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**CHEMISTRY**

**0620/42**

Paper 4 Theory (Extended)

**March 2017**

MARK SCHEME

Maximum Mark: 80

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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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>

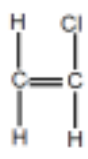
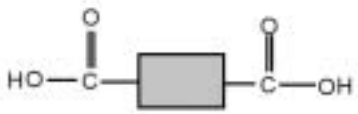
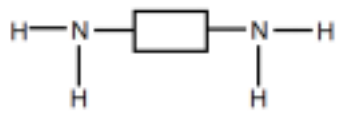
Question	Answer	Marks
2(e)(ii)	<b>M1</b> formula of chromium(III) oxide	1
	<b>M2</b> rest of equation correct to give a fully correct equation ( $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow \text{N}_2 + \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O}$ scores [2])	1

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>