2225 – 6217M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Chemistry

Standard level

Paper 1B

11 pages

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Subject Details: Chemistry Standard Level Paper 1B Markscheme

Candidates are required to answer **ALL** questions. Maximum total = **[25 marks]**.

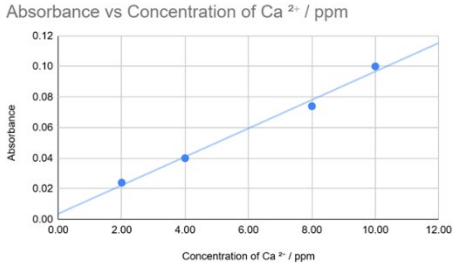
1. Each row in the "Question" column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the "Total" column.
3. Each marking point in the "Answers" column is shown by means of a tick (✓) at the end of the marking point.
4. A question subpart 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 <u>underlined</u> 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)**	***Alternative 1*** *Any two of:* use funnel «to transfer solution to volumetric flask and avoid loss of solution» ✓ rinse «beaker and funnel» and transfer washings «to volumetric flask» ✓ fill up to line/mark with deionized/distilled water ✓ « stopper the flask and » turn flask over «several times»/shake/homogenize « the solution » ✓ **Alternative 2** *Any two of:* determine volume of concentrated solution needed / c1V1=c2V2 ✓ use a volumetric pipette « to remove the determined volume and transfer to a volumetric flask» ***OR*** burette « to transfer the determined volume to a volumetric flask » ✓ fill up to line/mark with deionized/distilled water ✓ « stopper the flask and » turn flask over «several times»/shake/homogenize « the solution » ✓		**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»/ overshot 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 ✓	*Apply list principle (LP).*	**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)**	mean/average/calculated concentration too high ***OR*** value not concordant «with other three» ***OR*** systematic error would occur ✓	*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* cm^3 *from other trials' for M2* ***OR*** *'mean/average volume would be too high'.*	**1**
1	**(c)**	**(iv)**	$\left«\frac{0.1}{24.25}\times 100 =\right»$ $0.41/0.4$ «% » ✓		**1**

Question			Answers	Notes	Total
1	**(d)**	**(i)**	 Reasonable line of best fit with equal spacing of points above and below the line ✓	*Accept lines that are not extrapolated.*	**1**
1	**(d)**	**(ii)**	9.2 «ppm» ✓	*Mark can be scored based on part (d)(i) of this question.*	**1**
1	**(d)**	**(iii)**	«$C_1 = \frac{C_2V_2}{V_1} = \frac{4.00\times25.00}{2.00} =$» 50.0 «ppm» ✓		**1**
2	**(a)**	**(i)**	*Independent variable*: «boiling» time ***AND*** *Dependent variable*: volume/titre «of $KMnO_4$(aq) added» ✓	*Do **not** accept 'amount/[Fe^{2+}] in solution' as it is the derived dependent variable.*	**1**

Question			Answers	Notes	Total
2	**(a)**	**(ii)**	*Any two of:* final volumes of solution should be the same «by adding water after filtration» ✓ «samples of» spinach leaves should have stems removed ✓ spinach samples should be the same freshness/colour/ size/surface area ✓ boil water before adding spinach ✓ time spinach is left in hot solution «after boiling» should be the same ✓ use distilled/deionized water ✓ store solutions in refrigerator for same time ✓ use same sized storage bottles ✓ all samples must be at room temperatures/same temperature when titrating ✓ the solution/titrant has an acidic pH/is acidic ✓ $KMnO_4$ is photosensitive/should not be exposed to light ✓	*Apply list principle (LP).*	**2 Max.**
2	**(b)**	**(i)**	amount/concentration of Fe^{2+} extracted/released from spinach does not change as boiling time increases « from 5 to 20 minutes » ***OR*** no relationship/correlation/none « shown » ✓	*Accept 'negative correlation to 15 min **AND** positive correlation after 15 min'.*	**1**

Question			Answers	Notes	Total
2	**(b)**	**(ii)**	*Range:* 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 Fe^{2+} has been extracted before 5 mins ***OR*** additional boiling times needed to see trend ✓ *Quantity:* 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 » ***OR*** insufficient « boiling time » intervals ***OR*** one/a single interval between 0 and 5 minutes is insufficient «to notice a trend» ✓	*Accept 'limited quantity of trials doesn't allow to calculate the standard deviation' for M1 in Quantity.*	2

Question			Answers	Notes	Total
2	**(c)**	**(i)**	not supported ***AND*** cannot say if boiling makes any difference «as measurement at t = 0 not done» ***OR*** not supported ***AND*** results show no increase/ no relationship. ✓	*Accept specific suggestions such as 'amount at 5 min higher than at 15'.*	**1**
2	**(c)**	**(ii)**	«repeat the investigation» without boiling ***OR*** «repeat the investigation» for shorter times ***OR*** «repeat the investigation» for much longer ✓	*Apply List Principle (LP).* *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'.*	**1**

Question			Answers	Notes	Total
3	**(a)**	**(i)**	tangent drawn at t = 0 for 1.5 mol dm^{-3} solution ✓ «gradient calculated » ***AND*** positive value for rate $«\frac{\lvert 9.1 - 4.0 \rvert}{2.2 - 0} = »$ 2.3 « g s^{-1} » ✓	*M1 is required for M2.*	**2**
3	**(a)**	**(ii)**	$«\frac{\lvert 8.1 - 9.4 \rvert}{20} = »$ 0.065 « g s^{-1} » ✓	*Do not penalize negative sign here if already penalized in Q3(a)(i).*	**1**
	(b)		*Limiting reagent:* HCl ***AND*** *Reason:* same initial mass of solid produces different mass of CO_2 /carbon dioxide ***OR*** different concentration/initial amount in moles of HCl produced different mass of CO_2 /carbon dioxide/gas/overall mass loss ***OR*** final mass of all mixtures would be same if $NaHCO_3$ was limiting ✓	*Accept converse argument.*	**1**