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

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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This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

<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>

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**

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**

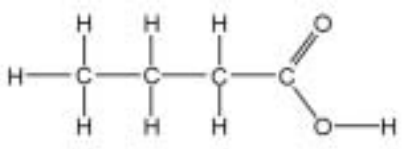
Question	Answer	Marks
4(a)(i)	roast in air	**1**
4(a)(ii)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ **M1** correct species **M2** correct balancing	**2**
4(b)(i)	coke	**1**
4(b)(ii)	zinc is vaporised / boiled	**1**
	and is condensed	**1**

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**

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**

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**