



Mark Scheme (Results)

November 2024

Pearson Edexcel International GCSE  
In Chemistry (4CH1) Paper 1C

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## General Marking Guidance

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

| Question number | Answer                                                                                                                                                                                                                                                                            | Notes                                    | Marks |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------|
| 1 (a)           | from liquid to solid freezing<br>from gas to liquid condensing<br>from solid to gas sublimation                                                                                                                                                                                   | ALLOW condensation<br>ALLOW subliming    | 3     |
| (b) (i)         | 6 circles similar size randomly arranged none touching                                                                                                                                                                                                                            | At least one circle in top/bottom of box | 1     |
| (ii)            | A (the atoms move randomly in the gas state)<br>B is not correct since atoms do not move randomly in the solid state<br>C is not correct since atoms are not in a fixed position in the gas state<br>D is not correct since atoms are not in a fixed position in the liquid state |                                          | 1     |
| (c)             | $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$                                                                                                                                                                                                           | ALLOW upper case/lower case              | 1     |
|                 |                                                                                                                                                                                                                                                                                   | Total = 6                                |       |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                | Notes                     | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------|
| 2 (a) (i)       | oxygen                                                                                                                                                                                                                                                                                                                                | ALLOW O <sub>2</sub>      | 1     |
| (ii)            | nitrogen                                                                                                                                                                                                                                                                                                                              | ALLOW N <sub>2</sub>      | 1     |
| (iii)           | chlorine                                                                                                                                                                                                                                                                                                                              | ALLOW Cl <sub>2</sub>     | 1     |
| (b)             | M1 (hydrogen chloride) has (atoms of) two / different elements<br><br>M2 (chemically) bonded/joined / (chemically) combined together                                                                                                                                                                                                  | ALLOW two different atoms | 2     |
| (c)             | D (chlorine has the strongest forces of attraction between its molecules)<br><br>A is not the correct answer because covalent bonds are not broken when chlorine boils<br>B is not the correct answer because covalent bonds do not occur between molecules<br>C is not the correct answer because chlorine does not have ionic bonds |                           | 1     |
|                 |                                                                                                                                                                                                                                                                                                                                       | Total = 6                 |       |

| Question number | Answer                                                                                    | Notes                                                                    | Marks |
|-----------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------|
| 3 (a) (i)       | M1 oxygen                                                                                 | ALLOW air<br>ALLOW O <sub>2</sub>                                        | 2     |
|                 | M2 water                                                                                  | ALLOW moisture<br>ALLOW H <sub>2</sub> O                                 |       |
| (ii)            | (hydrated) iron <u>(III)</u> oxide                                                        | ALLOW ferric oxide<br>ALLOW Fe <sub>2</sub> O <sub>3</sub>               | 1     |
| (b) (i)         | M1 paint acts as a barrier / (protective) layer<br>OWTTE                                  | NOT galvanising<br>NOT coating/covering                                  | 2     |
|                 | M2 which prevents water/oxygen/air getting to the iron/reacting with iron                 |                                                                          |       |
|                 | (ii) galvanising                                                                          | ALLOW sacrificial protection                                             | 1     |
|                 | (iii) M1 zinc is more reactive than iron OR zinc has a greater tendency to lose electrons | ALLOW zinc reacts instead of iron<br>NOT zinc reacts more rapidly/faster | 2     |
|                 | M2 zinc oxidises / forms zinc oxide/ reacts before iron                                   | REJECT references to zinc rusting<br>REJECT zinc reacts with iron        |       |
|                 |                                                                                           | Total = 8                                                                |       |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                            | Notes                                                                                                                          | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------|
| 4 (a)           | <p>M1 draw a line in pencil (just above the bottom of the paper)</p> <p>M2 put a spot of each ink on the line (before contact with solvent)</p> <p>M3 pour some solvent in the beaker</p> <p>M4 place the paper in the beaker so the spots are above the solvent</p> <p>M5 leave until the solvent has risen up the paper (nearly to the top)</p> | <p>ALLOW water for solvent</p> <p>ALLOW water for solvent</p> <p>ALL marks can be scored/supported from a labelled diagram</p> | 5     |
| (b) (i)         | <p>M1 E</p> <p>M2 because it stayed on the start line/did not travel up paper</p>                                                                                                                                                                                                                                                                 | <p>ALLOW didn't move/ Rf value =0</p> <p>M2 dep on M1</p>                                                                      | 2     |
| (ii)            | <p>M1 A and C</p> <p>M2 because they both (have a spot) at the same height OWTTE</p>                                                                                                                                                                                                                                                              | <p>ALLOW travelled same distance/same Rf value</p> <p>M2 dep on M1</p>                                                         | 2     |
| (iii)           | <p>M1 measure the distance from the start line to the spot and the distance from the start line to the solvent front</p> <p>M2 distance moved by the spot <math>\div</math> distance moved by the solvent</p>                                                                                                                                     | <p>M2 subsumes M1</p> <p>Allow 2 marks for a correct calculation method</p>                                                    | 2     |
|                 |                                                                                                                                                                                                                                                                                                                                                   | Total = 11                                                                                                                     |       |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Notes                                                                                                                                                                                                                                                                                                                                                   | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5 (a)           | oxygen relights a glowing splint                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                         | 1     |
| (b)             | M1 a catalyst provides an alternative pathway<br>M2 of lower activation energy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ALLOW alternative route                                                                                                                                                                                                                                                                                                                                 | 2     |
| (c) (i)         | A (conical) flask<br>B (gas) syringe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                         | 2     |
| (ii)            | M1 line from 4 minutes to the curved line<br>M2 38cm <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ALLOW values 37-39cm <sup>3</sup>                                                                                                                                                                                                                                                                                                                       | 2     |
| (iii)           | M1 tangent drawn to the graph at 8 minutes touches curve once only<br>M2 measurements made from <br>M3 use measurements to calculate rate (y <sub>2</sub> -y <sub>1</sub> /x <sub>2</sub> -x <sub>1</sub> )(1sf or more)<br>M4 cm <sup>3</sup> /minute<br><br>If <b>NO</b> tangent drawn or drawn incorrectly(M1 not awarded)<br>then M3 awarded for 58-60/8 or 480 calculated correctly OR numbers from a  calculated correctly<br><br>AND M4 for cm <sup>3</sup> /minutes | ALLOW ecf for tangent drawn at other than 8 minutes<br><br>ALLOW cm <sup>3</sup> /min<br>ALLOW cm <sup>3</sup> min <sup>-1</sup><br>ALLOW cm <sup>3</sup> /s<br>ALLOW cm <sup>3</sup> s <sup>-1</sup><br><br>ALLOW cm <sup>3</sup> /min<br>ALLOW cm <sup>3</sup> min <sup>-1</sup><br>ALLOW cm <sup>3</sup> /s<br>ALLOW cm <sup>3</sup> s <sup>-1</sup> | 4     |
|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Total = 11                                                                                                                                                                                                                                                                                                                                              |       |

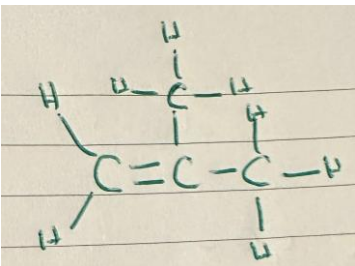
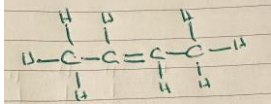


| Question number | Answer                                                                                                                                       | Notes                                                                                                                                                        | Marks |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 6 (a) (i)       | AlCl <sub>3</sub><br>ZnSO <sub>4</sub><br>(NH <sub>4</sub> ) <sub>3</sub> N                                                                  | ALLOW formula in reverse<br>NOT molecular formula<br>Penalise symbol letters/size of subscripts once only                                                    | 3     |
| (ii)            | aluminium sulfate                                                                                                                            | ALLOW aluminium sulphate                                                                                                                                     | 1     |
| (b)             | M1 magnesium loses electrons<br>M2 chlorine gains electrons<br><br>M3 magnesium loses two electrons and two chlorines each gain one electron | ALLOW magnesium gives/transfers electrons to chlorine for M1,M2<br>NOT chloride gains electrons<br><br>M3 assumes M1,M2<br><br>ALLOW correct ionic equations | 3     |
| (c) (i)         | M1 two electrons between each nitrogen and hydrogen atom<br>M2 two non-bonding electrons                                                     | M2 dep on M1                                                                                                                                                 | 2     |
| (ii)            | M1 (electrostatic) forces of attraction between shared pair(s) of electrons<br>M2 and the nuclei                                             | REJECT nucleus (must be plural)<br>REJECT intermolecular forces for both marks                                                                               | 2     |
|                 |                                                                                                                                              | Total = 11                                                                                                                                                   |       |

| Question number | Answer                                                                                                                                 | Notes                                                                                                                                                          | Marks |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 7 (a) (i)       | any <b>one</b> from:<br><br>M1 to condense the water vapour<br><br>M2 to ensure all the water collects in the tube (as a liquid)       | ALLOW condense steam/condense gas<br>NOT cools water<br><br>NOT stops water evaporating                                                                        | 1     |
| (ii)            | When the mass doesn't change / is constant/stops increasing                                                                            | Accept: the last two results are the same<br>Accept: balance reading stays the same                                                                            | 1     |
| (b)             | M1 add anhydrous/white copper(II) sulfate/sulphate<br><br><br><br>M2 which turns (from white to) blue                                  | ALLOW anhydrous/white copper sulfate/sulphate<br><br>ALLOW add anhydrous/blue cobalt chloride<br><br>ALLOW which turns (from blue to) pink<br><br>M2 dep on M1 | 2     |
| (c)             | M1 (mass of water) = 6.3g<br><br>M2 (moles of $\text{MgSO}_4$ ) = 0.05<br><br>M3 (moles of $\text{H}_2\text{O}$ ) 0.35<br><br>M4 $x=7$ | Ecf for incorrect mass of water<br><br>M1 can be awarded from moles of $\text{H}_2\text{O}$ in M3<br><br>Answer of 7 on its own scores 4 marks                 | 4     |
|                 |                                                                                                                                        | Total = 8                                                                                                                                                      |       |

| Question number | Answer                                                                                                                                                                                                  | Notes                                                                                                                                                                                                                                          | Marks      |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 8 (a)           | carbon dioxide/a gas escapes/is lost/released (through the cotton wool)                                                                                                                                 | NOT carbon dioxide/gas is given off/produced<br>NOT wrong named gas                                                                                                                                                                            | 1          |
| (b)             | M1 the concentration (of hydrochloric acid) is highest<br><br>M2 so there are more collisions per unit time                                                                                             | ALLOW there is a greater surface area of marble chips<br>ALLOW greater amount of hydrochloric acid/reactants<br>ALLOW more particles<br><br>ALLOW more frequent collisions<br><br>REJECT references to greater (kinetic) energy for both marks | 2          |
| (c)             | the hydrochloric acid has been used up OWTTE                                                                                                                                                            | NOT acid is saturated<br><br>IGNORE acid is a limiting factor                                                                                                                                                                                  | 1          |
| (d) (i)         | any two from:<br><br>(same) mass of marble chips<br><br>(same) surface area of marble chips<br><br>(same) concentration of hydrochloric acid<br><br>(same) volume of hydrochloric acid                  | ALLOW (same) amount of marble chips<br><br>ALLOW (same) size marble chips<br><br>NOT same amount of acid                                                                                                                                       | 2<br><br>3 |
| (ii)            | M1 rate of reaction increases<br><br>M2 particles have more energy OR more particles have energy greater than (or equal to) the activation energy<br><br>M3 so more successful collisions per unit time | ALLOW particles move faster<br><br>ALLOW more frequent successful collisions                                                                                                                                                                   |            |
|                 |                                                                                                                                                                                                         | Total = 9                                                                                                                                                                                                                                      |            |

| Question number | Answer                                                                                               | Notes                                                                                                                     | Marks |
|-----------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|
| 9 (a)           | aluminium is a better conductor (of heat) than glass (comparison needed)                             | REJECT insulation references                                                                                              | 1     |
| (b) (i)         | carbon / soot/ C                                                                                     |                                                                                                                           | 1     |
| (ii)            | incomplete combustion occurs OR the supply of oxygen/air is limited                                  |                                                                                                                           | 1     |
| (c) (i)         | M1 $100 \times 4.2 \times 50$<br>M2 21000(J)                                                         | ALLOW ecf for M2 if answer close to 20000J                                                                                | 2     |
| (ii)            | M1 21 kJ<br>M2 $1.84 \div 46$ OR 0.04 moles<br>M3 $21 \div 0.04$ OR 525 (kJ/mol)<br>M4 -525 (kJ/mol) | ALLOW 20kJ<br><br>ALLOW $21 \div M2$<br>ALLOW 500 (kJ/mol) if 20kJ used<br><br>M4 is for the - sign.<br>ALLOW ecf from M3 | 4     |
| (d) (i)         | 5O <sub>2</sub>                                                                                      | ALLOW multiples if the rest of the balancing numbers have been multiplied                                                 | 1     |
| (ii)            | M1 (M <sub>r</sub> of butanol) 74<br>M2 (moles of butanol) $3.7 \div 74$ OR 0.05<br>M3 0.45 moles    | ALLOW $3.7 \div M1$ if attempted M <sub>r</sub> shown<br><br>ALLOW M2 $\times 9$<br><br>Answer of 0.45 scores 3           | 3     |
|                 |                                                                                                      | Total = 13                                                                                                                |       |

| Question number | Answer                                                                                                                                                                                                                  | Notes                                                                                                               | Marks |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------|
| 10 (a) (i)      | any <b>one</b> from:<br><br>M1 ethane is saturated<br><br>M2 ethane has no double bonds<br><br>M3 ethane has single bonds only                                                                                          |                                                                                                                     | 1     |
| (ii)            | M1 <b>products</b> $\text{C}_2\text{H}_5\text{Br}$ and $\text{HBr}$<br><br>M2 <b>condition</b> ultra violet radiation / ultra violet light/UV                                                                           | In either order<br>ALLOW balanced equations with a polysubstituted halogenoalkane                                   | 2     |
| (iii)           | orange/yellow/brown to colourless/decolourises                                                                                                                                                                          | NOT red/red-brown                                                                                                   | 1     |
| (b) (i)         | any <b>two</b> from:<br><br>M1 same functional group<br><br>M2 the same/similar chemical properties OR undergo same/similar chemical reactions<br><br>M3 trend in physical properties<br><br>M4 differ by $\text{CH}_2$ | NOT similar reactivity<br><br>ALLOW a named physical property e.g. boiling point<br>NOT similar physical properties | 2     |
| (ii)            | M1 same molecular formula<br><br>M2 different displayed/structural formulae                                                                                                                                             | NOT same empirical/general formula<br><br>ALLOW different structures/arrangements                                   | 2     |
| (iii)           |                                                                                                                                      | ALLOW E/trans isomer<br>       | 1     |
|                 |                                                                                                                                                                                                                         |                                                                                                                     |       |

|     |                                                                                                                                                                                                      |                                                                                                                    |   |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---|
| (c) | M1 chain length longer in poly(ethene)<br><br>M2 polymer contains only single (covalent) bonds /no double bond<br><br><br><br><br><br><br><br><br><br>M3 ethene is a gas and poly(ethene) is a solid | ALLOW monomer contains double C=C bonds<br>ALLOW reactant/ethene unsaturated<br>ALLOW product/polyethene saturated | 3 |
|     |                                                                                                                                                                                                      | Total = 12                                                                                                         |   |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                     | Notes                                                                                                                                                                                                                      | Marks |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11 (a) (i)      | $2\text{PbS} + 3\text{O}_2 \rightarrow 2\text{PbO} + 2\text{SO}_2$<br>M1 formulae of $\text{O}_2$ and $\text{SO}_2$<br>M2 rest of equation correctly balanced                                                                                                                                                                                                                              | M2 dep on M1<br>ALLOW multiples/fractions                                                                                                                                                                                  | 2     |
| (ii)            | (sulfur dioxide causes) acid rain / breathing problems                                                                                                                                                                                                                                                                                                                                     | ALLOW named breathing problems such as asthma<br>ALLOW other effects of acid rain such as killing fish, damage to stonework, killing plants                                                                                | 1     |
| (iii)           | M1 (moles lead(II) oxide) = $892\,000\,000 \div 223$ OR $4\,000\,000$ moles<br>M2 (moles of carbon dioxide) = $2\,000\,000$<br>M3 (mass of carbon dioxide) = 88 (tonnes)                                                                                                                                                                                                                   | ALLOW calculations done in megamoles throughout<br>ALLOW $\text{M1} \div 2$<br>88 (tonnes) scores 3 marks                                                                                                                  | 3     |
| (iv)            | any 5 from:<br>lead(II) sulfide<br>M1 giant ionic structure/lattice<br>M2 strong (ionic) bonds OR strong electrostatic forces (between oppositely charged) ions<br>M3 which take a lot of energy to break / overcome sulfur dioxide<br>M4 simple molecular/covalent structure<br>M5 weak intermolecular forces OR weak forces between molecules<br>M6 which take little energy to overcome | REJECT molecules/covalent bonds/ intermolecular forces for all three marks<br>M3 dep on M2<br>REJECT ions/ionic bonds for all 3 marks<br>ALLOW molecules NOT particles/atoms<br>NOT weak IMF between atoms<br>M6 dep on M5 | 5     |
| (b)             | M1 $90.7 \div 207$ and $9.30 \div 16$<br>M2 0.438 (moles of lead) and 0.581 (moles of                                                                                                                                                                                                                                                                                                      | NOT atomic numbers<br>ALLOW $9.30 \div 32$ for ecf                                                                                                                                                                         | 4     |

|  |                                                                                                         |                                                                                                  |  |
|--|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--|
|  | oxygen)<br><br>M3 ratio of moles = 1:1.33<br><br>M4 empirical formula is Pb <sub>3</sub> O <sub>4</sub> | Answer must be 2sf or more<br><br>ALLOW 1.3<br><br>ALLOW ecf from ratio shown to produce formula |  |
|  |                                                                                                         | Total = 15                                                                                       |  |



