



# Mark Scheme (Results)

January 2016

International GCSE  
Chemistry (4CH0) Paper 2C

Pearson Edexcel Certificates in  
Chemistry (KCH0) Paper 2C

## **Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications come from Pearson, the world's leading learning company. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information, please visit our website at [www.edexcel.com](http://www.edexcel.com).

Our website subject pages hold useful resources, support material and live feeds from our subject advisors giving you access to a portal of information. If you have any subject specific questions about this specification that require the help of a subject specialist, you may find our Ask The Expert email service helpful.

[www.edexcel.com/contactus](http://www.edexcel.com/contactus)

## **Pearson: helping people progress, everywhere**

Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at:

[www.pearson.com/uk](http://www.pearson.com/uk)

January 2016

Publications Code UG043119

All the material in this publication is copyright

© Pearson Education Ltd 2016

## 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)         |                  | <table><tr><td></td><td></td><td>Quantity</td><td>Unit</td></tr><tr><td>A</td><td>balance</td><td>mass</td><td><b>M1 g</b></td></tr><tr><td>B</td><td>clock</td><td><b>M2 time</b></td><td>s</td></tr><tr><td>C</td><td>gas syringe</td><td><b>M3 volume</b></td><td><b>M4 cm<sup>3</sup></b></td></tr><tr><td>D</td><td>ruler</td><td><b>M5 length</b></td><td><b>M6 cm</b></td></tr></table> |       |       | Quantity | Unit | A | balance | mass | <b>M1 g</b> | B | clock | <b>M2 time</b> | s | C | gas syringe | <b>M3 volume</b> | <b>M4 cm<sup>3</sup></b> | D | ruler | <b>M5 length</b> | <b>M6 cm</b> | Accept other correct metric units, such as<br>M1 kg / mg<br>Ignore imperial units such as lb / oz<br>Reject units impossible in a laboratory, such as t and m <sup>3</sup><br><br>M4 dm <sup>3</sup> / ml / l<br><br>M6 mm / m<br><br>Do not penalise use of capital letters, such as KG / CM<br>Accept word equivalents, such as gram(s), second(s), centimetre(s)<br><br>M5 alternatives - accept distance / height / width / depth / diameter<br><br>Do not penalise references to specific examples, such as volume of gas / length of line | 6 |
|                      |             |                  | Quantity                                                                                                                                                                                                                                                                                                                                                                                       | Unit  |       |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| A                    | balance     | mass             | <b>M1 g</b>                                                                                                                                                                                                                                                                                                                                                                                    |       |       |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| B                    | clock       | <b>M2 time</b>   | s                                                                                                                                                                                                                                                                                                                                                                                              |       |       |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| C                    | gas syringe | <b>M3 volume</b> | <b>M4 cm<sup>3</sup></b>                                                                                                                                                                                                                                                                                                                                                                       |       |       |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| D                    | ruler       | <b>M5 length</b> | <b>M6 cm</b>                                                                                                                                                                                                                                                                                                                                                                                   |       |       |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
|                      | (b)         | C                | (ruler)                                                                                                                                                                                                                                                                                                                                                                                        |       | 1     |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| Total for Question 1 |             |                  |                                                                                                                                                                                                                                                                                                                                                                                                |       | 7     |          |      |   |         |      |             |   |       |                |   |   |             |                  |                          |   |       |                  |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |

| Question number   |                     |                 | Answer                                                                                                                                                                                                                                                                                                                                                                                                |  |  | Notes                | Marks               |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
|-------------------|---------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|----------------------|---------------------|-----------------|---------|-----------------|-----------------|-------------------|------------|-----------------|--------|----------------|------------|-----------------|-----------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 2                 | (a)                 |                 | <table><tr><td>Substance</td><td>Element or compound</td><td>Type of bonding</td></tr><tr><td>ammonia</td><td><b>compound</b></td><td><b>covalent</b></td></tr><tr><td>hydrogen chloride</td><td>(compound)</td><td><b>covalent</b></td></tr><tr><td>oxygen</td><td><b>element</b></td><td>(covalent)</td></tr><tr><td>magnesium oxide</td><td><b>compound</b></td><td><b>ionic</b></td></tr></table> |  |  | Substance            | Element or compound | Type of bonding | ammonia | <b>compound</b> | <b>covalent</b> | hydrogen chloride | (compound) | <b>covalent</b> | oxygen | <b>element</b> | (covalent) | magnesium oxide | <b>compound</b> | <b>ionic</b> | Ignore qualifiers for covalent, eg polar / dative<br><br>All 6 correct = 3 marks<br>5 or 4 correct = 2 marks<br>3 or 2 correct = 1 mark<br>1 or 0 correct = 0 marks | 3 |
| Substance         | Element or compound | Type of bonding |                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |                      |                     |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
| ammonia           | <b>compound</b>     | <b>covalent</b> |                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |                      |                     |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
| hydrogen chloride | (compound)          | <b>covalent</b> |                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |                      |                     |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
| oxygen            | <b>element</b>      | (covalent)      |                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |                      |                     |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
| magnesium oxide   | <b>compound</b>     | <b>ionic</b>    |                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |                      |                     |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
|                   | (b)                 |                 | B (MgO)                                                                                                                                                                                                                                                                                                                                                                                               |  |  |                      | 1                   |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
|                   | (c)                 |                 | B (g)                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |                      | 1                   |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |
|                   |                     |                 |                                                                                                                                                                                                                                                                                                                                                                                                       |  |  | Total for Question 2 | 5                   |                 |         |                 |                 |                   |            |                 |        |                |            |                 |                 |              |                                                                                                                                                                     |   |

| Question number |     |       | Answer                                                                                                                                            | Notes                                                                                                                                                                                                                                                                               | Marks |
|-----------------|-----|-------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3               | (a) |       | does not easily lose / gain electrons                                                                                                             | Accept has a complete/full outer shell/octet (of electrons)<br>Accept has 8 electrons in outer shell<br>Ignore references to being stable / inert / a noble gas                                                                                                                     | 1     |
|                 | (b) |       | B (2.8.18.8)                                                                                                                                      |                                                                                                                                                                                                                                                                                     | 1     |
|                 | (c) | (i)   | M1 for idea of electron transfer / loss and gain of electron(s)<br><br>M2 for direction of transfer<br><br>M3 for number of electrons transferred | 0/3 for electron sharing<br>Ignore covalent<br><br>eg calcium loses, chlorine gains electrons<br><br>eg calcium loses 2, (each) chlorine gains 1<br>Penalise use of chloride in place of chlorine once only<br>All marks may be scored from a correctly labelled diagram            | 3     |
|                 |     | (ii)  | Ca <sup>2+</sup>                                                                                                                                  | Accept Ca <sup>+2</sup> / Ca <sup>++</sup><br>Reject all other ions<br>Penalise incorrect use of lower and upper case letters and position of charge<br>If equation written containing calcium ion formula, the ion must be identified in some way, such as circling or underlining | 1     |
|                 |     | (iii) | A calcium (and) calcium                                                                                                                           |                                                                                                                                                                                                                                                                                     | 1     |

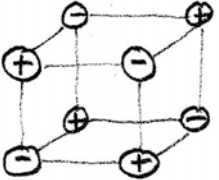
| Question number |     |  | Answer                                                                                                                                                                    | Notes                                                                                                                                                                                                                                                    | Marks     |
|-----------------|-----|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 3               | (d) |  | <p>M1 (step 1) dip a platinum wire into some concentrated <b>hydrochloric acid</b></p> <p>M2 (step 3) place the wire and sample into <b>non-luminous</b> Bunsen flame</p> | <p>Accept complete statements or changes</p> <p>M1 Do not penalise references to dilute instead of concentrated<br/>Accept hydrochloric acid / HCl</p> <p>M2 Accept blue flame / roaring flame<br/>Ignore references to hot / hotter / hottest flame</p> | 2         |
|                 | (e) |  | B (lilac)                                                                                                                                                                 |                                                                                                                                                                                                                                                          | 1         |
|                 |     |  |                                                                                                                                                                           | <b>Total for Question 3</b>                                                                                                                                                                                                                              | <b>10</b> |

| Question number |                   |  | Answer                                                                                                                         | Notes | Marks             |        |  |         |  |                                                                    |   |
|-----------------|-------------------|--|--------------------------------------------------------------------------------------------------------------------------------|-------|-------------------|--------|--|---------|--|--------------------------------------------------------------------|---|
| 4               | (a)               |  | B (a pressure of 65 atm)                                                                                                       |       | 1                 |        |  |         |  |                                                                    |   |
|                 | (b)               |  | <table><tr><td></td><td>Displayed formula</td></tr><tr><td>ethene</td><td></td></tr><tr><td>ethanol</td><td></td></tr></table> |       | Displayed formula | ethene |  | ethanol |  | <p>All atoms and bonds must be shown</p> <p>Ignore bond angles</p> | 2 |
|                 | Displayed formula |  |                                                                                                                                |       |                   |        |  |         |  |                                                                    |   |
| ethene          |                   |  |                                                                                                                                |       |                   |        |  |         |  |                                                                    |   |
| ethanol         |                   |  |                                                                                                                                |       |                   |        |  |         |  |                                                                    |   |



| Question number |     | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Notes                                                                                                                                                                                                  | Marks |
|-----------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 4               | (c) | <p>M1 (saturated because) there are only single bonds / all the bonds are single</p> <p>M2 (not a hydrocarbon) because it contains oxygen/another element</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Accept no double bonds / no multiple bonds</p> <p>Accept contains an OH group / an alcohol group</p> <p>Accept does not contain only hydrogen and carbon</p>                                        | 2     |
|                 | (d) | <p>Any three of the following:</p> <p>M1 correct statement about connection between crude oil and ethene, eg:<br/>crude oil is converted /fractionally distilled /cracked to obtain ethene</p> <p>M2 correct statement about connection between sugar cane or glucose and ethanol, eg:<br/>sugar/glucose is converted into ethanol / sugar/glucose fermented to make ethanol</p> <p>M3 correct statement about effect of crude oil being less available, eg:<br/>less ethene available /ethene more expensive / ethene production (more) difficult<br/>OR<br/>process 1 used less / less favoured / (more) expensive</p> | <p>Ignore references to time taken to obtain ethene or ethanol</p> <p>Ignore references to purity of ethene or ethanol</p> <p>Ignore references to global warming / finite and renewable resources</p> | 3     |

|  |  |  |                                                                                                                                                                                                                                                     |                             |          |
|--|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------|
|  |  |  | M4 correct statement about effect of climate change,<br>eg:<br>more sugar can be fermented / more ethanol can<br>be produced / ethanol cheaper / ethanol<br>production easier/easy<br>OR<br>process 2 used more / more favoured / less<br>expensive |                             |          |
|  |  |  |                                                                                                                                                                                                                                                     |                             |          |
|  |  |  |                                                                                                                                                                                                                                                     | <b>Total for Question 4</b> | <b>8</b> |

| Question number |     | Answer                                                                                                                                                                                                                                                                         | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Marks |
|-----------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5               | (a) |                                                                                                                                                                                               | <p>M1 for front face all correct</p> <p>M2 for rear face all correct</p> <p>M2 DEP on M1</p> <p>Do not penalise X in place of +</p> <p>Ignore symbols such as K and Cl</p> <p>Do not penalise use of Na<sup>+</sup> in place of K<sup>+</sup></p>                                                                                                                                                                                                                                                                                                      | 2     |
|                 | (b) | <p>(i) M1 (damp blue/red) litmus (paper)</p> <p>M2 bleached / goes colourless / goes white</p> <p>(ii) <math>2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-</math></p> <p>OR</p> <p><math>2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2</math></p> | <p>Ignore red as intermediate colour</p> <p>Accept use of universal indicator (paper) / pH paper</p> <p>M1 for H<sub>2</sub>O on lhs AND H<sub>2</sub> and OH<sup>-</sup> on rhs and no other formulae</p> <p>M1 for H<sup>+</sup> on lhs AND H<sub>2</sub> on rhs and no other formulae</p> <p>M2 for e<sup>(-)</sup> and balancing of correct equation</p> <p>Accept</p> <p>M1 <math>\text{H}^+ + \text{e}^- \rightarrow \text{H}</math></p> <p>M2 <math>2\text{H} \rightarrow \text{H}_2</math></p> <p>M2 DEP on M1</p> <p>Ignore state symbols</p> | 2     |

|  |  |       |                                                         |                                                                 |   |
|--|--|-------|---------------------------------------------------------|-----------------------------------------------------------------|---|
|  |  | (iii) | M1    alkaline / alkali formed<br>M2    OH <sup>-</sup> | Accept pH above 7<br><br>Ignore names<br><br>Mark independently | 2 |
|--|--|-------|---------------------------------------------------------|-----------------------------------------------------------------|---|

| Question number |     |      | Answer                                                                                                                | Notes                                                                                                                             | Marks     |
|-----------------|-----|------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------|
| 5               | (c) | (i)  | $0.0250 \div 2 / 0.0125$ (mol)                                                                                        |                                                                                                                                   | 1         |
|                 |     | (ii) | M1 $24 \times 0.0125$ OR $24000 \times 0.0125$<br>M2 $0.3(0) \text{ dm}^3 / 300 \text{ cm}^3 / 0.0003(0) \text{ m}^3$ | CQ on (c)(i)<br><br>Unit needed for M2<br>Accept 1 or more significant figures<br>Correct final answer with no working scores (2) | 2         |
|                 |     |      |                                                                                                                       | <b>Total for Question 5</b>                                                                                                       | <b>11</b> |

| Question number |     |       | Answer                                                               | Notes                                                                                                                                                                                                                                                                                                                                                                                   | Marks |
|-----------------|-----|-------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 6               | (a) |       | M1    23.60<br>M2    2.25<br>M3    21.35                             | Award 1 mark for both M1 and M2 correct but in wrong order<br>Penalise missing zero in 2nd dp once only<br><br>CQ on M1 and M2                                                                                                                                                                                                                                                          | 3     |
|                 | (b) | (i)   | ticks in columns 3 and 4                                             |                                                                                                                                                                                                                                                                                                                                                                                         | 1     |
|                 |     | (ii)  | M1 $\frac{23.50 + 23.70}{2}$<br><br>M2    23.6(0) (cm <sup>3</sup> ) | If no results ticked in (i), then only use of concordant titres can score in (ii)<br>If only one result ticked, then no marks can be scored in (ii)<br>Otherwise, both marks CQ on ticked results<br><br>Answers with zero as 2nd dp do not need trailing zero<br>Answers obtained by averaging other titre values do require 2nd dp<br>Correct final answer with no working scores (2) | 2     |
|                 | (c) | (i)   | M1 $\frac{0.107 \times 25.0}{1000}$<br>M2    0.00268 (mol)           | If no division by 1000, only M2 can be scored<br><br>Accept 2 or more significant figures                                                                                                                                                                                                                                                                                               | 2     |
|                 |     | (ii)  | (2 × 0.00268 =) 0.00535 (mol)                                        | CQ on (c)(i)                                                                                                                                                                                                                                                                                                                                                                            | 1     |
|                 |     | (iii) | M1 $\frac{0.00535}{0.02285}$<br>M2    0.234 (mol/dm <sup>3</sup> )   | CQ on (c)(ii)<br><br>Accept 2 or more significant figures                                                                                                                                                                                                                                                                                                                               | 2     |

| Question number |     |      | Answer            | Notes                                                                                        | Marks     |
|-----------------|-----|------|-------------------|----------------------------------------------------------------------------------------------|-----------|
| 6               | (d) | (i)  | white precipitate | Ignore names and formulae<br>Apply list principle for incorrect observations such as bubbles | 1         |
|                 |     | (ii) | barium sulfate    | Accept $\text{BaSO}_4$<br>If both name and formula given, mark name only                     | 1         |
|                 |     |      |                   | <b>Total for Question 6</b>                                                                  | <b>13</b> |

4CH0 | 2016 | January | Paper 2 | GradenMax





4CH0 | 2016 | January | Paper 2 | GradeMax