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**CHEMISTRY**

**0620/43**

Paper 4 Extended Theory

**October/November 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)	mixture	1
1(b)	element	1
1(c)	compound	1
1(d)	mixture	1

Question	Answer	Marks												
2(a)(i)	(two or more) <b>atoms</b>	1												
	combined/joined/sharing electrons (by a covalent bond)/bonded	1												
2(a)(ii)	substance that cannot be split up/broken down/decomposed (into anything simpler) <b>OR</b> (substance) made of <b>atoms</b> with the same atomic number/number of protons/proton number	1												
2(b)(i)	10	1												
2(b)(ii)	22	1												
2(b)(iii)	<b>A AND B</b>	1												
2(b)(iv)	<b>A AND B</b>	1												
2(b)(v)	<b>C AND D</b>	1												
2(c)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>number of protons</th> <th>number of electrons</th> </tr> </thead> <tbody> <tr> <td>Na</td> <td>11</td> <td>11</td> </tr> <tr> <td>S<sup>2-</sup></td> <td>16</td> <td>18</td> </tr> <tr> <td>Cl<sub>2</sub></td> <td>34</td> <td>34</td> </tr> </tbody> </table>		number of protons	number of electrons	Na	11	11	S <sup>2-</sup>	16	18	Cl <sub>2</sub>	34	34	3
	number of protons	number of electrons												
Na	11	11												
S <sup>2-</sup>	16	18												
Cl <sub>2</sub>	34	34												

Question	Answer	Marks
3(a)	hematite	1
3(b)	(coke reacts with oxygen/air) to produce heat/increase temperature/exothermically	1
	coke is reducing agent/produces reducing agent/produces carbon monoxide <b>OR</b> coke reduces Fe <sub>2</sub> O <sub>3</sub> / (iron) ore/hematite (producing iron)	1
	Fe <sub>2</sub> O <sub>3</sub> + 3CO → 2Fe + 3CO <sub>2</sub> <b>OR</b> Fe <sub>2</sub> O <sub>3</sub> + 3C → 2Fe + 3CO <b>OR</b> 2Fe <sub>2</sub> O <sub>3</sub> + 3C → 4Fe + 3CO <sub>2</sub> <b>M1</b> species correct <b>M2</b> balanced	2
	limestone (decomposes to calcium oxide which) reacts with/removes <b>acidic impurities</b> /SiO <sub>2</sub> /sand/silica/ silicon(IV) oxide/silicon dioxide	1
	limestone/calcium oxide/lime is involved in the production of slag/calcium silicate	1
3(c)(i)	positive ions / cations	1
	sea of electrons / mobile electrons / delocalised electrons / moving electrons / flowing electrons	1
	<b>attraction</b> between positive ions and electrons	1
3(c)(ii)	layers / rows / sheets of ions	1
	slide / slip / shift (over each other or past each other)	1
3(c)(iii)	particles have different sizes / radii	1
	layers cannot slide / slip / shift	1
3(d)(i)	Fe + H <sub>2</sub> SO <sub>4</sub> → FeSO <sub>4</sub> + H <sub>2</sub>	1

Question	Answer		Marks												
3(d)(ii)	$\text{Fe}_2\text{O}_3 + 3\text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ <b>M1</b> formula of $\text{Fe}_2(\text{SO}_4)_3$ <b>M2</b> all formulae correct (no additional species) <b>M3</b> balanced		3												
3(e)		<table border="1"> <thead> <tr> <th></th> <th>observation with aqueous iron(II) sulfate</th> <th>observation with aqueous iron(III) sulfate</th> </tr> </thead> <tbody> <tr> <td>aqueous sodium hydroxide</td> <td></td> <td><b>M3</b> brown precipitate</td> </tr> <tr> <td>aqueous potassium iodide</td> <td><b>M1</b> no change</td> <td><b>M4</b> brown solution/black solid</td> </tr> <tr> <td>aqueous acidified potassium manganate(VII)</td> <td><b>M2</b> (pink/purple to) colourless/decourised</td> <td></td> </tr> </tbody> </table>		observation with aqueous iron(II) sulfate	observation with aqueous iron(III) sulfate	aqueous sodium hydroxide		<b>M3</b> brown precipitate	aqueous potassium iodide	<b>M1</b> no change	<b>M4</b> brown solution/black solid	aqueous acidified potassium manganate(VII)	<b>M2</b> (pink/purple to) colourless/decourised		4
	observation with aqueous iron(II) sulfate	observation with aqueous iron(III) sulfate													
aqueous sodium hydroxide		<b>M3</b> brown precipitate													
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aqueous acidified potassium manganate(VII)	<b>M2</b> (pink/purple to) colourless/decourised														

Question	Answer	Marks
4(a)	fractional distillation	1
4(b)(i)	oxidation	1
4(b)(ii)	acid(ic)	1
4(c)	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$	1
4(d)(i)	no carbon dioxide produced/more efficient	1
4(d)(ii)	storage of hydrogen is difficult/takes more space to store (hydrogen)/high likelihood of (hydrogen) leaks/lack of availability of hydrogen	1
4(e)(i)	$\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ <b>M1</b> species correct <b>M2</b> balanced	2
4(e)(ii)	climate change/greenhouse effect/consequence of climate change	1

Question	Answer	Marks
4(e)(iii)	fermentation	1
4(f)	electrolysis	1

Question	Answer	Marks
5(a)(i)	oxygen/O <sub>2</sub>	1
	sodium nitrite/sodium nitrate(III)/NaNO <sub>2</sub>	1
5(a)(ii)	2Cu(NO <sub>3</sub> ) <sub>2</sub> → 2CuO + O <sub>2</sub> + 4NO <sub>2</sub> <b>M1</b> CuO <b>M2</b> rest of equation fully correct	2
5(b)(i)	reversible reaction in which the <b>rate</b> of the forward reaction <b>equals</b> the <b>rate</b> of the backward reaction	1
	<b>concentration</b> of all reactants and products becomes constant/does not change	1
5(b)(ii)	forward reaction is endothermic	1
	(increased temperature) causes equilibrium to shift to the right/to shift in the endothermic direction/to form more nitrogen dioxide/to form more product(s)	1
5(b)(iii)	less brown/lighter/paler/colour fades	1
	<b>more</b> molecules/moles/volume on the right <b>ORA</b> <b>OR</b> equilibrium shifts in the direction of <b>fewer</b> molecules/moles/lower volume	1

Question	Answer	Marks
6(a)(i)	compounds containing carbon and hydrogen <b>only</b>	1
6(a)(ii)	<i>alkanes</i> : $C_nH_{2n+2}$	1
	<i>alkenes</i> : $C_nH_{2n}$	1
6(a)(iii)	any 2 from: <ul style="list-style-type: none"> <li>• same or similar chemical properties</li> <li>• (consecutive members) differ by <math>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 <b>OR</b> example of a physical property variation</li> </ul>	2
6(a)(iv)	$  \begin{array}{ccccccc}  & H & & & H & & \\  &   & & &   & & \\  H & - C & - & C & = & C & - C & - H \\  &   & &   & &   & & \\  & H & & H & & H & & H  \end{array}  $ <p style="text-align: center;"><b>OR</b></p> $  \begin{array}{ccccccc}  & H & & & & H & \\  &   & & & & / & \\  H & - C & - & C & = & C & \\  &   & & & & \backslash & \\  & H & & & & & H \\  & & & & &   & \\  & & & & & H - C - H & \\  & & & & &   & \\  & & & & & H &   \end{array}  $	1
6(a)(v)	structural isomers	1

Question	Answer	Marks
6(b)(i)	more than enough oxygen to react with <b>all</b> of the hydrocarbon	1
6(b)(ii)	125 (cm <sup>3</sup> )	1
6(b)(iii)	1:5:3	1
6(b)(iv)	C <sub>3</sub> H <sub>8</sub> If full credit is not awarded, allow 1 mark for C <sub>x</sub> H <sub>y</sub> (g) + 5O <sub>2</sub> (g) → 3CO <sub>2</sub> (g) + 4H <sub>2</sub> O(l)	2

Question	Answer	Marks
7(a)(i)	diffusion	1
7(a)(ii)	silicon(IV) oxide is a solid, whereas carbon dioxide is a gas	1
7(a)(iii)	photosynthesis	1
	chlorophyll/chloroplasts	1
	<b>M2</b> sunlight/UV (light)	1
	6CO <sub>2</sub> + 6H <sub>2</sub> O → C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> + 6O <sub>2</sub> <b>M1</b> species correct <b>M2</b> balanced	2
7(b)(i)	condensation	1
7(b)(ii)	hydrolysis	1
7(b)(ii)	HO-□-OH <b>OR</b> H-O-□-O-H	1