Cambridge International AS & A Level

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**CHEMISTRY** **9701/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2016**

MARK SCHEME

Maximum Mark: 30

**Published**

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| Question | Expected Answer | Mark |
|---|---|---|
| 1 (a) | lithium and water being labelled in an arrangement that shows them coming into contact at some time<br><br>gas syringe OR collection over water, both using a leak-proof connection to the reaction vessel that would collect gas **after** the reagents have been mixed<br><br>a valid separation of the two reagents | [1]<br><br>[1]<br><br>[1] |
| (b) (i) | cut (a small piece) AND remove oil | [1] |
| (ii) | no change / increase in volume OR bubbles (in collector) cease (over water) OR no more gas / hydrogen collected | [1] |
| (iii) | safety precautions – in a Li / LiOH / $H_2$ context<br>Any two from<br>• avoid skin contact / wear gloves / lab coat / use tongs in context of prevention of burns or corrosive contact only<br>• keep piece of lithium / storage vessel / apparatus away from water<br>• ensure unused lithium is all returned to storage vessel or stored under oil<br>• keep away from naked flames / burner / sources of ignition | [2] |
| (iv) | (0.1 / 7 × 1 / 2 × 24 000) = 171 $cm^3$<br><br>correct unit **MUST** be present | <br><br>[1] |
| (v) | use 200 $cm^3$ OR 250 $cm^3$ OR 500 $cm^3$ - the size must be reasonable and consistent with the volume in **b(iv)**.<br><br>correct unit **MUST** be present | <br><br>[1] |
| (c) (i) | use a burette twice or 50 $cm^3$ pipette twice | [1] |
| (ii) | lithium / solid has all reacted / disappears / dissolves | [1] |

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| Question | Expected Answer | Mark |
|---|---|---|
| **(iii)** | pipette / burette / syringe / graduated pipette | [1] |
| **(iv)** | repeat the titration until results are within 0.1 $cm^3$ | [1] |
| **(d)** | beaker :<br>Effect: ($A_r$) (appears) more / larger<br>AND<br>Reason: (LiOH) solution more dilute (than expected)<br><br>Flask:<br>Effect: ($A_r$) None<br>AND<br>Reason: moles of (LiOH) (put in conical flask) remains the same / volume (i.e. moles) of LiOH not altered | [1]<br><br>[1] |
| | | **[15]** |

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| Question | Expected Answer | Mark |
|---|---|---|
| 2 (a) | | |

| $1/T/K^{-1}$ | $\log_{10}(1/t)$ |
|---|---|
| $3.47 \times 10^{-3}$ | –1.92 |
| $3.41 \times 10^{-3}$ | –1.76 |
| $3.33 \times 10^{-3}$ | –1.56 |
| $3.30 \times 10^{-3}$ | –1.45 |
| $3.26 \times 10^{-3}$ | –1.25 or –1.26 |
| $3.22 \times 10^{-3}$ | –1.28 |
| $3.19 \times 10^{-3}$ | –1.18 |
| $3.16 \times 10^{-3}$ | –1.08 |
| $3.12 \times 10^{-3}$ | –0.95 |
| $3.05 \times 10^{-3}$ | –0.90 |

| | |
|---|---|
| Column values for $1/T$ correctly calculated | [1] |
| Column values for $\log_{10}(1/t)$ correctly calculated | [1] |
| 3sf in $1/T$ AND 2 dp in $\log_{10}(1/t)$ | [1] |
| **(b)** candidate's points plotted correctly from table in 2(a) | [1] |
| line of best fit drawn | [1] |

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| Question | Expected Answer | Mark |
|---|---|---|
| **(c)** | Two anomalies identified<br><br>Reasons:<br>Points to the left of the line:<br>the time of disappearance was thought to be later<br>OR the time was stopped too late (after reaction ended)<br>OR the (hydrochloric acid) solution had not reached the temperature of the water bath<br>OR the timer was started early<br>OR magnesium folded up (reduced surface area)<br><br>Points to the right of the line:<br>the Mg may have been thought to have disappeared earlier than it did<br>OR the timer was started late<br>OR the timer was stopped too early (reaction still going) | [1] |
| **(d) (i)** | two co-ordinates in correct *x*, *y* format<br><br>gradient calculated correctly from candidate's stated co-ordinates<br><br>(the value **MUST** be negative unless the graph is mis-plotted)<br><br>value **MUST** be to 3 significant figures<br><br>Expected range –2500 to –3500 | [1]<br><br>[1] |
| **(ii)** | $-E_A$ = gradient × 0.0191<br>OR $-E_A$ = gradient × 0.0191 then divide by 1000<br>OR correct transformations<br><br>correct calculation and sign from candidate's gradient, gradient may be in calculation form, minimum 2 significant figures | [1]<br><br>[1] |

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|---|---|---|
| **(e)** | valid answer dependent on candidate's graph, e.g.<br>reliable because most of the points on / close to the line<br>OR<br>unreliable as most points not on the line | [1] |
| **(f)** | Student X is correct; reaction time less OR reaction is faster<br>AND<br>percentage error / uncertainty will be greater OR<br>greater error / uncertainty in time / data / recordings | [1] |
| **(g)** | reaction time is longer / rate slower<br>AND<br>some of the magnesium is not in contact (with the acid) OR less surface area for reaction (with HC*l*) OR only the bottom of the magnesium is reacting | [1] |
| **(h)** | initial rate lower / slower.<br>AND<br>the concentration of $H^+$ ions is lower / pH higher<br>OR ethanoic acid less dissociated / weaker acid | [1] |
| | | **[15]** |

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