



**Cambridge Assessment International Education**  
Cambridge Ordinary Level

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**CHEMISTRY**

**5070/21**

Paper 2 Theory

**October/November 2017**

MARK SCHEME

Maximum Mark: 75

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**Published**

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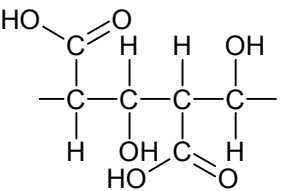
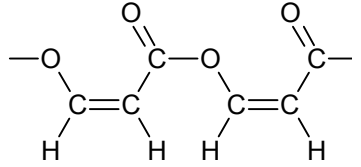
Question	Answer	Marks									
A1(a)(i)	krypton / Kr (1)	1									
A1(a)(ii)	nitrogen / N <sub>2</sub> (1)	1									
A1(a)(iii)	calcium / Ca (1)	1									
A1(a)(iv)	copper / Cu (1)	1									
A1(a)(v)	chlorine / Cl <sub>2</sub> (1)	1									
A1(b)	<table border="1"> <thead> <tr> <th></th> <th>number of electrons</th> <th>number of neutrons</th> </tr> </thead> <tbody> <tr> <td><sup>33</sup>S</td> <td>16 (1)</td> <td>17 (1)</td> </tr> <tr> <td><sup>25</sup>Mg<sup>2+</sup></td> <td>10 (1)</td> <td>13 (1)</td> </tr> </tbody> </table>		number of electrons	number of neutrons	<sup>33</sup> S	16 (1)	17 (1)	<sup>25</sup> Mg <sup>2+</sup>	10 (1)	13 (1)	4
	number of electrons	number of neutrons									
<sup>33</sup> S	16 (1)	17 (1)									
<sup>25</sup> Mg <sup>2+</sup>	10 (1)	13 (1)									

Question	Answer	Marks
A2(a)	arrangement: ordered / lattice / regular / layers / uniformly arranged / repeated pattern (1) type of force: electrostatic (1)	2
A2(b)	solid: ions cannot move (1) aqueous: ions can move (1)	2
A2(c)(i)	(ionisation of) water (1)	1
A2(c)(ii)	$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ (1)	1
A2(c)(iii)	hydroxide (ions) lower in reactivity (than sulfate (ions)) / sulfate (ions) less easily oxidised (than hydroxide (ions)) (1)	1
A2(d)(i)	H <sup>+</sup> , OH <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , Cu <sup>2+</sup> (1)	1

Question	Answer	Marks
A2(d)(ii)	hydroxide removed (1) idea of H <sup>+</sup> remaining (causing acidity) (1)	2
A2(d)(iii)	Cu <sup>2+</sup> ions removed (at negative electrode) (1)	1
A2(e)	two pairs of bonding electrons (1) rest of structure correct (1)	2

Question	Answer	Marks
A3(a)(i)	<b>Any two of:</b> reference to layers (1) (layers) slide (1)	2
A3(a)(ii)	mobile electrons / electrons can move (1)	1
A3(b)	silver < iron < titanium < calcium (1)	1
A3(c)(i)	mol Fe <sub>2</sub> O <sub>3</sub> = $\frac{14.4}{160}$ <b>OR</b> 0.090 (1) mol Fe = 2 × 0.090 <b>OR</b> 0.180 (1) mass = (0.180 × 56) = 10.1 (1)	3
A3(c)(ii)	mol CO <sub>2</sub> = $\frac{3}{2}$ × 0.18 <b>OR</b> 0.27 (1) volume = 0.27 × 24 = 6.48 (dm <sup>3</sup> ) (1)	2

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
A4(a)	alcohol (1)	<b>1</b>
A4(b)	propanol (1) reflux / heat (with sulfuric / strong acid / conc acid) (1)	<b>2</b>
A4(c)	bromine decolourised by fumaric acid / colour of bromine goes (brown to) colourless with fumaric acid (1) no colour change with malic acid / bromine remains brown with malic acid / bromine remains the same colour with malic acid (1)	<b>2</b>
A4(d)(i)	addition (1) condensation (1)	<b>2</b>

Question	Answer	Marks
A4(d)(ii)	<p>for addition polymer:</p>  <p>two (or more) repeat units with single bonds between carbon atoms (1)</p> <p>continuation bonds dependent on correct structure (1)</p> <p><b>OR</b></p> <p>for condensation polymer:</p>  <p>two (or more) repeat units with ester link and continuation bonds (2)</p> <p>if 2 marks not awarded, 1 mark for ester link drawn correctly</p>	<b>2</b>

Question	Answer	Marks
A5(a)	$2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$ correct reactants and products (1) balancing dependent on correct formulae (1)	<b>2</b>
A5(b)	bond breaking is endothermic <b>and</b> bond making is exothermic (1) more energy released (in bond making) than absorbed (in bond breaking) (1)	<b>2</b>
A5(c)	jet fuel, heating oil (1)	<b>1</b>

Question	Answer	Marks
B6(a)	acid which doesn't dissociate completely to give $\text{H}^+$ / doesn't ionise completely to give $\text{H}^+$ (1)	<b>1</b>
B6(b)(i)	equilibrium shifts to the right (1) to reduce the amount of ethanol added (1)	<b>2</b>
B6(b)(ii)	equilibrium moves to the left (1) the (forward) reaction is exothermic / backward reaction is endothermic / moves in the direction of the endothermic reaction (1)	<b>2</b>
B6(c)(i)	increases (with increasing number of carbon atoms) (1)	<b>1</b>
B6(c)(ii)	any value between 0.97 and 1.04 (1)	<b>1</b>
B6(c)(iii)	<b>solid</b> because $15^\circ\text{C}$ is below its melting point / <b>solid</b> because the melting point is above $15^\circ\text{C}$ (1)	<b>1</b>
B6(c)(iv)	there is no clear trend / the values go up and down (and up) (1)	<b>1</b>

Question	Answer	Marks
B6(c)(v)	correct structure of propanoic acid showing all atoms and all bonds (1) $  \begin{array}{c}  \text{H} \quad \text{H} \quad \text{O} \\    \quad   \quad // \\  \text{H}-\text{C}-\text{C}-\text{C} \\    \quad   \quad \backslash \\  \text{H} \quad \text{H} \quad \text{O}-\text{H}  \end{array}  $	1

Question	Answer	Marks
B7(a)(i)	giant (molecular) structure / many covalent bonds (1) takes a lot of energy to break the bonds / needs a high temperature to break the bonds (1)	2
B7(a)(ii)	Diamond has a giant covalent structure whereas tin has a metallic structure (1) because diamond or carbon has a much higher melting point <b>OR</b> diamond does not conduct electricity but tin does (1)	2
B7(a)(iii)	(oxide which) reacts with acids or bases (1)	1
B7(b)(i)	mass of germanium = 21.9 (g) (1) $\text{mol Ge} = \frac{21.9}{73} \text{ and mol Cl} = \frac{42.6}{35.5} \text{ OR mol ratio Ge : Cl is 0.3 to 1.2 (1)}$ $\text{GeCl}_4$ (1)	3
B7(b)(ii)	(simple) molecular (1) covalent bonding (1)	2
B8(a)	$\frac{3 \times 14}{149} \times 100 = 28.2 \% \text{ (2 marks)}$ If 2 marks not scored correct $M_r = 149$ (1)	2

Question	Answer	Marks
B8(b)	to increase plant growth / to help make more protein / to add nitrogen to soil depleted by previous year's growth (1)	1
B8(c)	(damp) red litmus paper (1) turns blue (1)	2
B8(d)	ammonia is formed (1) idea of ammonia escaping from the soil as a gas (1)	2
B8(e)	mol H <sub>2</sub> SO <sub>4</sub> = $0.150 \times \frac{10.5}{1000}$ <b>OR</b> $1.575 \times 10^{-3}$ (1) mol NH <sub>3</sub> (aq) = $2 \times 1.575 \times 10^{-3}$ <b>OR</b> $3.15 \times 10^{-3}$ (1) concentration of NH <sub>3</sub> (aq) = 0.158 (mol dm <sup>-3</sup> ) (1)	3

Question	Answer	Marks
B9(a)	they have the same molecular formula but the atoms are arranged differently (1)	1
B9(b)	rate decreases (1) the gradient of the graph decreases / slope of the graph decreases (1)	2
B9(c)	increases rate (no marks) particles closer together / more particles in a given volume / more crowded particles (1) greater collision frequency / more collisions per second / rate of collisions increases (1)	2



Question	Answer	Marks
B9(d)	decreases rate (no marks)  particles move more slowly / particles have less kinetic energy (1)  number of particles with energy equal to or greater than the activation energy is decreased / fewer successful collisions / fewer effective collisions (1)	<b>2</b>
B9(e)	left hand box:  propanol (1)  C <sub>3</sub> H <sub>7</sub> OH (1)  right hand conditions:  catalyst / Ni <b>AND</b> heat / high temperature / high pressure (1)	<b>3</b>