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Cambridge International General Certificate of Secondary Education

**CHEMISTRY** **0620/43**

Paper 4 Extended Theory **October/November 2017**

MARK SCHEME

Maximum Mark: 80

**Published**

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| 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) **atoms** | 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)<br>**OR**<br>(substance) made of **atoms** with the same atomic number / number of protons / proton number | 1 |
| 2(b)(i) | 10 | 1 |
| 2(b)(ii) | 22 | 1 |
| 2(b)(iii) | A **AND** B | 1 |
| 2(b)(iv) | A **AND** B | 1 |
| 2(b)(v) | C **AND** D | 1 |
| 2(c) | | 3 |

| | number of protons | number of electrons |
|---|---|---|
| Na | 11 | 11 |
| $S^{2-}$ | 16 | 18 |
| $Cl_2$ | 34 | 34 |

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| 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<br>**OR**<br>**coke reduces** $Fe_2O_3$ / (iron) ore / hematite (producing iron) | 1 |
| | $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$<br>**OR**<br>$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$<br>**OR**<br>$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$<br>**M1** species correct<br>**M2** balanced | 2 |
| | limestone (decomposes to calcium oxide which) reacts with / removes **acidic impurities** / $SiO_2$ / 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 |
| | **attraction** 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) | $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$ | 1 |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(d)(ii)</td><td>$Fe_2O_3 + 3H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3H_2O$<br>M1 formula of $Fe_2(SO_4)_3$<br>M2 all formulae correct (no additional species)<br>M3 balanced</td><td>3</td></tr>
<tr><td>3(e)</td><td>
<table>
<tr><th></th><th>observation with aqueous iron(II) sulfate</th><th>observation with aqueous iron(III) sulfate</th></tr>
<tr><td>aqueous sodium hydroxide</td><td></td><td>M3 brown precipitate</td></tr>
<tr><td>aqueous potassium iodide</td><td>M1 no change</td><td>M4 brown solution / black solid</td></tr>
<tr><td>aqueous acidified potassium manganate(VII)</td><td>M2 (pink / purple to) colourless / decolourised</td><td></td></tr>
</table>
</td><td>4</td></tr>
</table>

| Question | Answer | Marks |
|---|---|---|
| 4(a) | fractional distillation | **1** |
| 4(b)(i) | oxidation | **1** |
| 4(b)(ii) | acid(ic) | **1** |
| 4(c) | $2H_2 + O_2 \rightarrow 2H_2O$ | **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) | $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$<br>**M1** species correct<br>**M2** balanced | **2** |
| 4(e)(ii) | climate change / greenhouse effect / consequence of climate change | **1** |

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

| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | oxygen / $O_2$ | **1** |
| | sodium nitrite / sodium nitrate(III) / $NaNO_2$ | **1** |
| 5(a)(ii) | $2Cu(NO_3)_2 \rightarrow 2CuO + O_2 + 4NO_2$<br>**M1** CuO<br>**M2** rest of equation fully correct | **2** |
| 5(b)(i) | reversible reaction in which the **rate** of the forward reaction **equals** the **rate** of the backward reaction | **1** |
| | **concentration** 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 / light**er** / paler / colour fades | **1** |
| | **more** molecules / moles / volume on the right **ORA**<br>**OR**<br>equilibrium shifts in the direction of **fewer** molecules / moles / lower volume | **1** |

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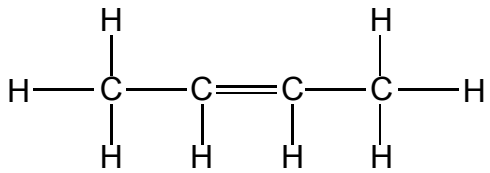
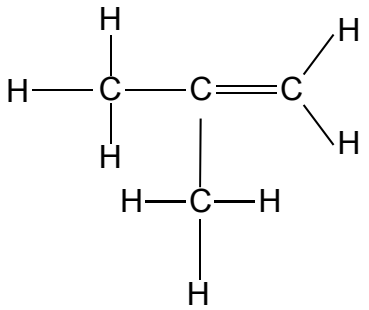
| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | compounds containing carbon and hydrogen **only** | **1** |
| 6(a)(ii) | *alkanes:* $C_nH_{2n+2}$ | **1** |
| | *alkenes:* $C_nH_{2n}$ | **1** |
| 6(a)(iii) | any 2 from:<br>• same or similar chemical properties<br>• (consecutive members) differ by $CH_2$<br>• same functional group<br>• common (allow similar) methods of preparation<br>• physical properties vary in predictable manner / show trends / gradually change **OR** example of a physical property variation | **2** |
| 6(a)(iv) |  <br>**OR**<br>  | **1** |
| 6(a)(v) | structural isomers | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 6(b)(i) | **more than** enough oxygen to react with **all** of the hydrocarbon | **1** |
| 6(b)(ii) | 125 ($cm^3$) | **1** |
| 6(b)(iii) | 1:5:3 | **1** |
| 6(b)(iv) | $C_3H_8$<br>If full credit is not awarded, allow 1 mark for $C_xH_y(g)$ + **5**$O_2(g)$ → **3**$CO_2(g)$ + **4**$H_2O(l)$ | **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** |
| | **M2** sunlight / UV (light) | **1** |
| | $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$<br>**M1** species correct<br>**M2** balanced | **2** |
| 7(b)(i) | condensation | **1** |
| 7(b)(ii) | hydrolysis | **1** |
| 7(b)(ii) | HO–□–OH **OR** H–O–□–O–H | **1** |

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