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CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the March 2016 series

9701 CHEMISTRY

9701/52 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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question	expected answer	mark
1 (a)	**M1** (apparatus mark) volumetric flask in range 25–250 cm^3; **M2** mol propanone = 1.00 × (flask volume / 1000); e.g. mol of propanone = 1.00 × 25 / 1000 = 0.025 mol **M3** **M2** × 58.0; e.g.0.025 × 58.0 = 1.45 g	[3]
(b) (i)	**B** must be added before first or second reactant	[1]
(ii)	the reactants are **A** and **C** so one of these must be mixed last; **or** the reaction must not start before all three substances are present;	[1]
(c) (i)	(10 cm^3) pipette	[1]
(ii)	**M1** $NaHCO_3$ will effervesce so when effervescence finishes it shows that all H^+ ions have been removed; **M2** NaOH will react with I_2 / CH_3COCH_3 / reactants;	[2]
(d) (i)	**M1** mol I_2 = (10 / 100) × 0.200 × (50 / 1000) = 1.(00) × 10^{-3} mol; **M2** mol $S_2O_3^{2-}$ = 2 × 1.00 × 10^{-3} = 2.(00) × 10^{-3} mol; **M3** volume 0.100 mol dm^{-3} $S_2O_3^{2-}$ = (1000 × 2.00 × 10^{-3}) / 0.100 = 20(.0) cm^3;	[3]
(ii)	indicator = starch; colour change = blue-black to colourless;	[2]
(e)	time **and** units of s; volume of thiosulfate **and** units of cm^3;	[2]
(f)	temperature;	[1]
(g) (i)	**M1** (labels) *x*-axis = time *y*-axis = concentration of iodine **M2** curved line decreasing from left to right starting from *x* = 0	[2]

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<table>
<tr><th>question</th><th>expected answer</th><th>mark</th></tr>
<tr><td>(ii)</td><td>idea of constant half-life:
determine at least two half-lives from the graph and ensure that they are the same;
or
half-lives determined from the graph should be constant;
or
determine the gradient (rate) at different points on the graph and plot rate v. concentration to determine if the plot is linear and goes through the origin;</td><td>[1]</td></tr>
<tr><td>(h)</td><td>(incorrect and)
half-life will still be constant;
or
temperature has no effect upon order (of reaction);</td><td>[1]</td></tr>
<tr><td>2 (a)</td><td>M1 column amount of ethanol burned correctly completed
M2 column energy transferred to the water correctly completed

<table>
<tr><th>experiment number</th><th>amount of ethanol burned / mol</th><th>energy transferred to the water / kJ</th></tr>
<tr><td>1</td><td>0.00850</td><td>3.26</td></tr>
<tr><td>2</td><td>0.0106</td><td>3.95</td></tr>
<tr><td>3</td><td>0.0110</td><td>4.10</td></tr>
<tr><td>4</td><td>0.0122</td><td>4.50</td></tr>
<tr><td>5</td><td>0.0158</td><td>5.62</td></tr>
<tr><td>6</td><td>0.0130</td><td>5.20</td></tr>
<tr><td>7</td><td>0.00891</td><td>3.39</td></tr>
<tr><td>8</td><td>0.0148</td><td>5.30</td></tr>
</table></td><td>[2]</td></tr>
<tr><td>(b)</td><td>M1 at least eight correctly plotted points;
M2 correct straight line;</td><td>[2]</td></tr>
<tr><td>(c)</td><td>experiment 6;</td><td>[1]</td></tr>
<tr><td>(d)</td><td>M1 co-ordinates, e.g. (0.0106, 3.95) and (0.0158, 5.62);
M2 gradient correctly calculated from points, e.g. 321 (kJ mol^{-1});</td><td>[2]</td></tr>
<tr><td>(e)</td><td>because the reaction is exothermic;</td><td>[1]</td></tr>
<tr><td>(f) (i)</td><td>((2 × 0.0005) / 0.391) × 100 = 0.256%
and
(0.05 / 40.0) × 100 = 0.125%;</td><td>[1]</td></tr>
</table>

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question	expected answer	mark
(ii)	(total) errors in weighing do not account for the (large) error in enthalpy change determined; **or** heat loss (is more significant);	[1]

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