Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/41**

Paper 4 Theory Extended **May/June 2017**

MARK SCHEME

Maximum Mark: 80

Published

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>proton number: the number of protons</td><td>1</td></tr>
<tr><td></td><td>nucleon number: the total number of protons and neutrons</td><td>1</td></tr>
<tr><td></td><td>nucleon number: in the nucleus / nuclei (of an atom)</td><td>1</td></tr>
<tr><td>1(b)</td><td>(hydrogen is the only atom to have) no neutrons</td><td>1</td></tr>
<tr><td>1(c)</td><td><table>
<tr><th></th><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr>
<tr><td>^{19}F</td><td>9</td><td>10</td><td>9</td></tr>
<tr><td>^{26}Mg</td><td>12</td><td>14</td><td>12</td></tr>
<tr><td>$^{31}P^{3-}$</td><td>15</td><td>16</td><td>18</td></tr>
<tr><td>$^{87}Sr^{2+}$</td><td>38</td><td>49</td><td>36</td></tr>
</table></td><td></td></tr>
<tr><td></td><td>fluorine protons AND neutrons correct</td><td>1</td></tr>
<tr><td></td><td>magnesium neutrons AND electrons correct</td><td>1</td></tr>
<tr><td></td><td>phosphorus protons AND neutrons correct</td><td>1</td></tr>
<tr><td></td><td>phosphorus electrons correct</td><td>1</td></tr>
<tr><td></td><td>strontium protons AND neutrons correct</td><td>1</td></tr>
<tr><td></td><td>strontium electrons correct</td><td>1</td></tr>
<tr><td>1(d)(i)</td><td>MgF_2</td><td>1</td></tr>
<tr><td>1(d)(ii)</td><td>Sr_3P_2</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(a)(i)	SO_2	**1**
2(a)(ii)	Na_2O	**1**
2(a)(iii)	Cr_2O_3	**1**
2(a)(iv)	SiO_2	**1**
2(a)(v)	Al_2O_3 / Cr_2O_3	**1**
2(a)(vi)	CO	**1**
2(b)(i)	an amphoteric oxide will react with acids **AND** with bases	**1**
2(b)(ii)	a neutral oxide will **not** react with acids **or** 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 deceases 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**

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Question	Answer	Marks
3(b)(iv)	$MgSO_4.7H_2O$ **M1** $MgSO_4$ **M2** 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)	$Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$ **M1** correct species **M2** correct state symbols	**2**

Question	Answer	Marks
4(a)(i)	roast in air	**1**
4(a)(ii)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ **M1** correct species **M2** correct balancing	**2**
4(b)(i)	coke	**1**
4(b)(ii)	zinc is vaporised / boiled	**1**
	and is condensed	**1**

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Question	Answer	Marks
4(c)(i)	$Zn \rightarrow Zn^{2+} + 2e^-$ **M1** correct species **M2** correct balancing	**2**
4(c)(ii)	$2H^+ + 2e^- \rightarrow H_2$ **M1** correct species **M2** 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**

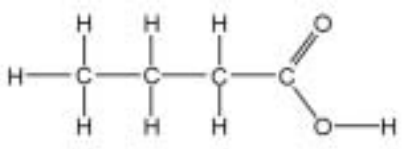
Question	Answer	Marks
5(a)	(stop-) watch **AND** syringe	**1**
5(b)	graph starts at **X** and is a curve with a decreasing gradient	**1**
	graph hits zero rate at 114 ± 6 seconds	**1**
5(c)	**M1** moles of carbon dioxide = 180 / 24 000 = 0.0075	**1**
	M2 molar mass of barium carbonate = 197	**1**
	M3 mass of barium carbonate = **M1** × **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**

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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 / dm^3 / cm^3	**1**
	because there are more collisions per second / unit time **OR** a greater collision rate	**1**
5(f)	360 (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: • same / similar chemical properties • (same) general formula • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation	**3**
6(c)	propene	**1**
	structure correctly shown	**1**
6(d)	steam	**1**
	catalyst	**1**

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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**
	$CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$	**1**

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