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**CHEMISTRY** **0620/41**

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

MARK SCHEME

Maximum Mark: 80

**Published**

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| Question | Answer | Marks |
|---|---|---|
| 1(a)(i) | **B** | **1** |
| 1(a)(ii) | **A** | **1** |
| 1(a)(iii) | **C** | **1** |
| 1(a)(iv) | **E** | **1** |
| 1(b) | $O^{2-}$<br>**M1** O<br>**M2** $^{2-}$ | **2** |

| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | **S** | **1** |
| 2(a)(ii) | **S** | **1** |
| 2(a)(iii) | **V** | **1** |
| 2(b) | any value in the range 130–145 °C | **1** |
| 2(c) | sublimation | **1** |
| 2(d)(i) | Brownian motion | **1** |
| 2(d)(ii) | nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles | **1** |
| | (the bombarding particles) move randomly | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | brown / orange solid (forms / is made) **OR** solution becomes paler / colourless | **1** |
| 3(a)(ii) | magnesium is oxidised **AND** copper ions are reduced<br>**OR**<br>magnesium loses electrons **AND** copper ions gain electrons<br>**OR**<br>magnesium increases in oxidation number **AND** copper decreases in oxidation number | **1** |
| 3(a)(iii) | $Cu^{2+}$ **OR** copper(II) ions **OR** copper ions | **1** |
| | gains electrons | **1** |
| 3(a)(iv) | $3Mg + Fe_2O_3 \rightarrow 3MgO + 2Fe$<br>**M1** $Fe_2O_3$ **AND** MgO<br>**M2** fully correct | **2** |
| 3(b)(i) | prevents air / oxygen **AND** water from reaching the steel | **1** |
| 3(b)(ii) | magnesium is more reactive than iron / steel | **1** |
| | the magnesium corrodes (before the iron / steel)<br>**OR**<br>the magnesium corrodes preferentially | **1** |
| 3(b)(iii) | copper is less reactive than iron / steel | **1** |

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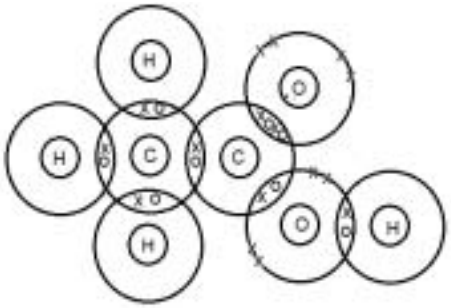
| Question | Answer | Marks |
|---|---|---|
| 4(a)(i) | → $2(C_2H_5OH)$ + $2CO_2$<br>**M1** carbon dioxide made as product<br>**M2** balanced | **2** |
| 4(a)(ii) | any 2 from:<br>• 37 °C<br>• anaerobic<br>• glucose is aqueous<br>• yeast | **2** |
| 4(b)(i) | (concentrated) phosphoric acid | **1** |
| 4(b)(ii) | 92<br>If full credit is not awarded, allow 1 mark for $M_r$ of ethene = 28 | **2** |
| 4(c)(i) | (acidified) potassium manganate(VII) **OR** potassium (di)chromate(VI) | **1** |
| 4(c)(ii) |  <br>**M1** all shared pairs of electrons correct for single bonds<br>**M2** 2 shared pairs of electrons for the C=O bond<br>**M3** total of 8 electrons on each O including 4 non-bonding electrons and no additional non-bonding electrons | **3** |
| 4(d)(i) | partially ionised / dissociated | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 4(d)(ii) | **M1** (acids) have same concentration | **1** |
| | **M2**: measure pH **OR** describe how to measure pH (such as use Universal Indicator)<br>**M3**: lower pH corresponds to the stronger acid / hydrochloric acid<br>**OR**<br>**M2**: add calcium / magnesium / zinc / iron<br>**M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid<br>**OR**<br>**M2**: rate of reaction with (metal) carbonate<br>**M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid<br>**OR**<br>**M2**: rate of reaction with (named) metal oxide<br>**M3**: dissolves faster means that reaction is with the stronger acid / hydrochloric acid<br>**OR**<br>**M2**: electrical conductivity<br>**M3**: greater conductivity corresponds to the stronger acid / hydrochloric acid<br>**OR**<br>**M2**: add sodium hydroxide (or other named alkali)<br>**M3**: greater temperature change corresponds to the stronger acid / hydrochloric acid | **2** |
| 4(e) | structure of propanoic acid | **1** |
| | propanoic acid | **1** |
| | structure of butan-1-ol | **1** |
| | butan-1-ol | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | *start colour:* green<br>*end colour:* black | **1** |
| 5(a)(ii) | $CuCO_3 \rightarrow CuO + CO_2$ | **1** |
| 5(b)(i) | (*copper(II) ions)* add sodium hydroxide (solution) | **1** |
| | (*copper(II) ions)* blue ppt. | **1** |
| | (*nitrate ions*) add aluminium **AND** aqueous sodium hydroxide **AND** warm | **1** |
| | ammonia given off / gas turns damp (red) litmus blue | **1** |
| 5(b)(ii) | 2 / 2 / 4 / 1 | **1** |
| 5(c)(i) | becomes paler | **1** |
| | equilibrium moves right | **1** |
| | (because) fewer moles (of gas) on right | **1** |
| 5(c)(ii) | equilibrium moved right / more $N_2O_4$ / less $NO_2$ | **1** |
| | (forward) reaction exothermic | **1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a) | aluminium is more reactive than carbon | **1** |
| 6(b)(i) | oxide ion has an outer shell with six dots and two crosses | **1** |
| | oxide ion has a charge of $2^-$ | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 6(b)(ii) | (electrostatic) forces of attraction between ions | 1 |
| | (are) strong **OR** require lots of energy to overcome | 1 |
| 6(c)(i) | *the wires:* electrons | 1 |
| | *the electrolyte:* ions | 1 |
| 6(c)(ii) | any 2 from:<br>• increases conductivity<br>• as a solvent<br>• lowers the operating temperature | 2 |
| 6(c)(iii) | $Al^{3+} + 3e^- \rightarrow Al$ | 1 |
| 6(c)(iv) | oxygen is made at the anode | 1 |
| | the anodes are made of carbon | 1 |
| | oxygen (made) reacts with carbon | 1 |
| 6(d) | aluminium coated with layer of (unreactive) aluminium oxide | 1 |

| Question | Answer | Marks |
|---|---|---|
| 7(a)(i) | more particles (of acid) in a given volume / $dm^3$ / $cm^3$ | 1 |
| | more collisions per second / unit time **OR** greater collision rate | 1 |

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| Question | Answer | Marks |
|---|---|---|
| 7(a)(ii) | particles have more energy / particles move faster / more collisions per second / more collisions per unit time / greater collision rate | **1** |
| | more (of the) particles / collisions have energy greater than the activation energy / more particles have sufficient energy to react / more collisions have sufficient energy to react / a greater percentage of collisions are successful | **1** |
| 7(b)(i) | 0.075<br>If full credit is not awarded, allow 1 mark for $M_r$ of CuO = 80 | **2** |
| 7(b)(ii) | 0.05 | **1** |
| 7(b)(iii) | 4 (g)<br>**M1** moles copper(II) oxide that reacted = (0.05 / 2) = 0.025 mol<br>**M2** mass copper(II) oxide = ((0.075 – 0.025) × 80) = 4 g | **2** |
| 7(c) | $CCl_2CuH_4O_2$<br>**M1** 41.52 / 35.5; 37.43 / 64; 2.34 / 1; 18.71 / 16 **OR** 1.17 : 0.58 : 2.34 : 1.17<br>**M2** appropriate scaling to give whole number ratios | **2** |

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