

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the May/June 2015 series

0620 CHEMISTRY

0620/33

Paper 3 (Extended Theory), maximum raw mark 80

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Abbreviations used in the Mark Scheme

- ; separates marking points
- / separates alternatives within a marking point
- **OR** gives alternative marking point
- **R** reject
- **I** ignore mark as if this material was not present
- **A** accept (a less than ideal answer which should be marked correct)
- **COND** indicates mark is conditional on previous marking point
- owtte or words to that effect (accept other ways of expressing the same idea)
- max indicates the maximum number of marks that can be awarded
- ecf credit a correct statement that follows a previous wrong response
- () the word / phrase in brackets is not required, but sets the context
- ora or reverse argument

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| Question | Answer | Marks | Guidance |
|-----------------|---|--------------|---|
| 1(a)(i) | AlF ₃ ; | 1 | |
| 1(a)(ii) | As ₂ O ₃ ; | 1 | A As ₂ O ₅ |
| 1(a)(iii) | SiBr ₄ ; | 1 | |
| 1(b)(i) | P ³⁻ ; | 1 | |
| 1(b)(ii) | Ba ²⁺ ; | 1 | |
| 1(b)(iii) | Fr ⁺ ; | 1 | |
| 1(c) | M1 2 double bonds, one between each O and the C atom; M2 each O has 8 outer electrons; M3 each C has 8 outer electrons; | 3 | R wrong symbols for O for M2 R wrong symbols for C for M3 I missing symbols A any combination of x and o |

| Question | Answer | Marks | Guidance |
|-----------------|---------------------------------------|--------------|--|
| 2(a) | carbon monoxide; | 1 | A CO |
| 2(b) | sodium oxide; | 1 | A Na ₂ O |
| 2(c) | sulfur dioxide; | 1 | A SO ₂ |
| 2(d) | zinc oxide OR aluminium oxide; | 1 | A ZnO or Al ₂ O ₃ |
| 2(e) | silicon(IV) oxide; | 1 | A silicon (di)oxide or SiO ₂ |
| 2(f) | sulfur dioxide; | 1 | A SO ₂ |

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| Question | Answer | Marks | Guidance |
|-----------------|--|--------------|--|
| 3(a) | carbon dioxide escapes / leaves / lost / released OR not a closed system; | 1 | A gas escapes / leaves / lost / released |
| 3(b) | CaO + H ₂ O → Ca(OH) ₂ reactants; product; | 2 | One mark for each side correct A multiples I state symbols |
| 3(c) | M1 number of moles of CaCO ₃ = (12.5 / 100 =) 0.125 or 125000 OR 56 / 100 = 0.56; M2 mass calcium oxide = (0.125 × 56) = 7 (tonnes) OR 0.56 × 12.5 = 7; | 2 | Correct answer scores both marks A answers in g or kg |
| 3(d)(i) | <i>Any two from:</i> does not wash away / insoluble / lasts a long time; does not increase pH above 7 / neutral / has pH 7; naturally occurring / does not need to be processed; | 2 | A does not leach out |
| 3(d)(ii) | <i>Any three from:</i> (flue gas contains) sulfur dioxide; flue gas / sulfur dioxide is acidic; calcium carbonate reacts with sulfur dioxide; to make a salt / calcium sulfite OR neutralisation; | 3 | A CaCO ₃ is a base |
| 3(d)(iii) | making steel or iron / in a <u>blast</u> furnace / toothpaste / (making) glass / building / (making) cement / treating acidic river or lakes / chalk; | 1 | |

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| Question | Answer | Marks | Guidance |
|-----------------|---|--------------|--|
| 4(a)(i) | <i>Any one fossil fuel from:</i> crude oil / petroleum / natural gas / methane / petrol / gasoline / kerosene / paraffin / diesel (oil) / gas oil / fuel oil / refinery gas / LPG / propane / butane; | 1 | I ethane / oil / naphtha / coal / gas R coke / bitumen / lubricating oil / wood |
| 4(a)(ii) | (burn to) release energy; take a long time to form (from organic material); | 2 | If time stated 1000 years or more |
| 4(b)(i) | oxygen / air and sulfur (from fuel) react; (forms) sulfur (di)oxide; (sulfur dioxide) reacts with oxygen / air and water (to form sulfuric acid) OR sulfur trioxide reacts with water (to form sulfuric acid) OR sulfurous acid reacts with oxygen (to form sulfuric acid); | 3 | A correct formulae throughout A sulfurous acid if sulfur reacts with oxygen and water |
| 4(b)(ii) | oxygen and nitrogen react; making oxides of nitrogen; (oxides of nitrogen) react with water (making nitric acid); | 3 | A nitrogen combust R if oxygen or nitrogen originate from the fuel A named oxide of nitrogen A correct formulae A NO _x |
| 4(b)(iii) | add sodium hydroxide (solution) and aluminium; (warm) and ammonia made; | 2 | A zinc or Devarda's A description of smell of ammonia or test for ammonia |

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| Question | Answer | Marks | Guidance |
|-----------------|--|--------------|---|
| 4(b)(iv) | <p>M1 measure pH/describe how to measure pH (such as use universal indicator); M2 lower pH greater concentration of H⁺;</p> <p>OR</p> <p>M1 add Ca, Mg, Zn, Fe; M2 faster reaction greater concentration of H⁺ /faster bubbles or more hydrogen (in same time);</p> <p>OR</p> <p>M1 rate of reaction with (metal) carbonate; M2 faster reaction greater concentration of H⁺ /faster bubbles or more carbon dioxide (in same time);</p> <p>OR</p> <p>M1 electrical conductivity; M2 greater conductivity greater concentration of H⁺;</p> <p>OR</p> <p>M1 titrate with (named) alkali; M2 correct result;</p> | 2 | A M2 if non specified or other metal added in M1 |

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| Question | Answer | Marks | Guidance |
|-----------------|--|--------------|---|
| 5(a) | (CuCO ₃ →) CuO + CO ₂ ; (Cu(OH) ₂ →) CuO + H ₂ O; (2Cu(NO ₃) ₂ →) 2CuO + (4NO ₂) + O ₂ species; balancing; | 4 | A multiples I state symbols |
| 5(b)(i) | (black to) pink / brown / orange; | 1 | I red |
| 5(b)(ii) | (hot) copper reacts / is oxidised; with oxygen / air; | 2 | A forms copper oxide for 2 marks |
| 5(b)(iii) | carbon monoxide / ammonia / methane; | 1 | |
| 5(b)(iv) | carbon / graphite or any metal more reactive than copper; | 1 | |
| 5(c)(i) | 79.2828685; 79.6205853; 84.7161572; | 2 | Minimum 3 sig figs A rounding or truncating <i>All three correct = 2 marks,</i> <i>Two correct = 1 mark</i> |
| 5(c)(ii) | the last one OR Cu and O ₂ OR the one from copper; not all the copper oxidised OR the outside of the pieces of copper oxidised but the inside did not OR (still) contains copper (metal); | 2 | e cf of biggest for M1 |

| Question | Answer | Marks | Guidance |
|-----------------|---|--------------|--|
| 6(a)(i) | Al ³⁺ + 3e → Al formula of Al ³⁺ ion; rest correct; | 2 | A multiples I state symbols A – 3e on right |

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| Question | Answer | Marks | Guidance |
|-----------------|--|--------------|---|
| 6(a)(ii) | $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}$ species; balancing; | 2 | A multiples I state symbols A – 4e on left |
| 6(a)(iii) | endothermic AND (electrical) energy supplied; | 1 | A energy required to break bonds |
| 6(b)(i) | exothermic AND (electrical) energy release; | 1 | I heat energy |
| 6(b)(ii) | magnesium forms ions (in solution) OR magnesium loses electrons OR magnesium is oxidised; copper is deposited (on the electrode) OR copper ions become copper atoms OR copper ions gain electrons OR copper ions are reduced; | 2 | A magnesium dissolves / goes into solution A equation (balanced or unbalanced) A equation (balanced or unbalanced) I use of terms anode or cathode |
| 6(b)(iii) | M1 set up a magnesium / manganese cell; M2 the negative electrode (is the more reactive) OR the electrode that loses mass (is more reactive); OR M1 replace magnesium with manganese; M2 if voltage less (positive) manganese is less reactive OR if voltage is more (positive) manganese is more reactive; | 2 | A replace Cu with Mn A converse |
| 6(c) | $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ species; balancing; | 2 | A multiples I state symbols |
| 6(d)(i) | (light from the) sun / sunlight; | 1 | A uv |
| 6(d)(ii) | carbon dioxide + water \rightarrow glucose + oxygen; | 1 | A starch / sugar / (named) carbohydrate I energy or light on LHS |

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| Question | Answer | Marks | Guidance |
|-----------------|---|--------------|---|
| 7(a)(i) | alkenes have a (carbon to carbon) double bond; | 1 | A “they” for alkenes A alkanes do not have a (carbon to carbon) double bond |
| 7(a)(ii) | alkene; C_nH_{2n} or twice as many hydrogen atoms as carbon atoms; | 2 | A fits general formula for alkenes |
| 7(a)(iii) | add bromine (water); remains brown / orange / yellow / no change; becomes colourless / decolourised; | 3 | I red A M2 and M3 only available if M1 correct or close (such as bromide or bromination) I clear |
| 7(b)(i) |  <p>correct structure with at least two carbons and single C-C bond; continuation bonds with at least 2 carbon atoms in chain; two or more correct repeat units (with correct use of n, if used) OR correct use of n;</p> | 3 | I incorrect additional units R any incorrect units or non-integral number of repeat units |
| 7(b)(ii) | $CH_3-CH=CH-CH_3$; | 2 | A award 1 mark for any monomer with C=C as long as both carbons have the correct valency I names |

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| Question | Answer | Marks | Guidance |
|-----------------|--|--------------|---|
| 7(b)(iii) | <p><i>one from:</i> addition polymerisation polymer only product; addition polymerisation same functional group in all monomers or C=C in monomers; addition polymer has same empirical formula as monomer;</p> <p><i>one from:</i> condensation makes (polymer and) simple/small molecule OR water OR hydrogen chloride; condensation polymerisation monomers have two (different) functional groups;</p> | 2 | <p>A only one monomer</p> <p>A (normally two) different monomers</p> |
| 7(b)(iv) | polyester / polyamide; | 1 | <p>A protein / polysaccharide / polypeptide / complex carbohydrate I names</p> |