GradeMax

Cambridge International AS & A Level

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**CHEMISTRY** **9701/21**

Paper 2 AS Level Structured Questions **May/June 2016**

MARK SCHEME

Maximum Mark: 60

**Published**

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| Question | Mark Scheme | Mark | Total |
|---|---|---|---|
| 1 (a) | <table><tr><th>name of element</th><th>nucleon no.</th><th>atomic no.</th><th>no. of protons</th><th>no. of neutrons</th><th>no. of electrons</th><th>overall charge</th></tr><tr><td>lithium</td><td>6</td><td>3</td><td>3</td><td>3</td><td>2</td><td>+1</td></tr><tr><td>oxygen</td><td>17</td><td>8</td><td>8</td><td>9</td><td>10</td><td>–2</td></tr><tr><td>iron</td><td>54</td><td>26</td><td>26</td><td>28</td><td>24</td><td>+2</td></tr><tr><td>chlorine</td><td>35</td><td>17</td><td>17</td><td>18</td><td>17</td><td>0</td></tr></table> | [1]<br>[1]<br>[1]<br>[1] | [4] |
| (b) | line straight on labelled 'neutrons'<br>line (curving) up labelled 'protons'<br>proton line clearly shows less (overall) deflection than electron curve | [1]<br>[1]<br>[1] | [3] |
| (c) (i) | Group 16 / 6 / VI<br>AND<br>Big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 6th IE | [1] | [1] |
| (ii) | increases (across period) due to increasing attraction (of nucleus for electrons)<br><br>due to increasing nuclear charge / atomic / proton number AND<br>constant/similar shielding / same (outer / number of) shell / energy level | [1]<br><br>[1] | [2] |
| (iii) | electron (pair) repulsion<br>(**Y** has a) pair of electrons in a (3)p orbital / a (3)p orbital is full ORA | [1]<br>[1] | [2] |
| (iv) | $(1s^2)2s^2 2p^6 3s^2 3p^5$ | [1] | [1] |
| (d) (i) | 0.56(%) | [1] | [1] |

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| Question | | Mark Scheme | Mark | Total |
|---|---|---|---|---|
| | (ii) | $\frac{(A \times 0.56) + (86 \times 9.86) + (87 \times 7.00) + (88 \times 82.58)}{100} = 87.71$ | [1] | [2] |
| | | $A$ = 84 | [1] | |
| | | | | **[16]** |
| 2 | (a) | **D** = Ga **G** = Se | [1] | [1] |
| | (b) (i) | $\mathbf{D}_2O_3$ + $6HCl \rightarrow 2\mathbf{D}Cl_3$ + $3H_2O$<br>M1 = species;<br>M2 = balancing | [1]<br>[1] | [2] |
| | (ii) | $\mathbf{D}_2O_3$ + $2NaOH$ + $7H_2O \rightarrow 2Na\mathbf{D}(OH)_4(H_2O)_2$ OR<br>$\mathbf{D}_2O_3$ + $2NaOH$ + $3H_2O \rightarrow 2Na\mathbf{D}(OH)_4$ OR<br>$\mathbf{D}_2O_3$ + $2NaOH \rightarrow 2Na\mathbf{D}O_2$ + $H_2O$ OR<br>$\mathbf{D}_2O_3$ + $2OH^-$ + $7H_2O \rightarrow 2[\mathbf{D}(OH)_4(H_2O)_2]^-$ OR<br>$\mathbf{D}_2O_3$ + $2OH^-$ + $3H_2O \rightarrow 2[\mathbf{D}(OH)_4]^-$ OR<br>$\mathbf{D}_2O_3$ + $2OH^- \rightarrow 2\mathbf{D}O_2^-$ + H2O<br><br>M1 = species;<br>M2 = balancing | <br><br><br><br><br><br><br><br>[1]<br>[1] | [2] |
| | (c) | giant ionic / ionic lattice | [1] | [1] |
| | (d) | $\mathbf{G}O_2$ + $H_2O \rightarrow H_2\mathbf{G}O_3$ | [1] | [1] |
| | | | | **[7]** |

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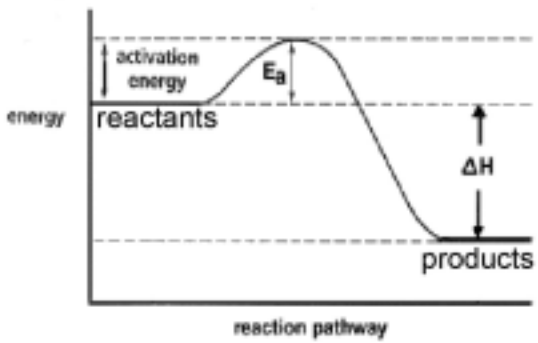
| Question | Mark Scheme | Mark | Total |
|---|---|---|---|
| 3 (a) (i) | bubbles / effervescence / fizzing | [1] | max [3] |
| | calcium gets smaller / disappears | [1] | |
| | water turns cloudy / milky | [1] | |
| | calcium sinks | [1] | |
| (ii) | $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ | [1] | [1] |
| (iii) | faster bubbling / disappearance of Ba<br>OR<br>no / less precipitate forms (owtte) | [1] | [1] |
| (b) (i) |  | | [2] |
| | M1 – general layout with products below reactants AND both labelled | [1] | |
| | M2 – $E_a$ and $\Delta H$ / energy change / released labelled with vertical lines | [1] | |
| (ii) | activation energy is high | [1] | [2] |
| | so few/no particles with $E \geqslant E_a$ | [1] | |

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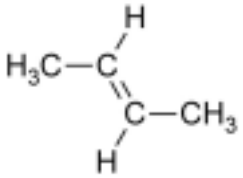
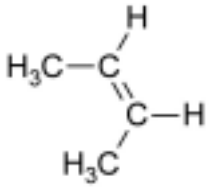
| Question | Mark Scheme | Mark | Total |
|---|---|---|---|
| (iii) | high melting / boiling point<br>strong forces (of attraction / between oppositely charged ions) / strong (ionic) bonding | [1]<br>[1] | [2] |
| (iv) | MgO is basic / reacts with acid | [1] | [1] |
| (c) (i) | increases (down the group) | [1] | [1] |
| (ii) | $MgCO_3 \rightarrow MgO + CO_2$ | [1] | [1] |
| (iii) | $2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$ | [1] | [1] |
| | | | **[15]** |
| 4 (a) | $CH_2=CHCH_2CH_3$ / $CH_2CHCH_2CH_3$<br>AND<br>$CH_3CH=CHCH_3$ / $CH_3CHCHCH_3$ | [1] | [1] |
| (b) | $CH_2=CHCH_2CH_3$ / $CH_2CHCH_2CH_3$<br>AND<br>$(CH_3)_2C=CH_2$ / $(CH3)_2CCH_2$ | [1] | [1] |
| (c) | <br>*trans*-but-2-ene (or *E*)<br><br>*cis*-but-2-ene (or *Z*) | [1]<br>[1] | [2] |

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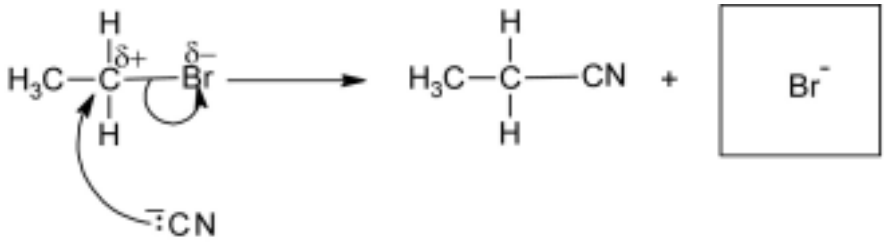
| Question | Mark Scheme | Mark | Total |
|---|---|---|---|
| (d) | **B** is $CH_2=CHCH_2CH_3$ OR $CH_3CH=CHCH_3$ OR $(CH_3)_2C=CH_2$ | [1] | |
| | distinguished by addition of bromine | [1] | [3] |
| | brown/red/orange/yellow to colourless/decolourises with **B** (but not **A**) | [1] | |
| | | | **[7]** |
| 5 (a) |  | | [2] |
| | M1 = lone pair on C of CN− AND curly arrow from lone pair to C of C—Br | [1] | |
| | M2 = correct dipole on C—Br, curly arrow from C—Br bond to Br AND $Br^-$ | [1] | |
| (b) (i) | reduction | [1] | [1] |
| (ii) | disappearance of peak / dip / trough / absorption at 1680–1730 | [1] | |
| | due to (loss of) C=O | [1] | |
| | OR | | [2] |
| | peak at 3200–3650 | [1] | |
| | due to (alcohol) O—H (formation) | [1] | |
| (c) (i) | sodium/potassium hydroxide<br>aqueous | [1]<br>[1] | [2] |

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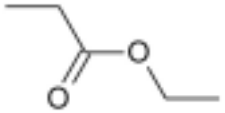
|---|---|---|---|
| (ii) | ethanol | [1] | [1] |
| (d) (i) | (conc) $H^+$ / (conc) acid / (conc)$H_2SO_4$ / (conc)$H_3PO_4$ | [1] | [1] |
| (ii) |  | [1] | [1] |
| (iii) | ethyl propanoate | [1] | [1] |
| (e) (i) | **V** = $CH_3CH_2CHCHCH_2CH_3$ / $CH_3CH_2CH{=}CHCH_2CH_3$<br>**T** = $CH_3CH_2CH(OH)CH(OH)CH_2CH_3$ | [1]<br>[1] | [2] |
| (ii) | **V** = geometric(al) / *cis-trans* / *E–Z*<br>**T** = optical | [1]<br>[1] | [2] |
| | | | **[15]** |

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