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**CHEMISTRY**

**0620/42**

Paper 4 Theory (Extended)

**March 2017**

MARK SCHEME

Maximum Mark: 80

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**Published**

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Question	Answer	Marks
1(a)(i)	<b>A</b>	<b>1</b>
1(a)(ii)	<b>B and C</b>	<b>1</b>
1(a)(iii)	<b>D</b>	<b>1</b>
1(a)(iv)	<b>A</b>	<b>1</b>
1(a)(v)	<b>A</b>	<b>1</b>
1(a)(vi)	carbon dioxide <b>and</b> water	<b>1</b>
1(b)(i)	bitumen	<b>1</b>
1(b)(ii)	refinery gas	<b>1</b>
1(b)(iii)	refinery gas	<b>1</b>
1(b)(iv)	kerosene	<b>1</b>
1(b)(v)	heated / boiled / evaporated / vaporised	<b>1</b>

Question	Answer	Marks
2(a)	<b>M1</b> filter	<b>1</b>
	<b>M2</b> wash (the residue) using water	<b>1</b>
	<b>M3</b> dry the residue between filter papers / in a warm place	<b>1</b>
2(b)(i)	2 <sup>-</sup>	<b>1</b>
2(b)(ii)	$2\text{Ag}^+ + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Ag}_2\text{Cr}_2\text{O}_7$	<b>1</b>
2(c)	<b>M1</b> Universal Indicator turns blue	<b>1</b>
	<b>M2</b> ammonia / $\text{NH}_3$ (is made)	<b>1</b>
2(d)(i)	<b>M1</b> dichromate ions / particles are heavier (than silver ions)	<b>1</b>
	<b>M2</b> so dichromate ions diffuse / move more slowly <b>ORA</b>	<b>1</b>
	<b>M3</b> (where they meet they react and) silver dichromate is made	<b>1</b>
2(d)(ii)	<b>M1</b> red solid forms in less than five minutes <b>or</b> red solid forms faster / sooner	<b>1</b>
	<b>M2</b> particles / ions move faster	<b>1</b>
2(e)(i)	<b>M1</b> breaking down	<b>1</b>
	<b>M2</b> when heated	<b>1</b>

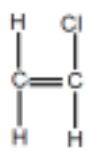
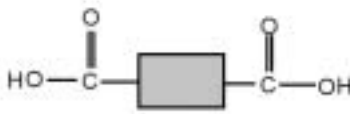
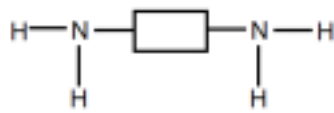
Question	Answer	Marks
2(e)(ii)	<b>M1</b> formula of chromium(III) oxide	1
	<b>M2</b> rest of equation correct to give a fully correct equation ( $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow \text{N}_2 + \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O}$ scores [2])	1

Question	Answer	Marks
3(a)	any 2 from: <ul style="list-style-type: none"> <li>• forward and backward reactions occur at equal rates</li> <li>• amounts / moles / concentrations (of substances) remain constant</li> <li>• closed system</li> </ul>	2
3(b)	<b>M1</b> (particles) have more energy <b>OR</b> (particles) move faster	1
	<b>M2</b> more collisions per second <b>OR</b> greater collision rate	1
	<b>M3</b> more (of the) particles / collisions have energy greater than the activation energy <b>OR</b> more particles / collisions have sufficient energy to react <b>OR</b> a greater percentage / proportion / fraction of collisions are successful	1
3(c)	<b>M1</b> equilibrium moves left / yield decreases	1
	<b>M2</b> because the forward reaction is exothermic <b>OR</b> because the reverse reaction is endothermic	1
3(d)	<b>M1</b> no change	1
	<b>M2</b> numbers of moles of gas on each side is the same	1
3(e)(i)	<b>M1</b> all bonding pairs correct (two pair of electrons shared between O and N <b>AND</b> one pair of electrons shared between N and Cl)	1
	<b>M2</b> four non-bonding electrons on O <b>AND</b> two non-bonding electrons on N <b>AND</b> six non-bonding electrons on Cl to give a fully correct diagram	1
3(e)(ii)	<b>M1</b> weak forces (of attraction)	1
	<b>M2</b> between molecules / intermolecular	1

Question	Answer	Marks
4(a)(i)	arrow labelled <b>A</b> on or near wire going in an anti-clockwise direction	1
4(a)(ii)	arrow labelled <b>B</b> in electrolyte pointing towards the cathode	1
4(b)(i)	electrons are lost	1
4(b)(ii)	<b>M1</b> $\text{Cu}^{2+}$ ions on left	1
	<b>M2</b> rest of equation correct and correctly balanced ( $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ scores [2])	1
4(c)	<b>M1</b> anode mass decreases	1
	<b>M2</b> copper lost as <u>ions</u> <b>OR</b> copper (atoms) becomes <u>ions</u> <b>OR</b> $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$	1
	<b>M3</b> cathode mass increases	1
	<b>M4</b> copper deposited / layer of copper forms / copper collected at cathode <b>OR</b> $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$	1

Question	Answer	Marks
5(a)	carbon dioxide <u>reacts</u> with carbon / coke <b>OR</b> $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$	1
5(b)	<b>M1</b> $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$	1
	<b>M2</b> CaO is a base	1
	<b>M3</b> $\text{SiO}_2$ is an acid	1
5(c)(i)	(the carbon makes the iron too) brittle	1
5(c)(ii)	reacted with oxygen / oxygen blown in	1
5(d)(i)	zinc blende	1
5(d)(ii)	$2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$	1
5(d)(iii)	any 2 from: <ul style="list-style-type: none"> <li>• forms acid rain</li> <li>• kills trees / plants</li> <li>• kills fish</li> <li>• damages (limestone / marble) buildings / statues</li> <li>• causes breathing difficulties</li> </ul>	2
5(d)(iv)	<b>M1</b> zinc boils	1
	<b>M2</b> (both) impurities do not boil because their boiling point is above 1000 °C	1

Question	Answer	Marks
6(a)(i)	<b>M1</b> (relative formula mass $\text{BaCO}_3 =$ ) 197	1
	<b>M2</b> ( $10.0/197 =$ ) 0.0508 (0.0508 alone scores [2])	1
6(a)(ii)	1.22	1
6(b)	2.24	1
6(c)(i)	0.00219	1
6(c)(ii)	<b>M1</b> moles $\text{HCl} = 2 \times 0.00219$ <b>OR</b> correct evaluation of this (= 0.00438)	1
	<b>M2</b> ( $0.00438/0.01875 =$ ) 0.234 (0.234 alone scores [2])	1

Question	Answer	Marks
7(a)(i)	circle drawn round two consecutive carbons which includes 3 H atoms and 1 Cl atom	1
7(a)(ii)		1
7(a)(iii)	<b>M1</b> stays yellow/orange/brown or no change	1
	<b>M2</b> becomes colourless	1
7(b)(i)	polyamide	1
7(b)(ii)	circle must include exactly two C=O, two N–H, one shaded square and one unshaded square	1
7(b)(iii)	<b>M1</b> 	1
	<b>M2</b> 	1

Question	Answer	Marks
7(c)(i)	<b>M1</b> 34.61/12 : 61.54/16 : 3.85/1 <b>OR</b> 2.885 : 3.846 : 3.85	<b>1</b>
	<b>M2</b> 2.885/2.885 : 3.846/2.885 : 3.85/2.885 <b>OR</b> 1 : 1.3(33) : 1.3(33) <b>OR</b> 3:4:4	<b>1</b>
	<b>M3</b> $C_3O_4H_4$	<b>1</b>
7(c)(ii)	relative formula mass / relative molecular mass	<b>1</b>