

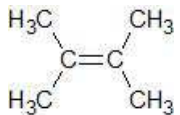
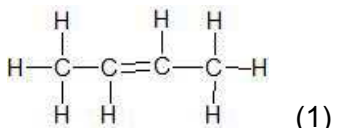
| Question | Answer | Marks | AO Element | Notes | Guidance |
|----------|--|-------|------------|--|----------|
| 1(a) | H ₂ O on right | 1 | | | |
| | 2 (HCl) on left | 1 | | note: mark dependent on H ₂ O on right | |
| 1(b)(i) | A = flask / Erlenmeyer | 1 | | | |
| | B = (top pan) balance | 1 | | | |
| 1(b)(ii) | carbon dioxide is a gas / gas escapes / carbon dioxide escapes / carbon dioxide given off / gas given off | 1 | | | |
| 2(a) | H ₂ O | 1 | | | |
| 2(b) | CO and CO ₂ are gases / CO and CO ₂ are given off / the products are gases (and water) | 1 | | ignore: other substances evaporated | |
| 3(a) | 3 (H ₂) | 1 | | | |
| 3(b) | (hydrogen is) flammable / explosive | 1 | | allow: fire hazard | |
| | (CO is) poisonous / toxic | 1 | | ignore: CO harmful | |

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|----------|---|----------|------------|--|----------|
| 4(a) | Any two from: <ul style="list-style-type: none"> • have same functional group • group of similar compounds / have similar chemical properties • (molecular) formula increases by CH₂ unit • physical properties show a trend / density shows a trend / boiling points show a trend • they have a <u>general</u> formula | 2 | | | |
| 4(b) | C ₅ H ₁₂ | 1 | | | |
| 4(c) | increases | 1 | | | |
| 5(a) | sulfate | 1 | | | |
| 5(b) | MgCl ₂ | 1 | | | |
| 5(c) | 26 g | 1 | | | |
| 6 | 2 (Ga ₂ O ₃) | 1 | | | |
| | 4 (Ga) | 1 | | note: 2 nd mark dependent on first being correct | |
| 7(a) | arrow under Al foil | 1 | | | |

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|----------|---|-------|------------|--|----------|
| 7(b) | Al_2Cl_6 | 1 | | ignore: $AlCl_3$ | |
| 8(a) | $AlCl_3 + 3Na \rightarrow 3NaCl + Al$ species (1) balancing (1) | 2 | | | |
| 8(b) | M1 electrolysis M2 molten sodium chloride or M1 add named more reactive metal (e.g. K) M2 molten sodium chloride | 2 | | | |
| 9(a) | speeds up reaction | 1 | | | |
| 9(b) | O_2 (on left) | 1 | | | |
| | correct balance (2 on right) | 1 | | note: second mark dependent on O_2 or 2O on left | |
| 9(c) | to prevent it turning into liquid / vapour | 1 | | allow: so temperature is below melting point / so that it can form crystals | |
| 10 | 2 (Cl_2); | 1 | | | |
| | CO_2 (on right); | 1 | | | |

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|----------|--|-------|------------|--|----------------------------|
| 11(a) | copper + nitric acid → copper nitrate + nitrogen dioxide + water | 2 | | | 1 mark if one / two errors |
| 11(b) | any three from: <ul style="list-style-type: none"> • blue (solution) / blue (precipitate) ; • precipitate / ppt ; • in excess the precipitate redissolves ; • dark blue solution (above precipitate) ; | 3 | | | |
| 11(c) | car engines / car exhausts / lightning / high temperature furnaces ; | 1 | | | |
| 12 | 2 (SO ₂); | 1 | | | |
| | 3 (O ₂); | 1 | | | |
| 13 | O ₂ | 1 | | | |
| | 4 (Rb) | 1 | | note: mark dependent on correct balance of O ₂ (allow: 2O) | |
| 14(a) | 4; | 1 | | | |

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|----------|--|----------|------------|---|----------|
| 14(b) | 212; | 2 | | For 1 mark one row correct e.g. H = 12 × 1 = 12 N = 4 × 14 = 56 | |
| 15 | calcium chloride ; | 1 | | | |
| | water ; | 1 | | | |
| 16(a) | A; | 1 | | | |
| 16(b) | (anode): decreases in size / becomes eroded; | 1 | | | |
| | cathode: increases in size; | 1 | | | |
| 16(c) | 134; | 2 | | | |
| 17 | $\text{PbBr}_2 / \text{Pb}^{2+}2\text{Br}^-$; | 1 | | | |
| 18 | 2 (CO); | 1 | | | |
| | 2 (C) dependent on 2CO being correct; | 1 | | | |
| 19 | B - 5 | 1 | | | |
| 20(a) | NH_4^+ | 1 | | | |

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|----------|---|-------|------------|-------|----------|
| 20(b) | PH ₄ I | 1 | | | |
| 21(a) | addition | 1 | | | |
| 21(b) | CH ₂ | 1 | | | |
| 21(c) |  <p>one C=C (1) fully correct structure (1)</p> | 2 | | | |
| 22(a) | white precipitate | 1 | | | |
| 22(b) | $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ <p>correct ionic equation (1) state symbols (1)</p> | 2 | | | |
| 23(a) | 3 | 1 | | | |
| 23(b) |  <p>but-2-ene (1)</p> | 2 | | | |

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|-----------|--|-------|------------|-------|----------|
| 23(c) | CH ₂ (1) CH ₂ (1) | 2 | | | |
| 24(a)(i) | cobalt carbonate | 1 | | | |
| 24(a)(ii) | lead iodide | 1 | | | |
| 24(b) | 2 AgNO ₃ + Na ₂ CO ₃ → Ag ₂ CO ₃ + 2 NaNO ₃ formula of silver carbonate correct (1) fully correct equation (1) | 2 | | | |
| 24(c) | Pb ²⁺ + 2I ⁻ → PbI ₂ Pb ²⁺ and I ⁻ on left of equation (1) fully correct equation (1) | 2 | | | |
| 25(a) | l....g....g. | 1 | | | |
| 25(b) | vanadium(V) oxide or vanadium pentoxide (1) 450 (°C) (1) | 2 | | | |
| 25(c) | SO ₃ + H ₂ SO ₄ → H ₂ S ₂ O ₇ (1) H ₂ S ₂ O ₇ + H ₂ O → 2H ₂ SO ₄ (1) | 2 | | | |

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|----------|---|-------|------------|-------|--|
| 26(a) | 78 (%) | 1 | | | |
| 26(b) | fractional (1) distillation (1) | 2 | | | |
| 26(c) | acid rain | 1 | | | |
| 26(d) | nitrogen and oxygen (from the air) react (in the engine) (1) (due to) high temperatures (1) | 2 | | | |
| 26(e) | nitrogen (1) carbon dioxide (1) platinum (1) | 3 | | | |
| 26(f) | $\text{CH}_4 + 1\frac{1}{2}\text{O}_2 \rightarrow \text{CO} + 2\text{H}_2\text{O}$ CO and H ₂ O as products and methane as reactant (1) rest of the equation (1) | 2 | | | |
| 27 | H ₂ O and CO or C formed (1) $2\text{C}_4\text{H}_{10} + 9\text{O}_2 \rightarrow 8\text{CO} + 10\text{H}_2\text{O}$ (1) | 2 | | | allow correctly balanced alternatives with CO and/or C formed |

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| 28 | $2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$ Fe ₂ O ₃ and Al ₂ O ₃ both correct (anywhere) (1) Equation completely correct (1) | 2 | | | |
| 29(a) | $Mg(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Mg^{2+}(aq)$ ionic equation correct (1) state symbols (1) | 2 | | | |
| 29(b) | any two from: • solid dissolves/ disappears • blue colour of solution fades OR paler solution OR colour of solution disappears OR becomes colourless solution • pink or orange or brown AND solid | 2 | | | |
| 29(c) | unreactive coating of aluminium oxide | 1 | | | |
| 30(a) | ultraviolet/UV light | 1 | | | |
| 30(b) | $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ | 1 | | | |

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|----------|--|----------|------------|-------|----------|
| 30(c) | substitution | 1 | | | |
| 30(d) | NaCl | 1 | | | |
| 31(a) | platinum | 1 | | | |
| 31(b) | chlorine | 1 | | | |
| 31(c) | $2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$ H ⁺ + e ⁻ on left hand side (1) rest of equation (1) state symbols of (aq) → (g) (1) | 3 | | | |
| 31(d) | increases (sodium) hydroxide is formed (sodium) hydroxide is an alkali | 3 | | | |
| 32(a) | 720(.09) | 1 | | | |
| 32(b) | (it contains) ions (1) (ions) are able to move (1) | 2 | | | |
| 32(c) | magnesium is not inert | 1 | | | |
| 32(d) | bromine / Br ₂ | 1 | | | |

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|----------|--|-------|------------|-------|----------|
| 32(e) | H ⁺ and e ⁽⁻⁾ on LHS (1) fully correct, i.e.: 2H ⁺ + 2e ⁻ → H ₂ (1) | 2 | | | |
| 33 | any two numbers correct (1) equation fully balanced (1) Ca ₃ P ₂ + 6H ₂ O → 3Ca(OH) ₂ + 2PH ₃ | 2 | | | |
| 34(a) | proton acceptor | 1 | | | |
| 34(b) | Contact (process) | 1 | | | |
| 34(c) | 2NH ₃ + H ₂ SO ₄ → (NH ₄) ₂ SO ₄ (NH ₄) ₂ SO ₄ (1) rest of the equation (1) | 2 | | | |
| 35(a) | P ₄ + 6Cl ₂ → 4PCl ₃ formulae correct (1) equation balanced (1) | 2 | | | |
| 35(b) | 3 bonding pairs and 1 lone pair on P (1) six non-bonding electrons on 3 chlorine atoms (1) | 2 | | | |

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|----------|--|----------|------------|-------|----------|
| 36(a) | M1 same number of electrons M2 (same number of) electrons in outer shell | 2 | | | |
| 36(b) | $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ M1 MgCl_2 as product M2 fully correct equation | 2 | | | |
| 36(c) | M1 test: lighted / burning splint M2 result: (squeaky) pop | 2 | | | |
| 37(a) | improves conductivity / better conductor (1) lower (operating) temperature (1) | 2 | | | |
| 37(b) | positive: $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ (1) negative: $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ (1) | 2 | | | |
| 37(c) | anodes or carbon react with oxygen (1) (form) carbon dioxide (1) | 2 | | | |
| 38(a) | N_3^- | 1 | | | |

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|----------|---|-------|------------|-------|----------|
| 38(b) | <p>M1 state symbols on right correct (s) then (aq)</p> <p>M2 $\text{Pb}(\text{NO}_3)_2 + 2 \text{NaN}_3 \rightarrow \text{Pb}(\text{N}_3)_2 + 2\text{NaNO}_3$</p> | 2 | | | |
| 38(c) | <p>M1 filter</p> <p>M2 wash with water</p> | 2 | | | |
| 39(a) | <p>M1 colourless</p> <p>M2 to brown / orange / yellow</p> | 2 | | | |
| 39(b) | <p>$\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$</p> <p>OR</p> <p>$\text{Cl}_2 + 2\text{Br}^- \rightarrow 2\text{Cl}^- + \text{Br}_2$</p> <p>M1 all formulae</p> <p>M2 equation balanced correctly</p> | 2 | | | |
| 40(a) | addition | 1 | | | |
| 40(b) | | 1 | | | |

- Mark Scheme

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|----------|---|----------|------------|-------|--------------|
| 40(c) | M1 CO on right M2 $2n(\text{O}_2)$ $2n(\text{CO})$ | 2 | | | |
| | | | | | [Total: 154] |

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