



Pearson

Mark Scheme (Results)

Summer 2017

Pearson Edexcel International GCSE
in Chemistry (4CH0) Paper 2C

Pearson Edexcel Level 1/Level 2 Certificate
in Chemistry (KCH0 2C)

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Summer 2017

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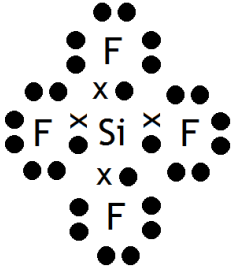
General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

| Question number | Answer | Notes | Marks | | | | | | | | | | |
|--|---|---|----------|---|--|--|--|--|--|---|---|--|---|
| 1 (a) | <p>C (4)</p> <p>The only correct answer is C</p> <p>A is not correct because there are 4 elements shown not 2</p> <p>B is not correct because there are 4 elements shown not 3</p> <p>D is not correct because there are 4 elements shown not 5</p> | | 1 | | | | | | | | | | |
| (b) | <p>2 NaOH + (1) H₂SO₄ → (1) Na₂SO₄ + 2 H₂O</p> | Accept fractions and multiples | 1 | | | | | | | | | | |
| (c) | <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="padding: 5px;">brine is a solution of sodium chloride in water</td> <td style="text-align: center; width: 50px;">✓</td> </tr> <tr> <td style="padding: 5px;">the temperature used in the contact process is greater than 1000 °C</td> <td></td> </tr> <tr> <td style="padding: 5px;">an equation for the contact process is SO₂ + H₂O → H₂SO₄</td> <td></td> </tr> <tr> <td style="padding: 5px;">the reactions in the diaphragm cell are displacement reactions</td> <td></td> </tr> <tr> <td style="padding: 5px;">the catalyst used in the contact process is vanadium(V) oxide</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table> | brine is a solution of sodium chloride in water | ✓ | the temperature used in the contact process is greater than 1000 °C | | an equation for the contact process is SO ₂ + H ₂ O → H ₂ SO ₄ | | the reactions in the diaphragm cell are displacement reactions | | the catalyst used in the contact process is vanadium(V) oxide | ✓ | <p>3 ticks with 2 correct scores 1</p> <p>3 ticks with 1 correct scores 0</p> <p>4 or 5 ticks scores 0</p> | 2 |
| brine is a solution of sodium chloride in water | ✓ | | | | | | | | | | | | |
| the temperature used in the contact process is greater than 1000 °C | | | | | | | | | | | | | |
| an equation for the contact process is SO ₂ + H ₂ O → H ₂ SO ₄ | | | | | | | | | | | | | |
| the reactions in the diaphragm cell are displacement reactions | | | | | | | | | | | | | |
| the catalyst used in the contact process is vanadium(V) oxide | ✓ | | | | | | | | | | | | |
| Total | | | 4 | | | | | | | | | | |

| Question number | Answer | Notes | Marks |
|-----------------|---|-------|-------|
| 2 (a) | <p>D (3 periods and 8 groups)</p> <p>The only correct answer is D</p> <p>A is not correct because there are 3 periods and 8 groups shown not 2 periods and 4 groups</p> <p>B is not correct because there are 3 periods and 8 groups shown not 3 periods and 4 groups</p> <p>C is not correct because there are 3 periods and 8 groups shown not 2 periods and 8 groups</p> | | 1 |
| (b) | <p>B (2)</p> <p>The only correct answer is B</p> <p>A is not correct because there are 2 noble gases shown not 1</p> <p>C is not correct because there are 2 noble gases shown not 3</p> <p>D is not correct because there are 2 noble gases shown not 4</p> | | 1 |

| Question number | Answer | Notes | Marks |
|-----------------|--|---|-------|
| (c) | <p>C (MgF₂)</p> <p>The only correct answer is C</p> <p>A is not correct because MgF is not the correct formula for magnesium fluoride</p> <p>B is not correct because Mg₂F is not the correct formula for magnesium fluoride</p> <p>D is not correct because Mg₂F₂ is not the correct formula for magnesium fluoride</p> | | 1 |
| (d) | <p>M1 $(28 \times 0.922) + (29 \times 0.047) + (30 \times 0.031)$</p> <p>OR</p> <p>28.109</p> <p>M2 28.1</p> | <p>ACCEPT $\frac{(28 \times 92.2) + (29 \times 4.7) + (30 \times 3.1)}{100}$</p> <p>Answer must be to one decimal place Correct final answer with no working scores 2</p> | 2 |

| Question number | Answer | Notes | Marks |
|-----------------|---|---|-------|
| (e) |  | <p>M1 all four Si-F bonding pairs</p> <p>M2 all 24 non-bonding electrons</p> <p>M2 DEP on M1</p> <p>ALLOW any combination of dots and crosses</p> <p>If overlapping/touching circles used both electrons must be within the overlapping/touching area</p> <p>IGNORE inner shell electrons even if incorrect</p> | 2 |

| Question number | Answer | Notes | Marks |
|-----------------|--|---|-----------|
| 2 (f) (i) | <p>M1 intermolecular forces (of attraction) / forces (of attraction) between molecules</p> <p>M2 stronger in SiCl₄ /weaker in SiF₄</p> | <p>ALLOW intermolecular bonds/van der Waals forces/London forces/dispersion forces/instantaneous dipole-induced dipole forces</p> <p>ACCEPT more energy is required to overcome the forces in SiCl₄ (or reverse argument)</p> <p>M2 DEP on M1</p> <p>ACCEPT attraction between SiCl₄ molecules is greater (than that between SiF₄ molecules) or reverse argument for 2 marks</p> <p>Award 0/2 if any reference to breaking covalent bonds</p> | 2 |
| (ii) | <p>M1 SiO₂ has strong covalent bonds (that must be broken)</p> <p>M2 (whereas) SiCl₄ has weak intermolecular forces (of attraction must be overcome)</p> | <p>ACCEPT strong intramolecular bonds/forces</p> <p>ACCEPT strong bonds between the atoms</p> <p>REJECT any mention of intermolecular forces or ionic bonding</p> <p>ALLOW intermolecular bonds/van der Waals forces/London forces/dispersion forces/instantaneous dipole-induced dipole forces</p> <p>ACCEPT more energy required to break covalent bonds in SiO₂ than is required to overcome intermolecular forces (of attraction) in SiCl₄ for 2 marks</p> | 2 |
| Total | | | 11 |

| Question number | Answer | Notes | Marks |
|-----------------|--|--|-----------|
| 3 (a) | electrons | ACCEPT e ⁻ or e | 1 |
| (b) | not (chemically) reactive / does not react (with the electrolytes/with the products of electrolysis) | ALLOW unreactive ALLOW non-reactive IGNORE references to full outer shell of electrons | 1 |
| (c) | M1 PbBr ₂ needs to be molten/liquid/melted M2 so that the ions can flow/move/are mobile | ACCEPT solid PbBr ₂ does not conduct ACCEPT the ions cannot flow/move/are not mobile in the solid IGNORE references to carry charge REJECT references to electrons moving | 2 |
| (d) (i) | (positive) chlorine AND oxygen (negative) hydrogen | ACCEPT Cl ₂ for chlorine and O ₂ for oxygen ACCEPT names in any order ACCEPT H ₂ If both name and formula given, mark name only | 2 |
| (ii) | M1 2Cl ⁻ → Cl ₂ + 2e ⁽⁻⁾ M2 2H ₂ O → 4H ⁺ + O ₂ + 4e ⁽⁻⁾ M3 2H ₂ O + 2e ⁻ → H ₂ + 2OH ⁻ MARK EQUATIONS INDEPENDENTLY OF ANSWERS GIVEN IN 3(d)(i) | ACCEPT 2Cl ⁻ - 2e ⁽⁻⁾ → Cl ₂ ALLOW 4OH ⁻ → 2H ₂ O + O ₂ + 4e ⁽⁻⁾ ALLOW 2H ⁺ + 2e ⁽⁻⁾ → H ₂ ACCEPT multiples/fractions in half-equations | 3 |
| (e) | M1 n[Cu] = 0.04(0) ÷ 2 OR 0.02(0) (mol) M2 mass[Cu] = 1.3 (g) OR M1 x 63.5 correctly evaluated | ACCEPT 1.27 (g) ACCEPT 1.28 (g) using 64 instead of 63.5 Correct final answer with no working scores 2 | 2 |
| Total | | | 11 |

| Question number | Answer | Notes | Marks |
|-----------------|---|--|-------|
| 4 (a) (i) | <p>M1 A and B and C</p> <p>M2 (they/all) contain only carbon and hydrogen (atoms)</p> | <p>ACCEPT formulae copied from table</p> <p>ACCEPT C and H</p> <p>ACCEPT words with same meaning as only, eg solely, exclusively, just etc</p> <p>ACCEPT particles/elements in place of atoms</p> <p>REJECT ions/molecules/compounds in place of atoms</p> <p>REJECT element/mixture in place of they/all</p> <p>REJECT H₂</p> <p>IGNORE D has Cl/another element as well</p> | 2 |
| (ii) | <p>M1 B</p> <p>M2 (because) it shows all the bonds (in the molecule)</p> | <p>ACCEPT converse argument about (all) the others</p> | 2 |

| Question number | Answer | Notes | Marks |
|-----------------|---|---|-------|
| 4 (b) | <p>(reaction 1):</p> <p>Any two from:</p> <p>M1 (it produces) pure(r) ethanol/alcohol/product</p> <p>M2 (it is a) fast(er) (reaction)</p> <p>M3 (it has a) greater atom economy</p> <p>M4 no carbon dioxide produced (so less pollution)</p> <p>(reaction 2):</p> <p>Any two from:</p> <p>M5 (it) uses renewable/sustainable resources / does not use finite resources</p> <p>M6 (it) uses atmospheric pressure / (it) does not need high pressure / (it) works at low pressures</p> <p>M7 (it) works at low/just above room temperature / (it) does not need much heat (energy)</p> | <p>IGNORE more concentrated ALLOW does not need further processing</p> <p>IGNORE no waste products ALLOW no greenhouse gas produced</p> <p>ACCEPT can be used in countries with no oil reserves/with available land /with suitable climate to grow sugar cane</p> <p>ALLOW 30 to 40 °C ACCEPT thermal energy</p> <p>IGNORE references to batch and continuous processes</p> <p>IGNORE references to lower cost</p> | 4 |

| Question number | Answer | Notes | Marks | | | | | | | | | | |
|-----------------|--|--|-------|-------------|--|-----------|---|-----------|--|-----------|--|--|---|
| 4 (c) (i) | but-2-ene | <p>ACCEPT 2-butene or 2-butylene</p> <p>ACCEPT butene or butylene or but-1-ene for 1 mark</p> | 2 | | | | | | | | | | |
| | (ii) colourless | <p>IGNORE clear</p> <p>IGNORE starting colour even if incorrect</p> | 1 | | | | | | | | | | |
| (d) (i) | <p>M1 (compounds/molecules that have the) same molecular formula/contain the same number of each type of atom</p> <p>M2 (but have) different structural formulae</p> | <p>ACCEPT both have molecular formula C₄H₈</p> <p>REJECT elements for compounds/molecules once only</p> <p>ACCEPT different structures /different displayed formulae / atoms arranged differently</p> | 2 | | | | | | | | | | |
| (ii) | <table border="1"> <tbody> <tr> <td>addition</td> <td>✓</td> </tr> <tr> <td>dehydration</td> <td></td> </tr> <tr> <td>hydration</td> <td>✓</td> </tr> <tr> <td>oxidation</td> <td></td> </tr> <tr> <td>reduction</td> <td></td> </tr> </tbody> </table> | addition | ✓ | dehydration | | hydration | ✓ | oxidation | | reduction | | <p>3 ticks with 2 correct scores 1</p> <p>3 ticks with 1 correct scores 0</p> <p>4 or 5 ticks scores 0</p> | 2 |
| addition | ✓ | | | | | | | | | | | | |
| dehydration | | | | | | | | | | | | | |
| hydration | ✓ | | | | | | | | | | | | |
| oxidation | | | | | | | | | | | | | |
| reduction | | | | | | | | | | | | | |

| Question number | Answer | Notes | Marks |
|-----------------|--|---|-----------|
| 4 (e) (i) | poly(chloroethene) | Do not penalise missing brackets or spaces in name ACCEPT polyvinyl chloride | 1 |
| | (ii) $ \begin{array}{c} \text{H} \quad \text{Cl} \\ \quad \\ n \text{ C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array} \longrightarrow \left(\begin{array}{c} \text{H} \quad \text{Cl} \\ \quad \\ - \text{C} - \text{C} - \\ \quad \\ \text{H} \quad \text{H} \end{array} \right)_n $ | M1 displayed formula of chloroethene (on left) M2 at least one correct repeat unit drawn as a displayed formula and continuation bonds M3 balancing using n (or equivalent) on left and n on right M3 DEP on M1 and M2 ACCEPT n anywhere before the monomer and anywhere after the brackets, but not before | 3 |
| Total | | | 19 |

| Question number | Answer | Notes | Marks |
|-----------------|---|---|-------|
| 5 (a) (i) | $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO} + 2 \text{H}_2\text{O}$ <p>M1 all formulae correct M2 correctly balanced</p> | <p>ACCEPT multiples and fractions</p> <p>M2 DEP on M1</p> | 2 |
| | (ii) thermal energy/heat (energy) lost to the surroundings/environment | <p>ACCEPT lost to atmosphere/beaker/thermometer</p> <p>ACCEPT evaporation of water/methanol</p> | 1 |

| Question number | Answer | Notes | Marks |
|-----------------|--|---|-------|
| 5 (b) (i) | <p>M1 (Q =) $125 \times 4.2 \times 36$</p> <p>M2 = 18 900 (J) /19 000 (J)</p> | <p>ACCEPT answer in kJ if unit included Correct final answer with no working scores 2 ALLOW one mark for $1.5 \times 4.2 \times 36 = 226.8$ ALLOW one mark for $126.5 \times 4.2 \times 36 = 19\,126.8$</p> | 2 |
| (ii) | <p>M1 mass[CH₃OH] = 84.7 – 83.2 OR 1.5 (g)</p> <p>M2 $n[\text{CH}_3\text{OH}] = 1.5 \div 32$ OR 0.046875 (mol)</p> <p>OR M1 $\div 32$</p> <p>M3 $\Delta H = 18\,900 \div \mathbf{M2}$ OR 403 200 (J/mol)</p> <p>M4 $\Delta H = -400$ (kJ/mol)</p> | <p>ACCEPT any number of sig fig except 1, eg 0.047</p> <p>ACCEPT M2 from (b)(i) \div M2 from (b)(ii) ACCEPT any number of sig fig</p> <p>ACCEPT any number of sig fig, eg 403, 403.2</p> <p>Negative sign must be included</p> <p>(+) 400/403/403.2 etc scores 3</p> <p>Mark CSQ throughout</p> <p>Correct final answer with no working scores 4</p> | 4 |

Alternative Method

| Question number | Answer | Notes | Marks |
|-----------------|---|--|-------|
| 5 (b) (ii) | <p>M1 mass[CH₃OH] = 84.7 – 83.2 OR 1.5 (g)</p> <p>M2 18 900 ÷ 1.5 OR 12 600 OR 18 900 ÷ M1</p> <p>M3 ΔH = 12 600 x 32 OR 403 200 (J)</p> <p>M4 ΔH = –400 (kJ/mol)</p> | <p>ACCEPT any number of sig fig except 1, eg 0.047</p> <p>ACCEPT M2 from (b)(i) ÷ M2 from (b)(ii)</p> <p>ACCEPT any number of sig fig</p> <p>ACCEPT any number of sig fig, eg 403, 403.2</p> <p>Negative sign must be included</p> <p>(+) 400/403/403.2 etc scores 3</p> <p>Mark CSQ throughout</p> <p>Correct final answer with no working scores 4</p> | 4 |

| Question number | Answer | Notes | Marks |
|-----------------|---|--|-------|
| 5 (b) (iii) | <p>M1 oxygen/other reactant missing from methanol</p> <p>M2 product level / carbon dioxide and water above reactant level</p> | <p>ACCEPT product level should be below reactant level</p> <p>ACCEPT answers shown on diagram</p> <p>IGNORE references to activation energy</p> <p>IGNORE references to missing x-axis</p> | 2 |

| Question number | Answer | Notes | Marks |
|-----------------|--|--|-----------|
| 5 (c) | <p>Route 1:</p> <p>M1 $\Sigma(\text{bonds broken}) = (412 \times 3) + 360 + 463 + (496 \times 1.5)$ OR 2803 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = (743 \times 2) + (463 \times 4)$ OR 3338 (kJ/mol)</p> <p>Route 2:</p> <p>M1 $\Sigma(\text{bonds broken}) = (412 \times 3) + 360 + (496 \times 1.5)$ OR 2340 (kJ/mol)</p> <p>M2 $\Sigma(\text{bonds made}) = (743 \times 2) + (463 \times 3)$ OR 2875 (kJ/mol)</p> <p>M3 Correct calculation of difference between M1 and M2</p> <p>M4 If M2 > M1 final answer must be negative If M2 < M1 final answer must be positive</p> | <p>IGNORE negative sign</p> <p>IGNORE negative sign</p> <p>IGNORE sign</p> <p>Expected final answer is -535</p> <p>Positive sign not required If a clear statement is made that the reaction is exothermic, then sign can be negative Correct final answer with no working scores 4</p> | 4 |
| Total | | | 15 |

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