



Mark Scheme (Results)

Summer 2023

Pearson Edexcel International GCSE  
In Chemistry (4CH1) Paper 2CR

| Question number    | Answer                                                                                                                                                                                                                                                                                         | Notes                                                      | Marks         |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------|-----------------|--------|---|----|---------|---|---|----------|--------|----|---------------------------------------------------------------------|---|
| 1 (a)              | <table><tr><th>Subatomic particle</th><th>Relative mass</th><th>Relative charge</th></tr><tr><td>proton</td><td>1</td><td>+1</td></tr><tr><td>neutron</td><td>1</td><td>0</td></tr><tr><td>electron</td><td>0.0005</td><td>-1</td></tr></table>                                                | Subatomic particle                                         | Relative mass | Relative charge | proton | 1 | +1 | neutron | 1 | 0 | electron | 0.0005 | -1 | All 4 correct = (2)<br>2 or 3 correct = (1)<br>0 or 1 correct = (0) | 2 |
| Subatomic particle | Relative mass                                                                                                                                                                                                                                                                                  | Relative charge                                            |               |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
| proton             | 1                                                                                                                                                                                                                                                                                              | +1                                                         |               |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
| neutron            | 1                                                                                                                                                                                                                                                                                              | 0                                                          |               |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
| electron           | 0.0005                                                                                                                                                                                                                                                                                         | -1                                                         |               |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
| (b) (i)            | A increasing atomic number<br><br>B is incorrect as elements are not arranged in order of increasing melting point<br>C is incorrect as elements are not arranged in order of increasing reactivity<br>D is incorrect as elements are not arranged in order of increasing relative atomic mass |                                                            | 1             |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
| (ii)               | D Group 5 Period 3<br><br>A is incorrect as phosphorus is not in Group 2 and Period 5<br>B is incorrect as phosphorus is not in Group 3 and Period 5<br>C is incorrect as phosphorus is not in Group 5 and Period 2                                                                            |                                                            | 1             |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
| (iii)              | <b>M1</b> Xe / xenon<br><br><b>M2</b> because it has a full outer shell (of electrons) / 8 electrons in the outer shell                                                                                                                                                                        | <b>M2</b> dep on <b>M1</b><br><br>IGNORE refs to noble gas | 2             |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |
|                    |                                                                                                                                                                                                                                                                                                |                                                            | Total 6       |                 |        |   |    |         |   |   |          |        |    |                                                                     |   |

| Question number | Answer                                                                                                                                                                                                                            | Notes                                                                                                                                                                                                                                                                                      | Marks   |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 2 (a)           |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                            | 2       |
|                 | Physical state at room temperature                                                                                                                                                                                                | Colour                                                                                                                                                                                                                                                                                     |         |
|                 | gas                                                                                                                                                                                                                               | pale green / yellow                                                                                                                                                                                                                                                                        |         |
|                 | gas                                                                                                                                                                                                                               | green                                                                                                                                                                                                                                                                                      |         |
|                 | liquid                                                                                                                                                                                                                            | red-brown                                                                                                                                                                                                                                                                                  |         |
|                 | solid                                                                                                                                                                                                                             | grey                                                                                                                                                                                                                                                                                       |         |
| (b)             | M1 bromine <u>water</u> / bromine <u>solution</u><br><br>M2 turns colourless / decolourised                                                                                                                                       | ALLOW <u>aqueous</u> bromine<br><br>IGNORE any starting colour<br><br>M2 is dep on mention of bromine in M1                                                                                                                                                                                | 2       |
| (c)             | M1 (mixture) turns (from colourless) to brown<br><br>M2 iodine / I <sub>2</sub> is displaced<br><br>OR<br>(chlorine reacts with iodide ions) to produce / form iodine<br><br>M3 (because) chlorine is more reactive (than iodine) | ALLOW red-brown / orange-brown<br><br>REJECT iodide<br><br>IGNORE a displacement reaction occurs<br><br>M2 can be scored by I <sub>2</sub> as a product in a balanced equation or by a word equation<br><br>ALLOW reverse argument<br><br>REJECT iodide, except if already penalised in M2 | 3       |
|                 |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                            | Total 7 |

| Question number | Answer                                                                                                                                                                                                                                                                                        | Notes                                                                                                                                                                                                                                                                                     | Marks   |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 3 (a) (i)       | magnesium                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                           | 1       |
| (ii)            | <b>M1</b> gold<br><b>M2</b> is the least reactive                                                                                                                                                                                                                                             | IGNORE silver<br><b>M2</b> DEP on <b>M1</b><br>ALLOW it is (the most) unreactive                                                                                                                                                                                                          | 2       |
| (b) (i)         | (an alloy is) a <b>mixture</b> of metals<br><b>OR</b><br>(an alloy is) a <b>mixture</b> of a metal and another metal                                                                                                                                                                          | ALLOW (an alloy is) a <b>mixture</b> of a metal and carbon<br>REJECT references to compounds / combining of metals                                                                                                                                                                        | 1       |
| (ii)            | <b>M1</b> the regular arrangement of atoms is distorted / disrupted / disturbed OWTTE<br><b>OR</b><br>carbon atoms are smaller than iron atoms / because iron atoms are larger than carbon atoms<br><b>M2</b> (therefore) it is more difficult for the atoms/layers to slide over one another | ALLOW lattice / layers / rows of atoms are disrupted / distorted / are less regular / are irregular<br>ALLOW carbon and iron atoms are of different sizes<br>ALLOW the atoms are not the same size / the atoms are different sizes<br>IGNORE references to the strength of metallic bonds | 2       |
|                 |                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                           | Total 6 |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                      | Notes                                                                                                 | Marks   |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------|
| 4 (a) (i)       | refinery gases: (fuel for) heating / cooking                                                                                                                                                                                                                                                                                                                                                                                                | ALLOW bottled gas                                                                                     | 2       |
|                 | bitumen: tar / road surfacing / road building / roofing                                                                                                                                                                                                                                                                                                                                                                                     | ALLOW roads                                                                                           |         |
| (ii)            | any one from:<br>refinery gases have the low(est) boiling point<br><b>OR</b><br>refinery gases do not condense in the column                                                                                                                                                                                                                                                                                                                | ALLOW they are the most volatile<br><br>REJECT refs to melting point                                  | 1       |
| (iii)           | it is heated / vaporised                                                                                                                                                                                                                                                                                                                                                                                                                    | IGNORE any temperatures given<br><br>ALLOW boiled                                                     | 1       |
| (b) (i)         | <b>M1</b> temperature 600 – 700°C                                                                                                                                                                                                                                                                                                                                                                                                           | ALLOW any temperature in the range                                                                    | 2       |
|                 | <b>M2</b> catalyst alumina / silica / zeolites / aluminium oxide / silicon dioxide                                                                                                                                                                                                                                                                                                                                                          | IGNORE pressures                                                                                      |         |
| (ii)            | an explanation containing any three of the following points:<br><br><b>M1</b> alkenes / propene / C <sub>3</sub> H <sub>6</sub> can be used to make (addition) polymers / plastics<br><br><b>M2</b> (because) they have double bonds / are unsaturated<br><br><b>M3</b> shorter alkanes / octane / C <sub>8</sub> H <sub>18</sub> are used as fuels / petrol<br><br><b>M4</b> (because) they have lower boiling points / are more flammable | ALLOW used to make poly(propene)<br><br>ALLOW to make alcohols / propanol<br><br>IGNORE used as fuels | 3       |
|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                       | Total 9 |

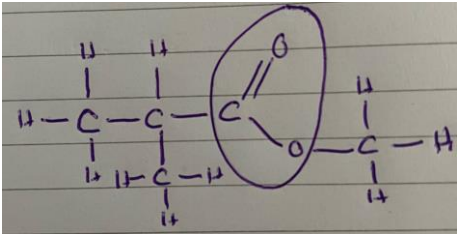
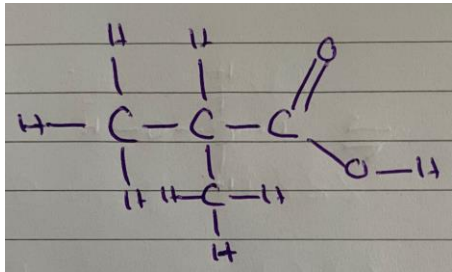
| Question number | Answer                                                                                                                                                                                                                                                                                | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5 (a)           | <p><b>M1</b> mix / react the two solutions (together)</p> <p><b>M2</b> filter (the solid lead bromide)</p> <p><b>M3</b> wash (using deionised water)</p> <p><b>M4</b> method of drying</p>                                                                                            | <p>IGNORE volumes</p> <p>IGNORE heating at this stage</p> <p>REJECT an indication that solids are mixed for <b>M1</b></p> <p>IGNORE any washing before filtering</p> <p>eg leave to dry / dry in an oven / leave in a warm place / dry with filter paper</p> <p>REJECT direct heating of final product for <b>M4</b></p> <p>REJECT if solid is washed again after drying for <b>M4</b></p> <p>Methods of producing a soluble salt eg evaporating after mixing, leaving solutions in an evaporating basin scores <b>M1</b> only</p> | 4     |
| (b)             | <p><b>M1</b> <math>0.150 \times 367</math> OR <math>55.05 \text{ g}</math></p> <p><b>M2</b> <math>(49.6 \div 55.05) \times 100</math></p> <p>OR</p> <p><b>M1</b> <math>(49.6 \div 367)</math> OR <math>0.1351</math></p> <p><b>M2</b> <math>(0.1351 \div 0.150) \times 100</math></p> | <p>ALLOW <math>0.135</math></p> <p>ALLOW a final answer of 90% by either method</p> <p>REJECT<br/> <math>(49.6 \div 0.15) = 330.67</math><br/> <math>(330.67 \div 367) \times 100</math><br/> for both marks</p>                                                                                                                                                                                                                                                                                                                   | 2     |
| (c) (i)         | all 6 points plotted $\pm$ half a square                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1     |
| (ii)            | <u>straight</u> line of best fit ignoring the anomalous result at volume = $20 \text{ cm}^3$                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1     |

|       |                                                                                     |                                                                                                                                                                                                                                                                        |          |
|-------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| (iii) | M1 the conductivity decreases (when the volume of lead(II) nitrate added increases) | IGNORE proportional /inversely proportional<br><br>REJECT directly proportional<br><br>ACCEPT negative correlation between volume of lead(II) nitrate and electrical conductivity<br><br>ALLOW the conductivity increases when the volume of lead(II) nitrate decrease | 2        |
|       | M2 there are fewer ions in the mixture                                              | ALLOW ions are being removed (as lead(II) bromide is formed)                                                                                                                                                                                                           |          |
|       | (iv) the student forgot to stir the mixture                                         | ALLOW the student didn't allow enough time for the reaction to take place before measuring conductivity<br><br>REJECT the student added less / too little lead(II) nitrate solution                                                                                    | 1        |
| (v)   | the conductivity would increase                                                     |                                                                                                                                                                                                                                                                        | 1        |
| (d)   | electrons are lost (from bromide ions)                                              | REJECT bromine / bromine ions lose electrons                                                                                                                                                                                                                           | 1        |
|       |                                                                                     |                                                                                                                                                                                                                                                                        | Total 13 |

| Question number | Answer                                                                                                                                                                                                                                                                                                             | Notes                                                                                                                                                                                                                                                                                                                                                                                                     | Marks |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 6 (a)           | <p><b>M1</b> (electrostatic attraction between) <u>positive</u> ions</p> <p><b>M2</b> (and) <u>delocalised</u> electrons</p>                                                                                                                                                                                       | <p>ACCEPT (electrostatic attraction between positive) nuclei of (metal) atoms</p> <p>REJECT any references to ionic bonding / sharing of electrons / intermolecular forces for both marks</p>                                                                                                                                                                                                             | 2     |
| (b) (i)         | (squeaky) pop with lighted splint/lit with a (Bunsen) flame                                                                                                                                                                                                                                                        | <p>IGNORE just 'burns with a squeaky pop'</p> <p>REJECT use of glowing splint</p>                                                                                                                                                                                                                                                                                                                         | 1     |
| (ii)            | <p>any two from:</p> <p><b>M1</b> lilac / purple flame</p> <p><b>M2</b> potassium melts / turns into a ball</p> <p><b>M3</b> potassium moves on the surface</p> <p><b>M4</b> potassium gets smaller</p>                                                                                                            | <p>ALLOW flame</p> <p>REJECT other colours</p> <p>ALLOW floats</p> <p>ALLOW potassium disappears / dissolves</p> <p>IGNORE fizzing / bubbles etc</p>                                                                                                                                                                                                                                                      | 2     |
| (c)             | <p>an explanation linking the following points:</p> <p><b>M1</b> lithium has fewer shells than potassium</p> <p><b>M2</b> <u>outer</u> shell / <u>outer</u> electron in lithium is more strongly attracted to the nucleus</p> <p><b>M3</b> (so in lithium the outer shell) <u>electron</u> is less easily lost</p> | <p>ALLOW lithium has smaller atoms than potassium</p> <p>ALLOW (outer shell) electron in lithium is closer to the nucleus</p> <p>ALLOW correct electron configurations</p> <p>REJECT 'fewer outer shells'</p> <p>ALLOW <u>outer</u> shell / <u>outer</u> electron in lithium is less shielded (by inner shells)</p> <p>ACCEPT valence electron</p> <p>ALLOW reverse argument throughout for potassium</p> | 3     |

|     |                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| (d) | <p><b>M1</b> (moles of sodium) <math>0.75 \div 23</math> <b>OR</b> 0.0326 moles</p> <p><b>M2</b> (moles of hydrogen) <math>0.0326 \div 2</math></p> <p><b>M3</b> (volume of hydrogen) 391.304 (cm<sup>3</sup>)</p> <p><b>M4</b> 391 (cm<sup>3</sup>)</p> | <p>ALLOW <b>M1</b> <math>\div 2</math></p> <p>ALLOW <b>M2</b> <math>\times 24\,000</math></p> <p>REJECT incorrect rounding / use of 1SF once in <b>M1</b> - <b>M3</b></p> <p>ALLOW <b>M3</b> to 3 significant figures, provided some attempt at calculation</p> <p>391 (cm<sup>3</sup>) scores 4 marks</p> <p>If <b>M1</b> is rounded to 0.033 moles, final answer of 396 (cm<sup>3</sup>) scores 4 marks</p> <p>If <b>M2</b> is absent, final answer of 782 / 783 (cm<sup>3</sup>) scores 3 marks</p> <p>If <math>\times 2</math> instead of <math>\div 2</math> in <b>M2</b> , final answer of 1560 (cm<sup>3</sup>) scores 3 marks</p> | 4        |
| (e) | <p><b>M1</b> (moles of sulfuric acid) <math>(16.3 \times 0.0500) \div 1000</math> <b>OR</b> 0.000815</p> <p><b>M2</b> (moles of sodium hydroxide) = 0.00163</p> <p><b>M3</b> 0.0652 (mol/dm<sup>3</sup>)</p>                                             | <p>ALLOW <math>8.15 \times 10^{-4}</math> (moles)</p> <p>ALLOW <b>M1</b> <math>\times 2</math></p> <p>ALLOW <b>M2</b> <math>\div 0.025</math></p> <p>0.0652 (mol/dm<sup>3</sup>) scores 3 marks</p> <p>ALLOW any SF except 1SF</p> <p>If <b>M2</b> is absent, final answer of 0.0326 (mol/dm<sup>3</sup>) scores 2 marks</p> <p>If <math>\div 2</math> instead of <math>\times 2</math> in <b>M2</b> , final answer of 0.0163 (mol/dm<sup>3</sup>) scores 2 marks</p> <p>REJECT <math>16.3 / 25.0 = 0.652</math> (mol/dm<sup>3</sup>) for all 3 marks</p>                                                                                 | 3        |
|     |                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Total 15 |

| Question number | Answer                                                                                                                                                                                                                                                 | Notes                                                                                                                                                                           | Marks |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 7 (a) (i)       | <p><b>M1</b> the forward and reverse reactions occur at the same <u>rate</u></p> <p><b>M2</b> so the concentrations of reactants and products remain constant</p>                                                                                      | <p>ALLOW so the moles of reactants and products remain constant</p> <p>REJECT so the concentrations of reactants and products are the same</p>                                  | 2     |
| (ii)            | a catalyst increases the rate of (both) the forwards and the reverse reaction <u>equally</u>                                                                                                                                                           | ALLOW has the same effect on the rate of forward and reverse reaction                                                                                                           | 1     |
| (iii)           | <p><b>M1</b> yield increases</p> <p><b>M2</b> the (forward) reaction is exothermic</p>                                                                                                                                                                 | <p>ALLOW the reverse reaction is endothermic</p> <p>IGNORE any references to Le Chatelier's Principle (moves / shifts)</p> <p><b>M2</b> dep on <b>M1</b> correct or missing</p> | 2     |
| (iv)            | <p><b>M1</b> yield increases</p> <p><b>M2</b> there are more moles of (gaseous) reactants than products / there are fewer (gaseous) moles on the right hand side / there are 3 moles (of gas) on the left and 1 mole (of gas) on the right<br/>ORA</p> | <p>IGNORE any references to Le Chatelier's Principle (moves / shifts)</p> <p><b>M2</b> dep on <b>M1</b> correct or missing</p>                                                  | 2     |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                          |                   |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <p>(b) (i)</p> <p>(ii)</p> | <p><b>M1</b> (bonds broken) = 436 + 436 + 1072 <b>OR</b> 1944</p> <p><b>M2</b> (bonds formed) = 414 + 414 + 414 + 358 + 463 <b>OR</b> 2063</p> <p><b>M3</b> 1944 - 2063 (= - 119)</p> <p>an explanation that links together the following two points:</p> <p><b>M1</b> more energy is given out when the bonds are made</p> <p><b>M2</b> than is taken in when the bonds are broken <b>ORA</b></p> <p><b>OR</b></p> <p><b>M1</b> breaking bonds is endothermic / takes in energy <b>AND</b> making bonds is exothermic / releases energy</p> <p><b>M2</b> the energy released is more than the energy taken in</p> | <p>IGNORE refs to numbers of bonds</p> <p><b>DEP on M1</b></p> <p>If state / imply that energy required to make bonds <b>OR</b> If state / imply that energy released when bonds are broken scores 0</p> | <p>3</p> <p>2</p> |
| <p>(c) (i)</p> <p>(ii)</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>REJECT -OH not displayed</p>                                                                                                                                                                          | <p>1</p> <p>1</p> |
|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                          | <p>Total 14</p>   |