81.3 = \right\rangle 18.7 \left\langle \% \right\rangle \checkmark$</p>	Award [2] for correct final answer.	2
1	(d)	(iv)	<p>$\left\langle C_1 = \frac{C_2 V_2}{V_1} = \frac{4.00 \times 25.00}{2.00} \right\rangle$</p> <p>50.0 «ppm» ✓</p>		1
1	(d)	(v)	<p>$\left\langle \frac{4.00 \times 10^{-3}}{40.08} \right\rangle$ $9.98 \times 10^{-5} \left\langle \text{mol dm}^{-3} \right\rangle \checkmark$</p>		1
2	(a)	(i)	<p><i>Independent variable:</i> «boiling» time</p> <p>AND</p> <p><i>Dependent variable:</i> volume/titre «of KMnO₄(aq) added» ✓</p>	Do not accept 'amount/[Fe ²⁺] in solution' as it's the derived dependent variable.	1

Question			Answers	Notes	Total
2	(a)	(ii)	<p>Any two of: final volumes of solution should be the same «by adding water after filtration» ✓</p> <p>«samples of» spinach leaves should have stems removed ✓</p> <p>spinach samples should be the same freshness / colour / size/surface area ✓</p> <p>boil water before adding spinach ✓</p> <p>time spinach is left in hot solution «after boiling» should be the same ✓</p> <p>use distilled/deionized water ✓</p> <p>store solutions in refrigerator for same time ✓</p> <p>use same sized storage bottles ✓</p> <p>all samples must be at room temperatures/same temperature when titrating ✓</p> <p>the solution/titrant has an acidic pH/is acidic ✓</p> <p>KMnO₄ is photosensitive/should not be exposed to light ✓</p>	<p><i>Apply list principle (LP)</i></p>	<p>2 max.</p>
2	(a)	(iii)	«boiled» water with no spinach		<p>1</p>

Question			Answers	Notes	Total
2	(a)	(iv)	<p>Any two of:</p> <p>KMnO₄(aq) is purple/too dark to read burette OR burette must be read from top of meniscus ✓</p> <p>spinach solutions green /have color/not colorless OR endpoint is mixture of green and «pale» pink ✓</p> <p>reaction might be slow «so colour takes a long time to disappear but titration should be done quickly to prevent organics reducing Fe³⁺ back to Fe²⁺ » ✓</p>	<p><i>Apply List Principle (LP).</i></p>	<p>2 max</p>
2	(b)	(i)	<p>amount/concentration of Fe²⁺ extracted/released from spinach does not change as boiling time increases « from 5 to 20 minutes » OR no relationship/correlation/none « shown » ✓</p>	<p><i>Accept 'negative correlation to 15 min AND positive correlation after 15 min'.</i></p>	<p>1</p>

Question			Answers	Notes	Total
2	(b)	(ii)	<p><i>Range:</i></p> <p>boiling times are realistic cooking times OR narrow range «of boiling times » OR range is not ideal to see a relationship as it is likely all Fe²⁺ has been extracted before 5 mins</p> <p>OR additional boiling times needed to see trend ✓</p> <p><i>Quantity:</i></p> <p>sufficient measurements for each boiling time OR variation between replicates needed « to inform response » OR measurement at t = 0 needed « to see whether boiling makes any difference »</p> <p>OR insufficient « boiling time » intervals</p> <p>OR one/a single interval between 0 and 5 minutes is insufficient «to notice a trend» ✓</p>	<p><i>Accept 'limited quantity of trials doesn't allow to calculate the standard deviation' for M1 in Quantity.</i></p>	2

Question			Answers	Notes	Total
2	(c)	(i)	<p>not supported AND cannot say if boiling makes any difference «as measurement at t = 0 not done»</p> <p>OR</p> <p>not supported AND results show no increase/ no relationship. ✓</p>	<p><i>Accept specific suggestions such as 'amount at 5 min higher than at 15'.</i></p>	1
2	(c)	(ii)	<p>«repeat the investigation» without boiling</p> <p>OR</p> <p>«repeat the investigation» for shorter times</p> <p>OR</p> <p>«repeat the investigation» for much longer ✓</p>	<p><i>Apply List Principle (LP).</i></p> <p><i>Accept specific suggestions such as 'single minute intervals from 1 to 5 minutes' OR 'determination « of a complex » using a spectrophotometer/colorimeter' OR 'Atomic absorption spectroscopy/AAS' OR 'larger mass of spinach'.</i></p>	1

Question		Answers	Notes	Total
3	(a)	<p>tangent drawn at t = 0 for 1.5 mol dm⁻³ solution ✓</p> <p>«gradient calculated » AND positive value for rate</p> <p>« $\frac{ 9.1 - 4.0 }{2.2 - 0} =$ »</p> <p>2.3 « g s⁻¹ » ✓</p>	<i>M1 is required for M2.</i>	2
3	(b)	<p><i>Limiting reagent:</i> HCl AND <i>Reason:</i> same initial mass of solid produces different mass of CO₂ /carbon dioxide</p> <p>OR different concentration/initial amount in moles of HCl produced different mass of CO₂ /carbon dioxide/gas/overall mass loss</p> <p>OR final mass of all mixtures would be same if NaHCO₃ was limiting ✓</p>	<i>Accept converse argument.</i>	1

Question			Answers	Notes	Total
3	(c)	(i)	«9.1 – 5.8 =» 3.3 «g»		1
3	(c)	(ii)	$\ll \frac{4.40-3.3}{4.40} \times 100 \gg$ 25 « % »	<i>Mark can be scored based on part c (i) of this question.</i>	1

Question			Answers	Notes	Total
3	(c)	(iii)	recording of mass started after reaction started OR button on data-logger was pressed too late OR random error/ error resulting from reaction time OR balance not tared/zeroed OR use of different beakers/flasks/glassware, « which have slightly different masses » OR glassware was not dried/cleaned from previous trial OR not all solid/liquid transferred OR balance calibrated between trials/calibration error OR data-logger malfunctioning/lack of synchronization/lag time ✓	<i>Apply List Principle (LP).</i>	1