# Mark Scheme (Results)

# Summer 2023

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

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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) | (i) | six particles should be arranged randomly | max of two particles should touch<br><br>ALLOW between 5 and 10 particles | 1 |
| | | (ii) | particles are (much) closer together | ALLOW the density is (much) greater / less space between particles / packed more tightly | 1 |
| | | (iii) | Any one from:<br><br>high pressure<br><br>risk of explosion<br><br>oxidising agent<br><br>risk in contact with combustible materials | <br><br><br><br><br><br><br><br>ALLOW risk of fire<br><br>IGNORE flammable | 1 |
| | (b) | (i) | blue flame | ALLOW choking /pungent gas produced / sulfur darkens | 1 |
| | | (ii) | M1 (final colour) red/orange/yellow<br><br>M2 an acidic solution/an acid/sulfurous acid is formed | IGNORE any original colour<br><br>ALLOW sulfuric acid<br><br>ALLOW sulfur dioxide is acidic<br><br>ACCEPT the solution formed contains hydrogen ions | 2 |
| | | | | Total for question = 6 | |

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 2 | (a) | | crystallisation | | 3 |
| | | | simple distillation | REJECT distillation | |
| | | | filtration | | |
| | (b) | | (the box contains) (2) different substances /elements | IGNORE type of particle REJECT compounds | 1 |
| | (c) | | Any two from: M1 D contains 3 food dyes M2 food colouring D contains A and C M3 food colouring D does not contain B / food colouring D contains another dye (which is not A. B or C) | | 2 |
| | (d) | (i) | 4 | | 1 |
| | | (ii) | 11 | | 1 |
| | | | | Total for question = 8 | |

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 3 | (a) | (i) | A (electron)<br><br>B is not the correct answer because neutrons exist in the nucleus.<br>C is not the correct answer because particle W is not a nucleus.<br>D is not the correct answer because protons exist in the nucleus. | | 1 |
| | | (ii) | C (25)<br><br>A is not the correct answer as the proton number is 12<br>B is not the correct answer as the number of neutrons is 13<br>D is not the correct answer as the number of protons, neutrons and electrons is not 49 | | 1 |
| | | (iii) | (atoms have the) same number of protons and electrons | | 1 |
| | | (iv) | B (2+)<br><br>A is not the correct answer as this atom will not form an ion with a + charge.<br>C is not the correct answer as this atom will not form an ion with a - charge.<br>D is not the correct answer as this atom will not form an ion with a 2- charge. | | 1 |
| | (b) | (i) | (both isotopes have) the same number of electrons / the same electron configuration | IGNORE same number of protons / same number of electrons in the outer shell | 1 |
| | | (ii) | <br><br>M1 $(7.60 \times 6) + (92.4 \times 7)$<br><br><br>M2 $692.4 \div 100$ OR $6.924$<br><br>M3 $6.92$ | Answer of 6.92 scores 3<br><br>ACCEPT $(6 \times 0.076) + (7 \times 0.924)$<br><br><br>ALLOW ecf if use of 6 and 7 in calculation | 3 |
| | | | | Total for question = 8 | |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 4 (a) | <table><tr><td>Information</td><td>Gas</td></tr><tr><td>the most abundant gas in air</td><td>nitrogen</td></tr><tr><td>a toxic gas that is a product of incomplete combustion of hydrocarbons</td><td>carbon monoxide</td></tr><tr><td>an unreactive gas that exists as atoms</td><td>helium</td></tr><tr><td>a gas produced by the fractional distillation of crude oil</td><td>methane</td></tr></table> | | 4 |
| (b) (i) | copper(II) oxide / CuO / copper oxide forms | REJECT copper(I) oxide | 1 |
| (ii) | the volume of a gas changes with temperature / gas expands when hot / heated / gas shrinks when cools OWTTE | | 1 |
| (iii) | M1 138 - 108 OR 30 (cm$^3$)<br><br>M2 ((30÷138) × 100 =) 21.7 | ALLOW minimum 2 significant figures<br><br>21.7 / 21.74 / 22 scores 2<br><br>78.3 / 78.26 / 78 scores 1 | 2 |
| | | Total for question = 8 | |

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 5 | (a) | (i) | M1 water<br><br>M2 oxygen | ALLOW moisture / $H_2O$<br><br>ALLOW air / $O_2$<br><br>answers can be in either order | 2 |
| | | (ii) | oxidation | ALLOW oxidisation / oxidising / redox | 1 |
| | (b) | (i) | M1 paint acts as a barrier / layer<br><br>M2 which prevents air / oxygen / water getting to / reacting with the iron | | 2 |
| | | (ii) | galvanising | ALLOW galvanisation<br><br>IGNORE sacrificial protection | 1 |
| | | (iii) | M1 zinc is more reactive than iron<br><br>M2 (therefore) is oxidised / reacts with oxygen / loses electrons more readily / in preference to /instead of iron | ALLOW corrodes instead of iron<br><br>REJECT zinc rusts | 2 |
| | (c) | (i) | M1 aluminium is more reactive than iron / ORA<br><br>M2 because aluminium displaces iron (from iron(III) oxide) | | 2 |
| | | (ii) | M1 iron(III) oxide (is the oxidising agent)<br><br>M2 iron(III) oxide donates oxygen to aluminium | ALLOW iron oxide / iron ions / $Fe^{3+}$ ions throughout<br><br>ALLOW (iron(III) oxide / iron ions / $Fe^{3+}$ ions) takes electrons from aluminium<br><br>ALLOW (iron(III) oxide / iron ions / $Fe^{3+}$ ions) causes aluminium to be oxidised | 2 |
| | | | | Total for question = 12 | |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 6 (a) | the gas also contains air (displaced from the conical flask) | | 1 |
| (b) | M1 a catalyst provides an alternative (reaction) pathway / route<br><br>M2 of lower activation energy | | 2 |
| (c) | M1 add hydrogen peroxide solution (to the conical flask) and add one of the catalysts<br><br>M2 record the time taken to collect a fixed volume of gas OR record the volume of gas collected in a fixed time<br><br>AND any 2 from<br><br>M3 repeat with the same volume / same concentration of hydrogen peroxide solution<br><br>M4 (repeat at) same temperature<br><br>M5 use same mass / same surface area of each catalyst<br><br>AND<br><br>M6 the most effective catalyst produces the greatest volume of gas per unit time OR takes the least time to produce a fixed volume of oxygen | ALLOW record the time when no more gas produced<br><br>ALLOW same amount<br><br>ALLOW same amount<br><br>ALLOW the least time taken to complete the reaction is the most effective catalyst | 5 |
| (d) | M1 steeper curve starting at the origin<br><br>M2 same volume of oxygen produced | | 2 |
| | | Total for question = 10 | |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 7 (a) | M1 limewater turns cloudy /milky<br><br>AND any one from:<br><br>M2 because carbon dioxide / $CO_2$ is / produced /one of the products<br><br>M3 which reacts with limewater forming calcium carbonate | ALLOW chalky / white precipitate<br><br><br><br>ALLOW carbon dioxide / $CO_2$ is present<br><br>ALLOW forming an insoluble product | 2 |
| (b) (i) | M1 amount of water = 2.16÷18 OR 0.12 mol<br><br>M2 number of hydrogen atoms (0.12÷0.01)×2 OR 24<br><br>M3 formula of alkene = $C_{12}H_{24}$ | <br><br>ALLOW $12H_2O$<br><br><br><br>Correct answer of $C_{12}H_{24}$ scores 3<br><br>$C_6H_{12}$ scores 2 | 3 |
| (ii) | some steam / water vapour is lost (to the atmosphere) | ALLOW some steam /water vapour does not condense<br><br>IGNORE references to incomplete combustion | 1 |
| (iii) | M1 heat (the water) / measure the boiling point<br><br><br><br>M2 (if it) boils at 100 ºC (it is pure water) / boiling point is 100 °C | ALLOW find the freezing point /melting point<br><br>REJECT evaporate<br><br>ALLOW freezes/ melts at 0ºC | 2 |
| (c) | M1 (moles of heptane) = 30 ÷ 100 OR 0.3(0)<br><br>M2 (moles of oxygen) = 0.3(0) × 11 OR 3.3<br><br>M3 (mass of oxygen) = (3.3 × 32) = 106 (g)<br><br><br>OR<br><br>M1 11 x 32 OR 352 (g) of oxygen<br><br>M2 so mass of oxygen = 352 x 30 ÷ 100<br><br>M3 106 (g) | Answer of 106 g OR 105.6 g scores 3<br><br>ALLOW M1 × 11<br><br>ALLOW ecf from M2<br><br>ALLOW 2 or more significant figures for M3<br><br><br><br><br>Answer of 9.6 (g) scores 2 | 3 |
| | | | Total for question = 11 |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 8 (a) | M1 graphite has delocalised electrons<br><br>M2 that are able to flow throughout the structure | IGNORE sea of electrons /free electrons<br><br>ACCEPT are able to move / are mobile<br><br>IGNORE references to carrying charge/ current<br><br>M2 dep on mention of electrons<br><br>Any mention of ions in graphite scores 0 out of 2 | 2 |
| (b) | M1 (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons<br><br><br><br>M2 (graphite is soft because) the layers can slide over one another | ALLOW 3D/ rigid/ tetrahedral structure<br><br>REJECT mention of intermolecular forces in diamond<br><br>IGNORE mention of intermolecular forces between layers in graphite | 2 |
| (c) | Any one from:<br><br>(the $C_{60}$ molecule/it) will not react with the blood/medicine<br><br>(the $C_{60}$ molecule/it) is non-toxic<br><br>the medicine can fit inside (the $C_{60}$ molecule) | ALLOW any acceptable answer<br><br>ALLOW it is inert /unreactive | 1 |
| | | Total for question = 5 | |

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 9 | (a) | (i) | M1 $Ca^{2+}$ <br><br> M2 $NO_3^-$ | Max 1 for use of incorrect subscripts, case | 2 |
| | | (ii) | M1 (calcium nitrate) has a giant ionic structure /lattice | | 4 |
| | | | M2 strong electrostatic forces / attraction | ALLOW strong ionic bonds | |
| | | | M3 between oppositely charged ions /negative and positive ions / anions and cations | No M2 or M3 if reference to sharing of electrons or intermolecular forces | |
| | | | M4 which take a lot of energy to overcome (the forces) / break the bonds | IGNORE more energy /heat | |
| | | (iii) | $2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$ | ALLOW fractions and multiples | 1 |
| | (b) | | Any 2 from M1, M2 and M3 <br><br> flame test <br><br> M1 do a flame test | <br><br><br><br> ALLOW description of flame test | 6 |
| | | | M2 sodium chloride and sodium sulfate give a yellow flame | ALLOW sodium (ions) | |
| | | | M3 calcium chloride and calcium bromide give an orange-red flame <br><br> Any 4 from M4 to M8 <br><br> halide ion test | ALLOW orange/brick-red <br><br> ALLOW calcium (ions) <br><br><br><br> REJECT any extra incorrect reagent for M4 | |
| | | | M4 add acidified silver nitrate / add nitric acid and silver nitrate | REJECT hydrochloric or sulfuric acid for M4 | |
| | | | M5 calcium bromide / bromide ions gives a cream precipitate | | |
| | | | M6 calcium chloride / sodium chloride /chloride ions give a white precipitate <br><br> sulfate ion test | M5 and M6 dep on silver nitrate in M4 <br><br> REJECT any extra incorrect reagent for M7 | |
| | | | M7 add acidified barium chloride / barium nitrate | ALLOW any named acid except sulfuric acid | |
| | | | M8 sodium sulfate / sulfate ions gives a white precipitate | M8 dep on barium chloride / barium nitrate in M7 | |
| | | | | Total for question = 13 | |

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 10 | (a) | (i) | M1 four electrons between carbon 2 and carbon 3 and two electrons between carbon 1 and carbon 2<br><br>M2 two electrons between each carbon and hydrogen<br><br> | ACCEPT any combination of dots and crosses<br><br>Max 1 if any extra non-bonding electrons added | 2 |
| | | (ii) | M1 shared pair(s) of electrons<br><br>M2 attracted to (two) nuclei<br><br>OR<br><br>M1 (two) nuclei<br><br>M2 attracted to shared pair(s) of electrons | REJECT nucleus. Must be plural for M2<br><br>REJECT nucleus. Must be plural for M1 | 2 |
| | (b) | | Any two from:<br><br>M1 cracking<br><br><br>M2 heat to / at a temperature of 600-700°C<br><br>M3 with a catalyst of silica/alumina | ALLOW a correct cracking equation including propene<br><br><br>ALLOW aluminosilicates / aluminium oxide / silicon oxide/$Al_2O_3$/$SiO_2$ /zeolites | 2 |
| | (c) | (i) | M1<br>    H  H<br>    &#124;   &#124;<br> &ndash; C &ndash; C &ndash;<br>    &#124;   &#124;<br>    H   $CH_3$<br><br><br>M2 extension bonds, brackets and n to the right | ALLOW correct repeat unit with or without extension bonds<br><br><br><br>M2 dep on M1 | 2 |
| | | (ii) | M1 (poly(propene)) remains for a long time (in landfill)<br><br>M2 because it is inert/unreactive/non-biodegradable | ALLOW takes up a lot of space<br><br>ALLOW does not decompose | 2 |

| (d) | (i) | M1 $\frac{60}{12}$  $\frac{13.3}{1}$  $\frac{26.7}{16}$ <br><br> M2 $\frac{5}{1.67}$  $\frac{13.3}{1.67}$  $\frac{1.67}{1.67}$ <br><br> OR 3:8:1 <br><br> M3 (36 + 8 + 16 = 60 / 60 ÷ 60 = 1 so molecular formula is) $C_3H_8O$ | $C_3H_8O$ scores 3 <br><br><br><br> atoms can be in any order <br><br> no marks for upside down calculation or use of atomic numbers <br><br> ACCEPT alternative methods | 3 |
| | (ii) | M1 intermolecular forces in compound X are stronger <br><br> AND any one from <br><br> M2 so require more energy to overcome <br><br> M3 because the $M_r$ / the surface area of the molecule is higher <br><br> M4 because the molecule has more electrons | M2, M3, and M4 dep on M1 | 2 |
| | | | Total for question = 15 | |

| Question number | | | Answer | Notes | Marks |
|---|---|---|---|---|---|
| 11 | (a) | (i) | all 9 points plotted ± half a square | | 1 |
| | | (ii) | circle around point at 3 g | ALLOW 18 or 3 circled in the table | 1 |
| | | (iii) | points joined by curved line of best fit | | 1 |
| | (b) | (i) | M1 polystyrene / it is a good insulator | ALLOW poor conductor (of heat) | 2 |
| | | | M2 polystyrene / it reduces heat (energy) / thermal energy gain / transfer from surroundings OWTTE | ALLOW polystyrene /it does not absorb heat /stops heat entering (the cup) <br><br> REJECT heat loss (to surroundings) | |
| | | (ii) | the student forgot to stir the mixture | ALLOW took the temperature reading too soon <br><br> REJECT the student added too little or forgot to add the solid | 1 |
| | | (iii) | (the last three) results / temperatures are the same | | 1 |
| | | (iv) | because the temperature decreases | ALLOW because heat / thermal energy is taken in | 1 |
| | (c) | | **M1 (ΔT =)** 20.8 – 15.3 OR 5.5 (°C) <br><br> M2 ($Q$ = 100 x 4.2 x 5.5 =) 2 310 (J) | Answer of 2310 scores 2 <br><br> ALLOW ecf if incorrect temperature change <br><br> IGNORE any sign given | 2 |
| | (d) | | M1 moles of $NaHCO_3$ = 7.0 ÷ 84 OR 0.0833 <br><br> M2 3 200 ÷ 0.0833 OR 38 400 (J) <br><br> M3 38 400 ÷ 1000 OR 38.4 (kJ/mol) <br><br> M4 +38.4 (kJ/mol) <br><br> OR <br><br> M1 moles of $NaHCO_3$ = 7.0 ÷ 84 OR 0.0833 <br><br> M2 3 200 ÷ 1 000 OR 3.20 (kJ) <br><br> M3 3.20 ÷ 0.0833 OR 38.4 (kJ/mol) <br><br> M4 +38.4 (kJ/mol) | | 4 |

|  |  | Answer of +38.4 scores 4 |  |
|  |  | Answer of 38.4 scores 3 |  |
|  |  | Use of 0.08 moles gives +40 which scores 4 |  |
|  |  | Use of 0.083 moles gives +38.6 which scores 4 |  |
|  |  | ALLOW any number of sig figs |  |
|  |  | Total for question = 14 |  |