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**CHEMISTRY**

**0620/41**

Paper 4 Theory Extended

**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>proton number</i> : the number of protons	1																				
	<i>nucleon number</i> : the total number of protons and neutrons	1																				
	<i>nucleon number</i> : in the nucleus / nuclei (of an atom)	1																				
1(b)	(hydrogen is the only atom to have) no neutrons	1																				
1(c)	<table border="1"> <thead> <tr> <th></th> <th>number of protons</th> <th>number of neutrons</th> <th>number of electrons</th> </tr> </thead> <tbody> <tr> <td><sup>19</sup>F</td> <td>9</td> <td>10</td> <td>9</td> </tr> <tr> <td><sup>26</sup>Mg</td> <td>12</td> <td>14</td> <td>12</td> </tr> <tr> <td><sup>31</sup>P<sup>3-</sup></td> <td>15</td> <td>16</td> <td>18</td> </tr> <tr> <td><sup>87</sup>Sr<sup>2+</sup></td> <td>38</td> <td>49</td> <td>36</td> </tr> </tbody> </table>		number of protons	number of neutrons	number of electrons	<sup>19</sup> F	9	10	9	<sup>26</sup> Mg	12	14	12	<sup>31</sup> P <sup>3-</sup>	15	16	18	<sup>87</sup> Sr <sup>2+</sup>	38	49	36	
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	fluorine protons <b>AND</b> neutrons correct	1																				
	magnesium neutrons <b>AND</b> electrons correct	1																				
phosphorus protons <b>AND</b> neutrons correct	1																					
phosphorus electrons correct	1																					
strontium protons <b>AND</b> neutrons correct	1																					
strontium electrons correct	1																					
1(d)(i)	MgF <sub>2</sub>	1																				
1(d)(ii)	Sr <sub>3</sub> P <sub>2</sub>	1																				

Question	Answer	Marks
2(a)(i)	SO <sub>2</sub>	1
2(a)(ii)	Na <sub>2</sub> O	1
2(a)(iii)	Cr <sub>2</sub> O <sub>3</sub>	1
2(a)(iv)	SiO <sub>2</sub>	1
2(a)(v)	Al <sub>2</sub> O <sub>3</sub> / Cr <sub>2</sub> O <sub>3</sub>	1
2(a)(vi)	CO	1
2(b)(i)	an amphoteric oxide will react with acids <b>AND</b> with bases	1
2(b)(ii)	a neutral oxide will <b>not</b> react with acids <b>or</b> with bases	1

Question	Answer	Marks
3(a)(i)	no (more) effervescence	1
3(a)(ii)	magnesium carbonate	1
3(a)(iii)	(a solution in which) no more solute will dissolve	1
	at that temperature	1
3(a)(iv)	the solubility decreases as the temperature decreases	1
3(b)(i)	moles of water = $2.52 / 18 = 0.14$ (mol)	1
3(b)(ii)	moles of anhydrous magnesium sulfate = 0.02 (mol)	1
3(b)(iii)	ratio = $0.02 / 0.02 : 0.14 / 0.02 = 1 : 7$	1

Question	Answer	Marks
3(b)(iv)	MgSO <sub>4</sub> ·7H <sub>2</sub> O <b>M1</b> MgSO <sub>4</sub> <b>M2</b> rest of the formula correct	2
3(c)	mix and stir the two solutions	1
	filter (to obtain residue)	1
	wash (the residue) using water	1
	dry the residue between filter papers / in a warm place	1
3(d)	Pb <sup>2+</sup> (aq) + SO <sub>4</sub> <sup>2-</sup> (aq) → PbSO <sub>4</sub> (s) <b>M1</b> correct species <b>M2</b> correct state symbols	2

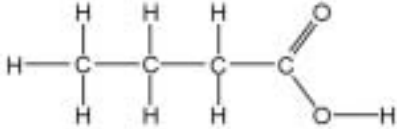
Question	Answer	Marks
4(a)(i)	roast in air	1
4(a)(ii)	2ZnS + 3O <sub>2</sub> → 2ZnO + 2SO <sub>2</sub> <b>M1</b> correct species <b>M2</b> correct balancing	2
4(b)(i)	coke	1
4(b)(ii)	zinc is vaporised / boiled	1
	and is condensed	1

Question	Answer	Marks
4(c)(i)	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^{-}$ <b>M1</b> correct species <b>M2</b> correct balancing	2
4(c)(ii)	$2\text{H}^{+} + 2\text{e}^{-} \rightarrow \text{H}_2$ <b>M1</b> correct species <b>M2</b> correct balancing	2
4(c)(iii)	change: (the intensity would) decrease	1
	reason: the difference in reactivity between zinc and iron is less than the difference in reactivity between zinc and copper	1

Question	Answer	Marks
5(a)	(stop-) watch <b>AND</b> syringe	1
5(b)	graph starts at <b>X</b> and is a curve with a decreasing gradient	1
	graph hits zero rate at $114 \pm 6$ seconds	1
5(c)	<b>M1</b> moles of carbon dioxide = $180 / 24\ 000 = 0.0075$	1
	<b>M2</b> molar mass of barium carbonate = 197	1
	<b>M3</b> mass of barium carbonate = $\text{M1} \times \text{M2} = 1.48$ (g)	1
5(d)	curve starts from (0,0) and has a lower gradient than the original curve	1
	because lumps have a lower surface area	1

Question	Answer	Marks
5(e)	curve starts from (0,0) and has a steeper gradient than the original curve	1
	finishes at the same volume of gas	1
	because there are more particles per unit volume / $\text{dm}^3 / \text{cm}^3$	1
	because there are more collisions per second / unit time <b>OR</b> a greater collision rate	1
5(f)	360 ( $\text{cm}^3$ )	1

Question	Answer	Marks
6(a)	(compound that) contains carbon and hydrogen	1
	and no other elements / only	1
6(b)	any 3 from: <ul style="list-style-type: none"> <li>• same / similar chemical properties</li> <li>• (same) general formula</li> <li>• (consecutive members) differ by <math>\text{CH}_2</math></li> <li>• same functional group</li> <li>• common (allow similar) methods of preparation</li> <li>• physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation</li> </ul>	3
6(c)	propene	1
	structure correctly shown	1
6(d)	steam	1
	catalyst	1

Question	Answer	Marks
6(e)(i)	butanoic acid	1
		1
6(e)(ii)	acidified	1
	(potassium) manganate(VII)	1
6(e)(iii)	oxidation	1
6(f)	methanol	1
	ethanoic acid	1
	catalyst	1
	heat	1
	$\text{CH}_3\text{COOH} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O}$	1