

Mark Scheme (Results)

June 2010

GCE

GCE Chemistry (6CH01/01)

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Section A (multiple choice)

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 1 (a) | B | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 1 (b) | D | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 2 | D | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 3 | A | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 4 (a) | B | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 4(b) | D | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 4 (c) | C | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 4 (d) | A | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 5 | B | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 6 | A | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 7 | C | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 8 | D | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 9 | C | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 10 | C | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 11 | D | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 12 | B | 1 |

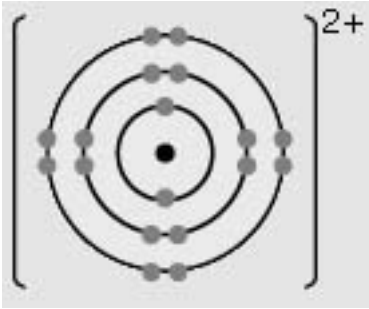
| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 13 | D | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 14 (a) | B | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 14 (b) | A | 1 |

| Question Number | Correct Answer | Mark |
|-----------------|----------------|------|
| 14 (c) | C | 1 |

Section B

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 15 (a)(i) |  <p>electrons (1) charge (1) square brackets not essential</p> <p>Mark independently</p> <p>Ignore (labelling of) nucleus unless incorrect</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 15 (a)(ii) | $1s^22s^22p^63s^23p^6$ <p>Allow electron number as sub script</p> <p>Allow orbitals as capital letters</p> <p>Allow TE from (a) (i) if Ca atom or Ca⁺ ion</p> | | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|---|------|
| 15 (a)(iii) | <p>Smaller</p> <p>Because it has one less (sub) shell of electrons / orbital / energy level / less shielding (1)</p> <p>And the ratio of protons : electrons has increased / more protons than electrons / greater net force on remaining electrons (so remainder of electrons held more closely) / greater effective nuclear charge (1)</p> | <p>bigger scores zero</p> <p>greater nuclear charge / positive charge</p> | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--|------|
| 15 (a)(iv) | <p>Any two from: Strong (electrostatic) forces / attractions / bonds (between ions) (1)</p> <p>(ions) held in giant lattice / many (ionic) attractions / forces / bonds (1)</p> <p>So large amount of energy needed (to break apart ions) (1)</p> | <p>Any mention of covalent or metallic bonds or atoms or molecules scores zero</p> <p>High temperature</p> | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--|------|
| 15 (b)(i) | Because the ions are free to move (when a potential difference is applied) | Electrons / particles are free to move | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|---------------------------|------|
| 15 (b)(ii) | <p>The cations / barium and calcium (ions) are different sizes</p> <p>Ignore any discussion of reasons</p> <p>(could select either the calcium ion because it has more water molecules associated with it OR the barium ion because it has more shells of electrons and so larger)</p> | Atoms are different sizes | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 15 (b)(iii) | <p>Mass of calcium ions in 1 kg = 0.100×40 (= 4.0) (g) (1)</p> <p>If mass quoted must be correct to score first mark</p> <p>Hence 4.0 g per 1000 g of solution So ppm = $(4.0/1000) \times 1000000$ = 4000 (ppm) (1)</p> <p>OR</p> <p>Mass of calcium ions in 1 kg = 0.100×40.1 (= 4.01) (g) (1)</p> <p>Hence 4.01 g per 1000 g of solution So ppm = $(4.01/1000) \times 1000000$ = 4010 (ppm) (1)</p> <p>Correct answer alone = 2 marks</p> <p>Allow TE for second mark from incorrect mass</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|----------------------|------|
| 15 (c) | <p>(Sulfur / nitrogen oxides) form when (fossil) fuels are burnt / when petrol or diesel burn in vehicle engines / emissions from vehicle (engines) / volcanoes / lightning (1)</p> <p>They (react with water to) form sulfuric / sulfurous acid / nitric acid / acid rain / gases are acidic (1)</p> <p>Which reacts with limestone (to form soluble compounds) / limestone and acid take part in neutralisation / dissolves building / corrodes building (1)</p> <p>Allow correct equation for third mark but ignore equations if mark already awarded. Ignore comments regarding erosion</p> | from factories alone | 3 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--|------|
| 15 (d) | <p>Either Yes, as the values match closely (so little deviation from ionic model) Or no, as the values are (slightly) different so a degree of covalency / not fully ionic</p> | <p>100% ionic covalent</p> | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 16 (a) | <p>Atoms (of an element) with the same number of protons (1)</p> <p>But with different number of neutrons (1)</p> <p>Same atomic number but different mass number only = (1)</p> <p>Element(s) with same number of protons but different number of neutrons = (1) max</p> <p>Ignore comments on electrons unless incorrect in which case award max 1</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|-----------------------------------|--------|------|
| 16 (b)(i) | (Electric field) accelerates ions | | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|-----------------|------|
| 16 (b) (ii) | <p>(Magnetic field) deflects / changes direction of / bends the beam of ions</p> <p>if the term 'ions' is missing or an incorrect term is used e.g. 'atoms', penalise only once in parts b (i) and b (ii)</p> | just bends ions | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--|------|
| 16 (c) | <p>% abundance = $(135 \times 9.01 + 136 \times 10.81 + 137 \times 12.32 + 138 \times 67.86) / 100$ (1)</p> <p>= 137.4 (1)</p> <p>ignore units</p> <p>Allow TE for one slip in transfer of data from question</p> <p>Correct answer scores (2)</p> | <p>Just 137 as final answer</p> <p>137.39</p> <p>137.3903</p> <p>137.390</p> | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 16 (d) | <p>three peaks (caused by Br_2^+ ions) (1)</p> <p>because ions $(^{79}\text{Br}-^{79}\text{Br})^{(+)}$ and $(^{81}\text{Br}-^{79}\text{Br})^{(+)}$ / $(^{79}\text{Br}-^{81}\text{Br})^{(+)}$ and $(^{81}\text{Br}-^{81}\text{Br})^{(+)}$ (1)</p> <p>Mark independently</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 16 (e) | <p>Any one</p> <p>analysis of material from space / drug testing in sport / identify breakdown products from drugs in body / quality control in pharmaceutical industry / identify molecules from sample with potential biological activity / radioactive dating with context e.g determine age of fossils / human remains</p> <p>The uses above must have a context</p> <p>/ determining M_r of a molecule / evidence for structure from fragmentation pattern</p> | | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 17 (a) | $ \begin{array}{c} \text{H} \\ \times \cdot \\ \text{H} \times \text{C} \times \ddot{\text{O}} \times \text{H} \\ \times \cdot \\ \text{H} \end{array} $ <p>(1) for around carbon and its hydrogens (1) for around oxygen and its hydrogen</p> <p>Allow all dots or all crosses Ignore circles around atoms</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 17 (b)(i) | <p>C(s) / (graphite) + 2H₂(g) + 2O₂(g) Correct species (1)</p> <p>Allow oxygen above arrows rather than in box</p> <p>Balancing and state symbols (1)</p> <p>Second mark dependent on correct species except as below with either hydrogen or oxygen or both as atoms e.g C(s) / (graphite) + 4H(g) + 4O(g)</p> <p>Scores second mark</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--|------|
| 17 (b)(ii) | <p>Enthalpy / energy / heat(energy) change when one mole of a substance (1)</p> <p>Is formed from its elements (in their most stable / standard states) (1)</p> <p>Under standard conditions of 298K/ 25 °C / any stated temperature AND 1 atm pressure / 101 kPa / 100 kPa (1)</p> <p>Definitions based on lattice enthalpies may score third mark only</p> | heat required / heat given out / heat taken in | 3 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 17 (b)(iii) | $\Delta H_c^\ominus = -\Delta H_1^\ominus + \Delta H_2^\ominus (1)$ $= (2 \times -285.8 + -393.5) - (-239.1)$ $= -726 (1)$ Ignore units Correct answer alone = 2 marks $+726 = 1$ $-440.2 = 1$ if omit multiply by 2 | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 17 (c)(i) | $20.7 \times 200 \times 4.18 = 17305(.2) (J)$ ignore sf except 1 sf i.e. 20000 OR $20.7 \times 200 \times 0.00418 = 17.305(2) \text{ kJ}$ ignore sf except 1 sf i.e. 20 ignore signs ignore mol^{-1} | | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 17 (c) (ii) | $0.848/32 = 0.0265 (mol)$ ignore sf except 1 sf i.e. 0.03 | | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 17 (c)(iii) | $17305.2/0.0265 = -653000 \text{ (J mol}^{-1}\text{) (3sf)}$ OR $-653 \text{ (kJ mol}^{-1}\text{) (3sf)}$ Ignore missing units but penalise incorrect units Allow TE from (c)(i) & (ii) | | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|---|------|
| 17 (c)(iv) | Any two from As heat/energy absorbed by apparatus / heat/energy 'lost' to surroundings (1) methanol not completely burnt / incomplete combustion (1) methanol 'lost' by evaporation (1) cannot ensure all products are at standard conditions at end of reaction / water is produced as a gas / reaction not carried out in the standard conditions (1) | just heat/energy loss just incomplete reaction | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|------------------------------|--|------|
| 18 (a)(i) | Crude oil / petroleum / coal | Oil on its own / Natural gas / fossil fuels / any named fraction of crude oil | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 18 (a)(ii) | <p>use of high temperatures / heat (in the absence of air) / thermal decomposition / catalysts (1)</p> <p>Either</p> <p>to break large molecules / to form smaller molecules / to break bonds in large molecules / to break carbon-carbon bonds (1)</p> <p>OR</p> <p>producing alkenes / producing carbon-carbon double bonds (1)</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark | | | | | | | | | | |
|--|---|--------|-----------|-----------------------------------|-------------------------|---|-------------------------|--|--|-----------|---|--|---|
| 18 (a)(iii) | <p>Risks (2) Amendments (2)</p> <table border="1"> <thead> <tr> <th>Risk</th> <th>Amendment</th> </tr> </thead> <tbody> <tr> <td>exposure to harmful / toxic fumes</td> <td>Set up in fume cupboard</td> </tr> <tr> <td>Escape of flammable / harmful / toxic reactants or products from ill fitting bung</td> <td>Correct fitting of bung</td> </tr> <tr> <td>Escape of flammable / harmful / toxic reactants or products from poorly positioned delivery tube</td> <td>Placement of delivery tube below mouth of test tube / use a longer delivery tube</td> </tr> <tr> <td>suck back</td> <td>Attach Bunsen valve / remove delivery tube from water before stopping heating etc</td> </tr> </tbody> </table> <p>Mark all 4 points independently If escaping gases linked to 2 amendments but no risk mentioned then allow 1 for risk</p> | Risk | Amendment | exposure to harmful / toxic fumes | Set up in fume cupboard | Escape of flammable / harmful / toxic reactants or products from ill fitting bung | Correct fitting of bung | Escape of flammable / harmful / toxic reactants or products from poorly positioned delivery tube | Placement of delivery tube below mouth of test tube / use a longer delivery tube | suck back | Attach Bunsen valve / remove delivery tube from water before stopping heating etc | <p>Dangerous</p> <p>collect in syringe</p> | 4 |
| Risk | Amendment | | | | | | | | | | | | |
| exposure to harmful / toxic fumes | Set up in fume cupboard | | | | | | | | | | | | |
| Escape of flammable / harmful / toxic reactants or products from ill fitting bung | Correct fitting of bung | | | | | | | | | | | | |
| Escape of flammable / harmful / toxic reactants or products from poorly positioned delivery tube | Placement of delivery tube below mouth of test tube / use a longer delivery tube | | | | | | | | | | | | |
| suck back | Attach Bunsen valve / remove delivery tube from water before stopping heating etc | | | | | | | | | | | | |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 18 (b)(i) | <p>Reagent - Hydrogen/H₂ (1) Catalyst - Nickel/Ni/palladium/Pd/platinum/Pt (1)</p> <p>Mark independently</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--|------|
| 18 (b)(ii) | <p>1,2 - dibromoethane (1)</p> <p>ignore punctuation</p> $ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{Br} \quad \text{Br} \end{array} $ <p>(1)</p> <p>Mark independently Allow CH₂BrCH₂Br</p> | <p>1,2 - bromoethane dibromoethane</p> <p>Skeletal formula</p> <p>C₂H₄Br₂</p> | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---------------------------------|--------|------|
| 18 (b)(iii) | From purple / pink → colourless | clear | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|---|------|
| 18 (c)(i) | <p>(1) for both arrows</p> <p>(1) for carbocation (1) for arrow</p> <p>arrow from bromide ion can start from any part of the bromide ion and can go towards the C or the + sign on the intermediate</p> <p>bromide ion must show negative charge</p> <p>allow 2 max for addition of Br₂ and any other electrophilic additions</p> <p>half headed arrows used throughout penalise only once</p> | <p>δ- on bromide ion for third mark</p> | 3 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|---|------|
| 18 (c)(ii) | <p>Bromine / bromide / hydrogen could add to either carbon (in the double bond) / bromide / bromine could add to either primary or secondary carbocation / (propene is unsymmetrical) so could form 1-bromopropane and / or 2-bromopropane.</p> <p>Allow correct structural or displayed formulae.</p> | bromine could add to any of the three carbons | 1 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 18 (d) | <div style="text-align: center;"> $\begin{array}{cccc} \text{H} & \text{C}_6\text{H}_5 & \text{H} & \text{C}_6\text{H}_5 \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$ </div> <p>position of hydrogen atoms and phenyl groups (1)</p> <p>Allow phenyl groups on 2nd and 3rd carbon OR 1st and 4th OR 1st and 3rd</p> <p>carbon carbon single bonds and continuation bonds (1)</p> <p>second mark not awarded for incorrect monomer</p> <div style="text-align: center; margin-top: 20px;"> </div> <p>(1) max with or without square brackets and n or numbers</p> <p>Do not penalise H from phenyl groups attaching to carbon chains</p> <p>Ignore extra square brackets, numbers and 'n' provided 2 monomer units shown</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|--|--------|------|
| 18 (e)(i) | <p>Any two</p> <p>(raw material for) paper cup requires cutting down trees (1)</p> <p>polystyrene cup uses less energy (280 kWh rather than 980 kWh) to produce so less CO₂ released / less fossil fuels (1)</p> <p>polystyrene cup releases less sulfur based compounds into air so less chance of forming acid rain / less chance of damaging buildings / acidifying lakes (produces 3.5 kg rather than 11 kg) (1)</p> <p>polystyrene cup releases no chlorine compounds which damages ozone layer / poisonous (produce 0 kg rather than 0.4 kg) (1)</p> <p>2 pieces of data chosen with no explanation allow 1 mark</p> <p>Ignore comments regarding water</p> | | 2 |

| Question Number | Acceptable Answers | Reject | Mark |
|-----------------|---|--------|------|
| 18 (e)(ii) | <p>2 additional factors</p> <p>e.g ease of recyclability whether cup is easy to reuse space taken up in landfill type and amount of gases formed if incinerated useful heat obtained if incinerated biodegradability / how long they take to decompose management of gases produced during decomposition durability / how long the cup lasts method of disposal</p> <p>Ignore comments regarding atom economy</p> <p>Ignore comments regarding acid rain / ozone layer / greenhouse gases unless linked to gases produced during disposal</p> | | 2 |

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