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 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 a valid separation of the two reagents	[1] [1] [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 Any two from • avoid skin contact / wear gloves / lab coat / use tongs in context of prevention of burns or corrosive contact only • keep piece of lithium / storage vessel / apparatus away from water • ensure unused lithium is all returned to storage vessel or stored under oil • keep away from naked flames / burner / sources of ignition	[2]
(iv)	(0.1 / 7 × 1 / 2 × 24 000) = 171 cm^3 correct unit **MUST** be present	 [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)**. correct unit **MUST** be present	 [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 : Effect: (A_r) (appears) more / larger AND Reason: (LiOH) solution more dilute (than expected) Flask: Effect: (A_r) None AND Reason: moles of (LiOH) (put in conical flask) remains the same / volume (i.e. moles) of LiOH not altered	[1] [1]
		[15]

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<table>
<tr><th>Question</th><th>Expected Answer</th><th>Mark</th></tr>
<tr><td>2 (a)</td><td>
<table>
<tr><td>$1/T/K^{-1}$</td><td>$\log_{10}(1/t)$</td></tr>
<tr><td>3.47×10^{-3}</td><td>–1.92</td></tr>
<tr><td>3.41×10^{-3}</td><td>–1.76</td></tr>
<tr><td>3.33×10^{-3}</td><td>–1.56</td></tr>
<tr><td>3.30×10^{-3}</td><td>–1.45</td></tr>
<tr><td>3.26×10^{-3}</td><td>–1.25 or –1.26</td></tr>
<tr><td>3.22×10^{-3}</td><td>–1.28</td></tr>
<tr><td>3.19×10^{-3}</td><td>–1.18</td></tr>
<tr><td>3.16×10^{-3}</td><td>–1.08</td></tr>
<tr><td>3.12×10^{-3}</td><td>–0.95</td></tr>
<tr><td>3.05×10^{-3}</td><td>–0.90</td></tr>
</table>
Column values for $1/T$ correctly calculated
Column values for $\log_{10}(1/t)$ correctly calculated
3sf in $1/T$ AND 2 dp in $\log_{10}(1/t)$
</td><td>[1]
[1]
[1]</td></tr>
<tr><td>(b)</td><td>candidate’s points plotted correctly from table in 2(a)
line of best fit drawn</td><td>[1]
[1]</td></tr>
</table>

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

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Question	Expected Answer	Mark
(e)	valid answer dependent on candidate's graph, e.g. reliable because most of the points on / close to the line OR unreliable as most points not on the line	[1]
(f)	Student X is correct; reaction time less OR reaction is faster AND percentage error / uncertainty will be greater OR greater error / uncertainty in time / data / recordings	[1]
(g)	reaction time is longer / rate slower AND 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. AND the concentration of H^+ ions is lower / pH higher OR ethanoic acid less dissociated / weaker acid	[1]
		[15]

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