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**CHEMISTRY**

**0620/31**

Paper 3 Theory (Core)

**May/June 2017**

MARK SCHEME

Maximum Mark: 80

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**Published**

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This document consists of **7** printed pages.

Question	Answer	Marks
1(a)(i)	<b>A</b>	<b>1</b>
1(a)(ii)	<b>E</b>	<b>1</b>
1(a)(iii)	<b>C</b>	<b>1</b>
1(a)(iv)	<b>B</b>	<b>1</b>
1(a)(v)	<b>C</b>	<b>1</b>
1(b)	number of electrons in $\text{Br}^- = 36$	<b>1</b>
	number of neutrons in $\text{Cl} = 18$	<b>1</b>
	number of protons in $\text{Cl} = 17$ <b>AND</b> number of protons in $\text{Br}^- = 35$	<b>1</b>

Question	Answer	Marks
2(a)(i)	$\text{Na}^+$ / sodium	<b>1</b>
2(a)(ii)	sulfite / sulfate(IV)	<b>1</b>
2(a)(iii)	3 (mg)	<b>1</b>
2(a)(iv)	36.3 (mg)	<b>1</b>
2(a)(v)	calcium hydrogencarbonate	<b>1</b>
2(b)	flame test	<b>1</b>
	yellow	<b>1</b>
2(c)	$\text{MgCl}_2$	<b>1</b>

Question	Answer	Marks
2(d)	negative electrode: calcium / Ca	1
	positive electrode: chlorine / Cl <sub>2</sub>	1

Question	Answer	Marks
3(a)	<p>any 5 of:</p> <p><b>X</b> has covalent bonding</p> <p><b>X</b> particles are randomly arranged / irregularly arranged</p> <p><b>X</b> particles are moving rapidly / freely / randomly / irregularly</p> <p><b>Y</b> has ionic bonding / ionic</p> <p><b>Y</b> particles are regularly arranged / lattice / in rows / uniformly arranged</p> <p><b>Y</b> particles (only) vibrate / do not move from place to place</p> <p><b>Z</b> has covalent bonding</p> <p><b>Z</b> particles are regularly arranged / lattice / in a tetrahedral shape</p> <p><b>Z</b> particles (only) vibrate / do not move from place to place</p>	5
3(b)	volume gets smaller	1
	particles get closer together	1
3(c)	drill tips / drills / cutting (tools)	1
3(d)	<b>A</b> / substance <b>Y</b> dissolves easily in water	1
	<b>C</b> / substance <b>Y</b> melts (at 8015 °C)	1
	the change can be reversed by altering the conditions	1

Question	Answer	Marks
4(a)	has two atoms in a molecule/two atoms combined	1
4(b)(i)	the chlorine has displaced/replaced the bromine (in KBr)	1
4(b)(ii)	(from green / colourless) to orange	1
4(b)(iii)	I <sub>2</sub>	1
	KBr	1
4(c)	add (nitric acid then aqueous) silver nitrate	1
	yellow precipitate	1
4(d)(i)	water purification / water treatment / killing bacteria / in (swimming) pools / disinfectant	1
4(d)(ii)	breaking down of a compound / breaking down of a substance	1
	(using) heat	1
4(d)(iii)	any 2 distinct pollution problems: <ul style="list-style-type: none"> <li>• litter <b>OR</b> eyesore</li> <li>• sticks in gullets <b>OR</b> throats of birds / animals</li> <li>• blocking of drains <b>OR</b> watercourses</li> <li>• animals gets trapped <b>OR</b> tangled (in plastic)</li> <li>• poisonous vapours <b>when burned</b></li> <li>• fills landfill sites</li> </ul>	2

Question	Answer	Marks
5(a)	circle drawn around the OH group	1
5(b)	20	1
5(c)	C=C double bond	1
5(d)(i)	increases with an increasing number of carbon atoms <b>ORA</b>	1
5(d)(ii)	any value between $-88$ and $0$ ( $^{\circ}\text{C}$ ) (exclusive of these values)	1
5(d)(iii)	there is no (clear) trend / the numbers go down and up	1
5(d)(iv)	liquid	1
	$30^{\circ}\text{C}$ is between melting and boiling point / $30^{\circ}\text{C}$ is above the melting point and below the boiling point	1
5(d)(v)	substance containing carbon and hydrogen	1
	only / and no other element	1
5(d)(vi)	$  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $	1
5(d)(vii)	3 ( $\text{CO}_2$ )	1
	5 ( $\text{O}_2$ )	1

Question	Answer	Marks
6(a)(i)	aluminium	
	low density	1
	good electrical conductivity	1
6(a)(ii)	iron is cheap(er)/tungsten is (too) expensive <b>OR</b> iron is strong(er)/tungsten is weaker	1
6(a)(iii)	tungsten because it has a (very) high melting point	1
6(b)	any 2 properties: <ul style="list-style-type: none"> <li>• high melting point / high boiling point</li> <li>• high density</li> <li>• hard / strong</li> <li>• sonorous / rings (when hit)</li> <li>• ions are coloured / compounds are coloured</li> </ul>	2
6(c)	2 (W)	1
	3 (O <sub>2</sub> )	1
6(d)	tungsten < cobalt < iron < magnesium <b>IF</b> full credit is not awarded, allow 1 mark for either a correct sequence apart from a consecutive pair reversed <b>OR</b> for the whole sequence reversed	2
6(e)(i)	the more concentrated the acid, the greater the rate <b>ORA</b>	1
6(e)(ii)	nitric (acid)	1
6(e)(iii)	any value between 19 and 39 hours (exclusive of these values)	1
6(e)(iv)	pH 4	1

Question	Answer	Marks
7(a)	the energy of the reactants is greater than the energy of the products / the product has less energy than the reactants / the arrow is going down (from reactants to product)	<b>1</b>
7(b)	any 2 sources: <ul style="list-style-type: none"> <li>• carbon monoxide from incomplete combustion of fossil fuels / named fossil fuel / named carbon-containing fuel</li> <li>• carbon dioxide from combustion of fossil fuels / respiration</li> <li>• methane from animal flatulence / rice paddy fields / bacteria / decomposition of vegetation / decomposition of animals</li> </ul> any 3 effects: <ul style="list-style-type: none"> <li>• carbon dioxide: global warming / greenhouse effect / acidification of oceans</li> <li>• methane: global warming / greenhouse effect</li> <li>• carbon monoxide: poisonous / toxic</li> </ul>	<b>5</b>
7(c)(i)	making mortar / whitewash / neutralising (acidic) soils / neutralising acidic lakes / flue gas desulfurisation / steelmaking / glassmaking / making plaster	<b>1</b>
7(c)(ii)	100 <b>IF</b> full credit is not awarded, allow 1 mark for (Ca =) 40, (C =) 12 and (O =) 16	<b>2</b>
7(d)	add hydrochloric acid to the mixture	<b>1</b>
	filter off the carbon	<b>1</b>
	wash carbon (with water or other solvent) <b>AND</b> dry in an oven / air dry / leave in air / leave to dry	<b>1</b>