Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/42**

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

MARK SCHEME

Maximum Mark: 80

Published

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Question	Answer	Marks
1(a)(i)	fractional distillation	**1**
1(a)(ii)	chromatography	**1**
1(a)(iii)	fermentation / ferment	**1**
1(a)(iv)	(simple) distillation / distil	**1**
1(a)(v)	filtration / decantation / centrifugation	**1**
1(b)(i)	(substance that) cannot be split up / broken down into (two or more) simpler substances by chemical means **OR** (substance) made of **atoms** with the same atomic number / number of protons / proton number	**1**
1(b)(ii)	(two or more) **elements** joined or combined or bonded (together)	**1**
1(b)(iii)	(particle) containing different numbers of protons and electrons **OR** atom or group of atoms that has gained or lost an electron / electrons	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="2">2(a)</td><td>atoms of the same element / atoms with the same proton number / atoms with the same atomic number</td><td>1</td></tr>
<tr><td>different neutron number / different nucleon number / different mass number</td><td>1</td></tr>
<tr><td>2(b)</td><td><table><tr><td></td><td>carbon</td><td>silicon</td><td></td></tr><tr><td>proton number</td><td>6</td><td>14</td><td>M1</td></tr><tr><td>electronic structure</td><td>2,4</td><td>2,8,4</td><td>M2</td></tr><tr><td>nucleon number</td><td>12</td><td>28</td><td></td></tr><tr><td>number of neutrons in one atom</td><td>6</td><td>14</td><td>M3</td></tr></table></td><td>3</td></tr>
<tr><td>2(c)(i)</td><td>covalent</td><td>1</td></tr>
<tr><td rowspan="6">2(c)(ii)</td><td>award 1 mark for each correct property and one mark for each correct matching reason.</td><td>4</td></tr>
<tr><td>property: high melting point / high boiling point
reason: bonds between atoms are strong OR covalent bonds are strong / bonds need large amount of energy to break</td><td></td></tr>
<tr><td>property: non-conductor / poor conductor(of electricity) / insulator
reason: no moving charged particles / no moving ions / no moving electrons / all (outer shell) electrons used in bonding</td><td></td></tr>
<tr><td>property: hard
reason: bonds between atoms are strong OR covalent bonds are strong</td><td></td></tr>
<tr><td>property: brittle
reason: bonds between atoms are strong OR covalent bonds are strong / bonds are directional</td><td></td></tr>
<tr><td>property: insoluble
reason: does not form hydrogen bonds with water / no ions that can be hydrated</td><td></td></tr>
<tr><td rowspan="2">2(d)(i)</td><td>incomplete combustion / incomplete burning / combustion in insufficient air / oxygen</td><td>1</td></tr>
<tr><td>of fossil fuels / named fossil fuel / named petroleum fraction / name or formula of a type of substance containing carbon</td><td>1</td></tr>
<tr><td>2(d)(ii)</td><td>toxic / poisonous / combines with or binds to haemoglobin</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(e)(i)	carbon dioxide: (simple) molecular / simple covalent	**1**
	silicon(IV) dioxide: macromolecular / giant molecular / giant covalent / giant atomic	**1**
2(e)(ii)	carbon dioxide: **weak** (**force of) attraction** between molecules / **weak** intermolecular forces / **weak** van der Waals' forces / **weak** dispersion forces / **weak** London forces	**1**
	silicon(IV) dioxide: covalent bonds are **strong** / force of attraction between atoms is **strong** / no weak bonds (are present) / **all** bonds are **strong**	**1**
	(weak) **forces of attraction** in carbon dioxide need small amounts of **energy** or heat to break / **less energy** or heat needed to break **forces of attraction** in carbon dioxide **OR** (strong) **bonds** in silicon(IV) dioxide need large amounts of **energy** or heat to break / **more energy** or heat needed to break **bonds** in silicon(IV) dioxide	**1**
2(f)	$2NaOH + SiO_2 \rightarrow Na_2SiO_3 + H_2O$ **IF** full credit is not awarded, allow 1 mark for Na_2SiO_3 **OR** $2OH^- + SiO_2 \rightarrow SiO_3^{2-} + H_2O$ **M1** species correct **M2** balancing	**2**

Question	Answer	Marks
3(a)(i)	450 °C	**1**
	200 atmospheres	**1**
3(a)(ii)	iron	**1**
3(b)(i)	4(NO)	**1**
	5(O_2) **AND** 6(H_2O)	**1**
3(b)(ii)	lower yield of NO / lower yield of nitric acid / lower yield of product / equilibrium shifts to left (at higher temperatures) / backward reaction favoured(at higher temperatures) **ORA**	**1**
3(b)(iii)	too slow / rate decreases **ORA**	**1**
3(c)	$4NO + 3O_2 + 2H_2O \rightarrow 4HNO_3$ **M1** all formulae correct **M2** balancing	**2**
3(d)	add copper(II) carbonate (to acid) until it stops dissolving or no more effervescence / bubbling / fizzing	**1**
	filter (to remove copper(II) carbonate)	**1**
	evaporate / heat / warm / boil / leave in sun **AND** until most of the water has gone / some water is left / evaporate **some** of the water / until it is concentrated / saturation (point) / crystallisation point / crystals form on glass rod or microscope slide / crystals **start** to form	**1**
	(for any solution) leave / allow to cool / allow to crystallise **OR** (for any crystals) filter / wash / dry with filter paper / dry in warm place / dry in a **(low)** oven / leave to dry	**1**
	formula of $Cu(NO_3)_2$	**1**
	equation: $CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + CO_2 + H_2O$	**1**

Question	Answer	Marks
4(a)	any 3 from: • catalyst • more than one / variable oxidation state / oxidation number / valency • form coloured **compounds** / coloured **ions** • forms complex ions / complexes	**3**
4(b)	add sodium hydroxide (solution) / NaOH / potassium hydroxide (solution) / KOH	**1**
	zinc oxide dissolves / reacts **OR** copper(II) oxide does not dissolve / react	**1**
	filter / decant / centrifuge (copper(II) oxide)	**1**
4(c)(i)	$Zn \rightarrow Zn^{2+} + 2e / 2e^{-}$ **M1** formula of Zn^{2+} on the right-hand side **M2** equation fully correct	**2**
4(c)(ii)	zinc / Zn nickel / Ni copper / Cu	**1**
4(c)(iii)	copper (+) and nickel (–)	**1**
	0.59 V	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)(i)</td><td>
<table>
<tr><td></td><td>aqueous
potassium chloride</td><td>aqueous
potassium bromide</td><td>aqueous
potassium iodide</td></tr>
<tr><td>chlorine</td><td></td><td></td><td>✓</td></tr>
<tr><td>bromine</td><td>✗</td><td></td><td>✓</td></tr>
<tr><td>iodine</td><td>✗</td><td>✗</td><td></td></tr>
</table>
5 cells completed correctly = [3]
3 or 4 cells completed correctly = [2]
2 cells completed correctly = [1]
</td><td>3</td></tr>
<tr><td>5(a)(ii)</td><td>$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$
OR
$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$</td><td>1</td></tr>
<tr><td>5(b)(i)</td><td>white</td><td>1</td></tr>
<tr><td>5(b)(ii)</td><td>0.02 (mol)</td><td>1</td></tr>
<tr><td>5(b)(iii)</td><td>0.02 (mol)</td><td>1</td></tr>
<tr><td rowspan="2">5(b)(iv)</td><td>1:2</td><td>1</td></tr>
<tr><td>VCl_2</td><td>1</td></tr>
</table>

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Question	Answer	Marks
5(c)(i)	solid	**1**
5(c)(ii)	$2Na + At_2 \rightarrow 2NaAt$ **M1** formula of NaAt **M2** equation fully correct	**2**
5(d)(i)	393 (kJ)	**1**
5(d)(ii)	416 (kJ)	**1**
5(d)(iii)	–23 (kJ / mol)	**1**

Question	Answer	Marks
6(a)(i)	alkene	**1**
	carboxylic acid	**1**
6(a)(ii)	any 2 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	**2**
6(b)	carboxylic acid / aldehyde	**1**
	ester	**1**
6(c)(i)	colourless / decolourised	**1**
	bubbles / fizzing / effervescence	**1**

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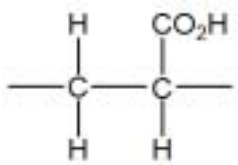
Question	Answer	Marks
6(c)(ii)	addition	**1**
	 repeat unit	**1**
	continuation bonds at both ends	**1**