

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Level

MARK SCHEME for the May/June 2015 series

9701 CHEMISTRY

9701/53

Paper 5 (Planning, Analysis and Evaluation),
maximum raw mark 30

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| Question | Statement | Expected Answer | Mark |
|-----------|-----------|---|----------------|
| 1 (a) (i) | M10 | $\text{HCOO}^-(\text{aq}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}^+(\text{aq}) + 2\text{e}^-$ $\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \longrightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$ | [1] [1] |
| (ii) | M6 | Magnesium methanoate is $1.312 \text{ mol dm}^{-3}$ $[\text{HCOO}^-(\text{aq})] = 2.624 \text{ mol dm}^{-3}$ | [1] [1] |
| (iii) | M6 | Use <u>volumetric apparatus</u> (to measure 5.0 cm^3 / saturated (magnesium) methanoate solution). Make (the above) up to the mark (with water) in a 250 cm^3 volumetric / graduated flask | [1] [1] |
| (iv) | M3/P4 | H^+ is needed for the reaction with manganite Provided the acid is in excess / sufficient / enough, the volume does not matter | [1] [1] |
| (v) | M5 | A pale pink colour | [1] |
| (vi) | M10 | $0.051 \text{ mol dm}^{-3}$ | [1] |
| (vii) | M10 | 1.28 mol dm^{-3} | [1] |

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|-----------|-----------|--|-------------|
| (b) | P1/P2 | (Independent) Temperature (Dependent) Concentration of magnesium methanoate | [1] |
| (c) | P3 | ΔH is positive | [1] |
| | | (An increase in temperature) will favour / promote / increase / a movement in the direction of the endothermic change / reaction | [1] |
| (d) | P3 | Precipitate is formed / barium sulfate is insoluble / insoluble product | [1] |
| | | | [15] |
| 2 (a) (i) | D1 | $K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$ | [1] |
| (ii) | D1 | $K_c = \frac{4y^2}{(a - y)^2}$ | [1] |

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| Question | Statement | Expected Answer | Mark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|------------------|--|----------------------------------|----------------------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------------|
| (b) (i) | D3 | <table border="1"> <thead> <tr> <th>a mol dm⁻³</th> <th>a – y mol dm⁻³</th> <th>y mol dm⁻³</th> </tr> </thead> <tbody> <tr><td>0.200</td><td>0.022</td><td>0.178</td></tr> <tr><td>0.500</td><td>0.050</td><td>0.450</td></tr> <tr><td>0.800</td><td>0.252</td><td>0.548</td></tr> <tr><td>1.000</td><td>0.200</td><td>0.800</td></tr> <tr><td>1.500</td><td>0.365</td><td>1.135</td></tr> <tr><td>2.100</td><td>0.570</td><td>1.530</td></tr> <tr><td>2.800</td><td>0.652</td><td>2.148</td></tr> <tr><td>3.400</td><td>0.700</td><td>2.700</td></tr> <tr><td>3.800</td><td>0.867</td><td>2.933</td></tr> <tr><td>4.200</td><td>0.868</td><td>3.332</td></tr> <tr><td>4.900</td><td>1.150</td><td>3.750</td></tr> </tbody> </table> | a mol dm⁻³ | a – y mol dm⁻³ | y mol dm⁻³ | 0.200 | 0.022 | 0.178 | 0.500 | 0.050 | 0.450 | 0.800 | 0.252 | 0.548 | 1.000 | 0.200 | 0.800 | 1.500 | 0.365 | 1.135 | 2.100 | 0.570 | 1.530 | 2.800 | 0.652 | 2.148 | 3.400 | 0.700 | 2.700 | 3.800 | 0.867 | 2.933 | 4.200 | 0.868 | 3.332 | 4.900 | 1.150 | 3.750 | <p>[1] [1]</p> |
| | | a mol dm⁻³ | a – y mol dm⁻³ | y mol dm⁻³ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0.200 | 0.022 | 0.178 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0.500 | 0.050 | 0.450 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0.800 | 0.252 | 0.548 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1.000 | 0.200 | 0.800 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1.500 | 0.365 | 1.135 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 2.100 | 0.570 | 1.530 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 2.800 | 0.652 | 2.148 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 3.400 | 0.700 | 2.700 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 3.800 | 0.867 | 2.933 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 4.200 | 0.868 | 3.332 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.900 | 1.150 | 3.750 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| All results for y are to 3 decimal places All values for y are correct | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (ii) | D1 | All points plotted correctly | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (iii) | E5 | Appropriate straight line drawn through the origin | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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|----------|-----------|--|------|
| (c) (i) | D3/C1 | Co-ordinates read correctly from the line | [1] |
| | | Slope of the graph calculated correctly and given to three significant figures with no units. | [1] |
| (ii) | D3/C1 | Uses $\frac{\sqrt{K_c}}{2 + \sqrt{K_c}}$ = gradient (value or y/a) and provides working | [1] |
| | | Gives value of K_c | [1] |
| (d) | P4 | The hydrogen with air / oxygen is explosive at 760K / raised temperature | [1] |
| (e) | E4 | Faster reaction / increased rate | [1] |
| | | The value of K_c would be unaffected | [1] |
| (f) (i) | E4/C2 | The line drawn on the graph has a less steep gradient | [1] |
| (ii) | | The equilibrium constant will be smaller | [1] |
| | | | [15] |