



CHEMISTRY

0620/42

Paper 4 Extended Theory

October/November 2017

MARK SCHEME

Maximum Mark: 80

Published

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This document consists of **7** printed pages.

| Question | Answer | Marks |
|-----------|---|-------|
| 1(a)(i) | Brownian (motion) | 1 |
| 1(a)(ii) | molecules | 1 |
| | nitrogen / N ₂ / N OR oxygen / O ₂ / O | 1 |
| 1(a)(iii) | nitrogen OR oxygen (particles) collide with / bombard / hit the dust (particles) | 1 |
| | (the bombarding particles) move randomly | 1 |
| 1(b)(i) | diffusion | 1 |
| 1(b)(ii) | Br ₂ has an <i>M_r</i> of 160 AND Cl ₂ has an <i>M_r</i> of 71 / bromine has an <i>A_r</i> of 80 AND chlorine has an <i>A_r</i> of 35.5 | 1 |
| | (heavier) bromine (molecules / particles) diffuses more slowly | 1 |
| 1(b)(iii) | particles have more energy / move faster | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 2(a) | Si: 2: 8 : 4 | 1 |
| | Ca ²⁺ : 2 : 8: 8 | 1 |
| | N ³⁻ : 2 : 8 | 1 |
| 2(b) | Ca ₃ N ₂ | 1 |
| 2(c) | Li shown as having one shell with 2 electrons OR no electrons OR no outer shell | 1 |
| | Cl shown as having an outer shell of 7 electrons of one type, plus one different electron which matches Li electrons | 1 |
| | '+' charge on Li AND '-' charge on Cl | 1 |

| Question | Answer | Marks |
|----------|---|-------|
| 2(d) | two shared pairs of electrons | 1 |
| | both Cl with complete outer shells | 1 |
| | S with complete outer shell | 1 |
| 2(e) | SCl ₂ has intermolecular forces (of attraction) | 1 |
| | LiCl has (electrostatic) forces (of attraction) between ions | 1 |
| | intermolecular forces are weaker / less energy is needed to break intermolecular forces | 1 |
| 2(f) | silicon(IV) oxide | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 3(a) | <i>exothermic mark</i> : horizontal line representing the energy of the products below the energy of the reactants | 1 |
| | <i>label of products mark</i> : product line labelled with 2CO ₂ + 3H ₂ O | 1 |
| | <i>correct direction of vertical heat of reaction arrow</i> : arrow starts level with reactant energy and finishes level with product energy AND has (only) one arrow head | 1 |
| 3(b) | activation energy / E _a | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 3(c) | –650 kJ / mol M1 bonds broken $2 \times ((3 \times 410) + 360 + 460) + (3 \times 500)$ $2 \times (1230 + 360 + 460) + 1500$ $2 \times 2050 + 1500$ $4100 + 1500 = 5600$ M2 bonds formed $(2 \times (2 \times 805)) + (4 \times (2 \times 460))$ $2 \times 1610 + 4 \times 920$ $3220 + 3680 = 6900$ M3 = M1 – M2 energy change of reaction = $5600 - 6900 = -1300$ M4 = M3 / 2 | 4 |
| 3(d)(i) | cracking | 1 |
| 3(d)(ii) | $C_{12}H_{26} \rightarrow 3C_2H_4 + C_6H_{14}$ M1 $C_{12}H_{26}$ M2 rest of equation | 2 |
| 3(d)(iii) | phosphoric acid | 1 |
| | heat | 1 |
| 3(d)(iv) | addition / hydration | 1 |
| 3(d)(v) | measure its boiling temperature | 1 |
| | compare to (known) data | 1 |
| 3(e)(i) | any 2 from: <ul style="list-style-type: none"> • 37 °C • anaerobic • glucose is aqueous • yeast | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 3(e)(ii) | $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ M1 CO ₂ as a product M2 Rest of equation | 2 |
| 3(e)(iii) | yeast is killed by the ethanol | 1 |
| 3(e)(v) | slow rate of reaction | 1 |
| 3(e)(v) | uses renewable resources / does not use a finite resource | 1 |
| 3(e)(vi) | fractional distillation | 1 |
| 3(f)(i) | CH ₃ O | 1 |
| 3(f)(ii) | no (C=C) double bonds | 1 |
| 3(f)(iii) | at least two alternating rectangles with attempted linking | 1 |
| | one displayed ester link (all atoms and all bonds) | 1 |
| | fully correct structure with at least one repeat unit including continuation bonds from correct atom or rectangle | 1 |
| 3(f)(iv) | polyester | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 4(a) | the breakdown (into elements) | 1 |
| | of an (ionic) compound by (the passage of) electricity | 1 |
| 4(b)(i) | oxygen | 1 |
| 4(b)(ii) | glowing splint | 1 |
| | relights | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 4(b)(iii) | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ M1 gain of electrons by H^+ M2 rest of equation | 2 |
| 4(c) | <i>the wires:</i> electrons | 1 |
| | <i>the electrolyte:</i> ions | 1 |
| 4(d) | any 2 from: <ul style="list-style-type: none"> • green gas at positive electrode • bulb is brighter • rate of bubbles increases | 2 |
| 4(e)(i) | <i>anode made of:</i> impure copper | 1 |
| | <i>cathode made of:</i> (pure) copper | 1 |
| | <i>electrolyte of:</i> (aqueous) copper sulfate | 1 |
| 4(e)(ii) | silver (impurities) fall to the bottom of the cell | 1 |
| | zinc (impurities) (dissolve) into solution (as ions) | 1 |
| | because zinc is more reactive than copper AND silver is less reactive than copper | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 5(a) | both colours referred to correctly as observations in both parts of the answer | 1 |
| | (if sulfuric acid is added to solution Y,) equilibrium moves to the right-hand side | 1 |
| | because the concentration of acid has increased | 1 |
| | (if sodium hydroxide is added to solution Y,) equilibrium moves to the left-hand side | 1 |
| | because sodium hydroxide reacts with / neutralises sulfuric acid | 1 |
| 5(b)(i) | 210 cm ³ M1 expected volume of hydrogen = 300 cm ³ M2 70% of M1 | 2 |
| 5(b)(ii) | fewer moles / molecules / particles (of gas) on the left-hand side | 1 |
| 5(b)(iii) | endothermic | 1 |
| 5(b)(iv) | increases rate (of reaction) | 1 |