

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the May/June 2015 series

0620 CHEMISTRY

0620/31

Paper 3 (Extended Theory), maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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|---------------|--|-----------------|--------------|
| Page 2 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

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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|---------------|--|-----------------|--------------|
| Page 3 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|--|--------------|
| 1(a) | <p><i>Any two fossil fuels from:</i></p> <p>crude oil / petroleum; natural gas / methane; petrol / gasoline; kerosene / paraffin; diesel (oil) / gas oil; fuel oil; refinery gas / LPG; propane; butane;</p> | 2 |
| 1(b) | <p>hydrogen, oxygen, nitrogen; <i>All three for 2 marks two for 1 mark</i></p> | 2 |
| 1(c)(i) | <p>M1 oxygen and nitrogen (from air) react; M2 oxides of nitrogen OR nitrogen oxide(s) are formed; M3 nitrogen oxides formed react with water (to form acid);</p> | 3 |
| 1(c)(ii) | <p><i>Any two from:</i></p> <p>M1 lowers pH or acidifies lakes / rivers or kills fish; M2 changes composition of soils or reduces fertility of soil or reduces crop yields deforestation or kills crops / trees / plants / leaves; M3 attacks (limestone) buildings or statues; M4 attacks metal (structures) / bridges;</p> | 3 |

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|---------------|--|-----------------|--------------|
| Page 4 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|---|--------------|
| 1(d) | <p>Any three from:</p> <p>M1 wood burns to produce (less) carbon dioxide;</p> <p>M2 trees (wood) take in carbon dioxide;</p> <p>M3 by photosynthesis;</p> <p>M4 wood is carbon neutral fuel;</p> | 3 |

| Question | Answer | Marks |
|-----------------|--|--------------|
| 2(a) | <p>M1 <i>Forming an oxide</i> (all) elements or (all) impurities become oxides;</p> <p>M2 <i>Gaseous oxides</i> carbon dioxide or sulfur (di)oxide escape / are removed as gases;</p> <p>M3 <i>Acidic oxides</i> silicon(IV) oxide or phosphorus(III/V) oxide react / are neutralised by calcium oxide / lime;</p> <p>M4 <i>Equation mark</i> any one of the following equations $S + O_2 \rightarrow SO_2$; $C + O_2 \rightarrow CO_2$ or $2C + O_2 \rightarrow 2CO$; $Si + O_2 \rightarrow SiO_2$; $4P + 5O_2 \rightarrow 2P_2O_5$ or $P_4 + 5O_2 \rightarrow 2P_2O_5$; $4P + 3O_2 \rightarrow 2P_2O_3$ or $P_4 + 3O_2 \rightarrow 2P_2O_3$;</p> <p>M5 <i>Word equation mark</i> any one of the following word equations calcium oxide + silicon(IV) oxide \rightarrow calcium silicate; calcium oxide + phosphorus(III/V) oxide \rightarrow calcium phosphate;</p> | 5 |

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|---------------|--|-----------------|--------------|
| Page 5 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|---|--------------|
| 2(b)(i) | <i>Any one from:</i> (making) car (bodies); machinery; chains; pylons; white goods; nails; screws; as a building material; sheds / roofs; reinforcing concrete; | 1 |
| 2(b)(ii) | <i>Any one from:</i> knives; drills; railway tracks; machine / cutting tools / hammers; razor blades; chisels; | 1 |
| 2(b)(iii) | M1 atoms or cations or (positive) ions or metal ions; M2 arranged in a lattice or in layers or in rows or in a regular structure; M3 rows or layers slide over one another; | 3 |
| 2(b)(iv) | M1 carbon atoms or particles in structure different size (to cations); M2 so reduce moving or interrupt movement; | 2 |

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|---------------|--|-----------------|--------------|
| Page 6 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|--|--------------|
| 3(a)(i) | Zn to Zn ²⁺ ; because electron loss; | 2 |
| 3(a)(ii) | (2)H ⁺ or 'hydrogen ion(s)'; it accepts electrons or takes electrons (from zinc atoms); | 2 |
| 3(b)(i) | zinc displaces copper or zinc more reactive than copper; Zn + CuCl ₂ → ZnCl ₂ + Cu OR Zn + Cu ²⁺ → Cu + Zn ²⁺ ; | 2 |
| 3(b)(ii) | steeper (line) or higher gradient; (means an) increased rate; but the same (final) volume; | 3 |
| 3(c) | M1 less steep (line) or lower gradient; M2 (because of) decreased rate; M3 ethanoic is a weak(er) acid; M4 only partially ionised or dissociated OR lower concentration of hydrogen ions; | 4 |
| 3(d) | M1 moles of HCl = 0.1 (mol); M2 moles of Zn = 0.05 (mol); mass of zinc = 3.25g; | 3 |

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|---------------|--|-----------------|--------------|
| Page 7 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|---|--------------|
| 4(a)(i) | Any three from: same general formula; contain the same functional group; consecutive members differ by CH ₂ ; common methods of preparation; same or similar chemical properties; physical properties vary in a predictable manner / show trends / show a gradual change / an example of a physical variation e.g. mpt, bpt volatility viscosity; | 3 |
| 4(a)(ii) | propanol / propan-1-ol / propan-2-ol; | 1 |
| 4(a)(iii) | if molecular formula is given as C ₁₀ H ₂₂ O award 2 marks if not, look for evidence of some correct working for one mark 158 – 17 = 141 OR 12n + 2n + 1 = 141 OR n = 10 | 2 |
| 4(b) | they have the same molecular formula (C ₄ H ₁₀ O); different structures; | 2 |
| 4(c)(i) | M1 butene or but-1-ene; M2 structural formula of but-1-ene; | 2 |
| 4(c)(ii) | butyl ethanoate; | 1 |
| 4(c)(iii) | butanoic acid; structural formula of butanoic acid; | 2 |

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|---------------|--|-----------------|--------------|
| Page 8 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|--|--------------|
| 5(a) | M1 add chlorine to (potassium) iodide solution; M2 red/brown/yellow/orange (solution) is formed; M3 $Cl_2 + 2KI \rightarrow 2KCl + I_2$ $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$; | 3 |
| 5(b) | M1 (0.013 moles of I and 0.065 moles of F atoms gives a) ratio 1:5; Formula = IF ₅ ; | 2 |
| 5(c)(i) | example of a reversible reaction including attempts at removing/adding waters of crystallisation OR example of a reaction which under closed conditions would be reversible; | 1 |
| 5(c)(ii) | <i>Any two from:</i> (a reaction) M1 which can take place in both directions OR which can be approached from both directions; M2 in which concentrations/macroscopic properties do not change (with time); M3 the two reaction rates are equal; | 2 |
| 5(d) | M1 equilibrium goes to LHS OR equilibrium goes to reactants side; M2 because the concentration of chlorine decreases; | 2 |
| 5(e) | M1 equilibrium goes to RHS OR equilibrium goes to products side; M2 exothermic reactions are favoured by low temperatures; M3 the forward reaction is exothermic; | 3 |

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|---------------|--|-----------------|--------------|
| Page 9 | Mark Scheme | Syllabus | Paper |
| | Cambridge IGCSE – May/June 2015 | 0620 | 31 |

| Question | Answer | Marks |
|-----------------|---|--------------|
| 6(a)(i) | M1 proton acceptor; M2 does not accept (protons) readily OR less able to accept protons (than strong bases); | 2 |
| 6(a)(ii) | M1 same <u>concentration</u> of both bases; M2 measure their pH; M3 the higher pH is the stronger base; | 3 |
| 6(b)(i) | $2\text{CH}_3\text{CH}_2\text{NH}_2 + \text{H}_2\text{SO}_4 \rightarrow (\text{CH}_3\text{CH}_2\text{NH}_3)_2\text{SO}_4$ species; balancing; the salt is ethylammonium sulfate; | 3 |
| 6(b)(ii) | sodium hydroxide / calcium hydroxide / NaOH / Ca(OH) ₂ ; | 1 |
| 6(c)(i) | <i>Any two from:</i> (particles move in) random motion; (particles) collide; (particles) move from a region of high concentration to low concentration; | 2 |
| 6(c)(ii) | C; M2 it has a lower (relative) molecular mass (than HBr); M3 ethylamine diffuses faster (than HBr); | 3 |