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**CHEMISTRY**

**0620/41**

Paper 4 Extended Theory

**October/November 2017**

MARK SCHEME

Maximum Mark: 80

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**Published**

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This document consists of **8** printed pages.

Question	Answer	Marks
1(a)(i)	<b>B</b>	<b>1</b>
1(a)(ii)	<b>A</b>	<b>1</b>
1(a)(iii)	<b>C</b>	<b>1</b>
1(a)(iv)	<b>E</b>	<b>1</b>
1(b)	O <sup>2-</sup> <b>M1</b> O <b>M2</b> 2 <sup>-</sup>	<b>2</b>

Question	Answer	Marks
2(a)(i)	<b>S</b>	<b>1</b>
2(a)(ii)	<b>S</b>	<b>1</b>
2(a)(iii)	<b>V</b>	<b>1</b>
2(b)	any value in the range 130–145 °C	<b>1</b>
2(c)	sublimation	<b>1</b>
2(d)(i)	Brownian motion	<b>1</b>
2(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	<b>1</b>
	(the bombarding particles) move randomly	<b>1</b>

Question	Answer	Marks
3(a)(i)	brown / orange solid (forms / is made) <b>OR</b> solution becomes paler / colourless	1
3(a)(ii)	magnesium is oxidised <b>AND</b> copper ions are reduced <b>OR</b> magnesium loses electrons <b>AND</b> copper ions gain electrons <b>OR</b> magnesium increases in oxidation number <b>AND</b> copper decreases in oxidation number	1
3(a)(iii)	Cu <sup>2+</sup> <b>OR</b> copper(II) ions <b>OR</b> copper ions	1
	gains electrons	1
3(a)(iv)	3Mg + Fe <sub>2</sub> O <sub>3</sub> → 3MgO + 2Fe <b>M1</b> Fe <sub>2</sub> O <sub>3</sub> <b>AND</b> MgO <b>M2</b> fully correct	2
3(b)(i)	prevents air / oxygen <b>AND</b> water from reaching the steel	1
3(b)(ii)	magnesium is more reactive than iron / steel	1
	the magnesium corrodes (before the iron / steel) <b>OR</b> the magnesium corrodes preferentially	1
3(b)(iii)	copper is less reactive than iron / steel	1

Question	Answer	Marks
4(a)(i)	$\rightarrow 2(\text{C}_2\text{H}_5\text{OH}) + 2\text{CO}_2$ <b>M1</b> carbon dioxide made as product <b>M2</b> balanced	2
4(a)(ii)	any 2 from: <ul style="list-style-type: none"> <li>• 37 °C</li> <li>• anaerobic</li> <li>• glucose is aqueous</li> <li>• yeast</li> </ul>	2
4(b)(i)	(concentrated) phosphoric acid	1
4(b)(ii)	92 If full credit is not awarded, allow 1 mark for $M_r$ of ethene = 28	2
4(c)(i)	(acidified) potassium manganate(VII) <b>OR</b> potassium (di)chromate(VI)	1
4(c)(ii)	<p><b>M1</b> all shared pairs of electrons correct for single bonds  <b>M2</b> 2 shared pairs of electrons for the C=O bond  <b>M3</b> total of 8 electrons on each O including 4 non-bonding electrons and no additional non-bonding electrons</p>	3
4(d)(i)	partially ionised / dissociated	1

Question	Answer	Marks
4(d)(ii)	<b>M1</b> (acids) have same concentration	<b>1</b>
	<b>M2:</b> measure pH <b>OR</b> describe how to measure pH (such as use Universal Indicator) <b>M3:</b> lower pH corresponds to the stronger acid / hydrochloric acid <b>OR</b> <b>M2:</b> add calcium / magnesium / zinc / iron <b>M3:</b> faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid <b>OR</b> <b>M2:</b> rate of reaction with (metal) carbonate <b>M3:</b> faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid <b>OR</b> <b>M2:</b> rate of reaction with (named) metal oxide <b>M3:</b> dissolves faster means that reaction is with the stronger acid / hydrochloric acid <b>OR</b> <b>M2:</b> electrical conductivity <b>M3:</b> greater conductivity corresponds to the stronger acid / hydrochloric acid <b>OR</b> <b>M2:</b> add sodium hydroxide (or other named alkali) <b>M3:</b> greater temperature change corresponds to the stronger acid / hydrochloric acid	<b>2</b>
4(e)	structure of propanoic acid	<b>1</b>
	propanoic acid	<b>1</b>
	structure of butan-1-ol	<b>1</b>
	butan-1-ol	<b>1</b>

Question	Answer	Marks
5(a)(i)	start colour: green end colour: black	1
5(a)(ii)	$\text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2$	1
5(b)(i)	(copper(II) ions) add sodium hydroxide (solution)	1
	(copper(II) ions) blue ppt.	1
	(nitrate ions) add aluminium <b>AND</b> aqueous sodium hydroxide <b>AND</b> warm	1
	ammonia given off / gas turns damp (red) litmus blue	1
5(b)(ii)	2 / 2 / 4 / 1	1
5(c)(i)	becomes paler	1
	equilibrium moves right	1
	(because) fewer moles (of gas) on right	1
5(c)(ii)	equilibrium moved right / more $\text{N}_2\text{O}_4$ / less $\text{NO}_2$	1
	(forward) reaction exothermic	1

Question	Answer	Marks
6(a)	aluminium is more reactive than carbon	1
6(b)(i)	oxide ion has an outer shell with six <u>dots</u> and two <u>crosses</u>	1
	oxide ion has a charge of $2^-$	1

Question	Answer	Marks
6(b)(ii)	(electrostatic) forces of attraction between ions	1
	(are) strong <b>OR</b> require lots of energy to overcome	1
6(c)(i)	<i>the wires</i> : electrons	1
	<i>the electrolyte</i> : ions	1
6(c)(ii)	any 2 from: <ul style="list-style-type: none"> <li>• increases conductivity</li> <li>• as a solvent</li> <li>• lowers the operating temperature</li> </ul>	2
6(c)(iii)	$Al^{3+} + 3e^{-} \rightarrow Al$	1
6(c)(iv)	oxygen is made at the anode	1
	the anodes are made of carbon	1
	oxygen (made) reacts with carbon	1
6(d)	aluminium coated with layer of (unreactive) aluminium oxide	1

Question	Answer	Marks
7(a)(i)	more particles (of acid) in a given volume / $dm^3$ / $cm^3$	1
	more collisions per second / unit time <b>OR</b> greater collision rate	1

Question	Answer	Marks
7(a)(ii)	particles have more energy / particles move faster / more collisions per second / more collisions per unit time / greater collision rate	1
	more (of the) particles / collisions have energy greater than the activation energy / more particles have sufficient energy to react / more collisions have sufficient energy to react / a greater percentage of collisions are successful	1
7(b)(i)	0.075 If full credit is not awarded, allow 1 mark for $M_r$ of CuO = 80	2
7(b)(ii)	0.05	1
7(b)(iii)	4 (g) <b>M1</b> moles copper(II) oxide that reacted = $(0.05 / 2) = 0.025$ mol <b>M2</b> mass copper(II) oxide = $((0.075 - 0.025) \times 80) = 4$ g	2
7(c)	$C_1_2CuH_4O_2$ <b>M1</b> 41.52 / 35.5; 37.43 / 64; 2.34 / 1; 18.71 / 16 <b>OR</b> 1.17 : 0.58 : 2.34 : 1.17 <b>M2</b> appropriate scaling to give whole number ratios	2