

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9701 CHEMISTRY

9701/21

Paper 2 (AS Structured Questions), maximum raw mark 60

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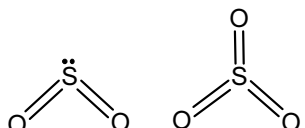
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| Question | Mark Scheme | Marks | Total |
|-----------|---|-------|-------|
| 1 (a) (i) | increasing distance of (outer) electron(s) from nucleus OR increasing distance of outer / valence shell from nucleus | 1 | [3] |
| | increased shielding / screening (from inner shells) | 1 | |
| | reduces attraction | 1 | |
| (ii) | (3 rd electron for each in) inner / lower energy level / shell / closer to nucleus (than first two) / less shielding | 1 | [2] |
| | (large) increase in nuclear attraction | 1 | |
| (b) (i) | $(1s^2 2s^2 2p^6) 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$ | 1 | [1] |
| (ii) | four isotopes owtte | 1 | [1] |
| (iii) | $\frac{(84 \times 0.56) + (86 \times 9.86) + (87 \times 7) + (88 \times 82.58)}{100}$ | 1 | [2] |
| | = 87.7 (must be 3 sig figs) | 1 | |
| (c) (i) | (a species that) gains / takes electron(s) | 1 | [1] |

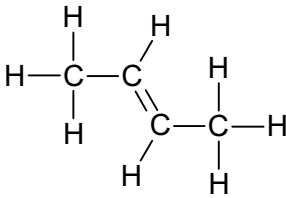
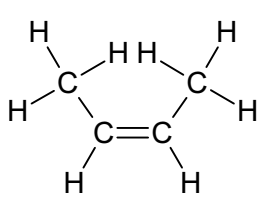
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| Question | Mark Scheme | Marks | Total |
|----------|---|----------------------------|-------------|
| (ii) | <p>Ba Cl O</p> <p>$\frac{45.1}{137}$ $\frac{23.4}{35.5}$ $\frac{31.5}{16}$</p> <p>$\frac{0.329}{0.329}$ $\frac{0.659}{0.329}$ $\frac{1.969}{0.329}$</p> <p>1.00 2.00 5.98 / 6</p> <p>emp form = BaCl₂O₆</p> | <p>1</p> <p>1</p> <p>1</p> | <p>[3]</p> |
| (d) (i) | <p>X = Mg(OH)₂</p> <p>Y = MgO</p> <p>Z = Mg(NO₃)₂</p> | <p>1</p> <p>1</p> <p>1</p> | <p>[3]</p> |
| (ii) | <p>reagent = nitric acid</p> <p>MgO + 2HNO₃ → Mg(NO₃)₂ + H₂O</p> | <p>1</p> <p>1</p> | <p>[2]</p> |
| (iii) | Heat / thermal decomposition | 1 | [1] |
| (iv) | <p>Mg + 2H₂O → Mg(OH)₂ + H₂</p> <p>2Mg(NO₃)₂ → 2MgO + 4NO₂ + O₂</p> | <p>1</p> <p>1</p> | <p>[2]</p> |
| | | | [21] |

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|----------|--|--------------------------|-------|
| 2 (a) | $4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$ | 1 1 | [2] |
| (b) (i) | Very exothermic/gets very hot OR creates (acid/ H_2SO_4) spray/mist/fog/fumes | 1 | 1 |
| (ii) | $\text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$ $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$ | 1 1 | [2] |
| (c) (i) |  <p>M1 SO_2 correct M2 SO_3 correct</p> | 1+1 | [2] |
| (ii) | 115–120° bent / non-linear 120° trigonal planar | 1 1 | [2] |
| (d) (i) | Advantage = higher rate Greater KE/energy/speed/collision frequency/proportion of successful collisions/more particles with $E > E_a$ Disadvantage – reduced yield/less product (Forward reaction) exothermic AND (hence in accordance with LCP) equilibrium/reaction shifts left (to counteract inc T) ora | 1 1 1 1 | [4] |
| (ii) | $K_p = \frac{p\text{SO}_3^2}{p\text{SO}_2^2 \times p\text{O}_2}$ | 1 | [1] |

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| (iii) | $ \begin{array}{ccc} 2\text{SO}_2(\text{g}) & + & \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}) \\ 2 & 2 & 0 \\ (-1.8) & (-0.9) & \\ 0.2 & 1.1 & 1.80 \end{array} $ $ \begin{aligned} x\text{SO}_3 &= 1.8/3.1 = 0.581 \\ x\text{SO}_2 &= 0.2/3.1 = 0.065 \\ x\text{O}_2 &= 1.1/3.1 = 0.355 \end{aligned} $ $ K_p = \frac{0.581^2 \times (2 \times 10^5)^2}{0.065^2 \times (2 \times 10^5)^2 \times 0.355 \times 2 \times 10^5} = 1.13 \times 10^{-3} \text{ Pa}^{-1} $ | 1 1 1 1+1 | [5] |
| | | | [19] |
| 3 (a) | P ; $\text{CH}_2 = \text{C}(\text{CH}_3)_2$ Q ; $\text{CH}_3\text{CH}_2\text{CH} = \text{CH}_2$ R ; $\text{CH}_3\text{CH} = \text{CHCH}_3$ S ; $(\text{CH}_3)_2\text{CO}$ | 1 1 1 1 | [4] |
| (b) (i) | (Different molecules with) the same (molecular and) structural formula different arrangements of atoms (in space)/ different displayed formula | 1 1 | [2] |
| (ii) |  trans-but-2-ene  cis-but-2-ene | 1 1 | [2] |

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| (c) | reagent; NaBH ₄ or LiAlH ₄ or names | 1 | [2] |
| | product; propan-2-ol | 1 | |
| | | | [10] |
| 4 (a) | CH ₃ CH ₂ CO ₂ H + 4[H] → CH ₃ CH ₂ CH ₂ OH + H ₂ O | 1+1 | [2] |
| (b) (i) | Oxidation | 1 | [1] |
| (ii) | Sodium/potassium dichromate or correct formula | 1 | [2] |
| | H ⁺ /acidified and (heat under) reflux | 1 | |
| (c) | 2 CH ₃ CH ₂ CO ₂ H + CaCO ₃ → (CH ₃ CH ₂ CO ₂) ₂ Ca + H ₂ O + CO ₂ | 1+1 | [2] |
| (d) (i) | CH ₃ CO ₂ H | 1 | [2] |
| | warm/hot/high temperature/heat/reflux AND concentrated sulfuric acid | 1 | |
| (ii) | water (or hydrogen chloride or ethanoic acid) | 1 | [1] |
| | | | [10] |