



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  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:  high pressure  risk of explosion  oxidising agent  risk in contact with combustible materials	      ALLOW risk of fire  IGNORE flammable	1
(b) (i)	blue flame	ALLOW choking /pungent gas produced / sulfur darkens	1
(ii)	M1 (final colour) red/orange/yellow  M2 an acidic solution/an acid/sulfurous acid is formed	IGNORE any original colour  ALLOW sulfuric acid  ALLOW sulfur dioxide is acidic  ACCEPT the solution formed contains hydrogen ions	2
Total for question = 6			

Question number	Answer	Notes	Marks
2 (a)	crystallisation simple distillation filtration	REJECT distillation	3
(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)  B is not the correct answer because neutrons exist in the nucleus. C is not the correct answer because particle W is not a nucleus. D is not the correct answer because protons exist in the nucleus.		1
	(ii) C (25)  A is not the correct answer as the proton number is 12 B is not the correct answer as the number of neutrons is 13 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+)  A is not the correct answer as this atom will not form an ion with a + charge. C is not the correct answer as this atom will not form an ion with a - charge. 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)  M1 $(7.60 \times 6) + (92.4 \times 7)$  M2 $692.4 \div 100$ OR 6.924  M3 6.92	Answer of 6.92 scores 3  ACCEPT $(6 \times 0.076) + (7 \times 0.924)$  ALLOW ecf if use of 6 and 7 in calculation	3
Total for question = 8			

Question number	Answer	Notes	Marks										
4 (a)	<table border="1"> <thead> <tr> <th>Information</th> <th>Gas</th> </tr> </thead> <tbody> <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> </tbody> </table>	Information	Gas	the most abundant gas in air	nitrogen	a toxic gas that is a product of incomplete combustion of hydrocarbons	carbon monoxide	an unreactive gas that exists as atoms	helium	a gas produced by the fractional distillation of crude oil	methane		4
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(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 <sup>3</sup> ) M2 ((30÷138) × 100 =) 21.7	ALLOW minimum 2 significant figures 21.7 / 21.74 / 22 scores 2 78.3 / 78.26 / 78 scores 1	2										
Total for question = 8													

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

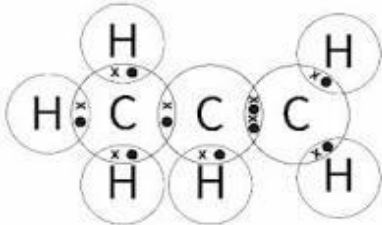


Question number	Answer	Notes	Marks
6 (a)	the gas also contains air (displaced from the conical flask)		1
(b)	M1 a catalyst provides an alternative (reaction) pathway / route  M2 of lower activation energy		2
(c)	M1 add hydrogen peroxide solution (to the conical flask) and add one of the catalysts  M2 record the time taken to collect a fixed volume of gas OR record the volume of gas collected in a fixed time  AND any 2 from  M3 repeat with the same volume / same concentration of hydrogen peroxide solution  M4 (repeat at) same temperature  M5 use same mass / same surface area of each catalyst  AND  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  ALLOW same amount  ALLOW same amount  ALLOW the least time taken to complete the reaction is the most effective catalyst	5
(d)	M1 steeper curve starting at the origin  M2 same volume of oxygen produced		2
Total for question = 10			

Question number	Answer	Notes	Marks
7 (a)	M1 limewater turns cloudy /milky AND any one from: M2 because carbon dioxide / CO <sub>2</sub> is / produced /one of the products M3 which reacts with limewater forming calcium carbonate	ALLOW chalky / white precipitate  ALLOW carbon dioxide / CO <sub>2</sub> is present  ALLOW forming an insoluble product	2
(b) (i)	M1 amount of water = $2.16 \div 18$ OR 0.12 mol M2 number of hydrogen atoms $(0.12 \div 0.01) \times 2$ OR 24 M3 formula of alkene = C <sub>12</sub> H <sub>24</sub>	ALLOW 12H <sub>2</sub> O  Correct answer of C <sub>12</sub> H <sub>24</sub> scores 3 C <sub>6</sub> H <sub>12</sub> scores 2	3
(ii)	some steam / water vapour is lost (to the atmosphere)	ALLOW some steam /water vapour does not condense  IGNORE references to incomplete combustion	1
(iii)	M1 heat (the water) / measure the boiling point  M2 (if it) boils at 100 °C (it is pure water) / boiling point is 100 °C	ALLOW find the freezing point /melting point  REJECT evaporate  ALLOW freezes/ melts at 0°C	2
(c)	M1 (moles of heptane) = $30 \div 100$ OR 0.3(0) M2 (moles of oxygen) = $0.3(0) \times 11$ OR 3.3 M3 (mass of oxygen) = $(3.3 \times 32) = 106$ (g)  OR M1 $11 \times 32$ OR 352 (g) of oxygen M2 so mass of oxygen = $352 \times 30 \div 100$ M3 106 (g)	Answer of 106 g OR 105.6 g scores 3  ALLOW M1 $\times 11$  ALLOW ecf from M2  ALLOW 2 or more significant figures for M3  Answer of 9.6 (g) scores 2	3
Total for question = 11			

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

Question number	Answer	Notes	Marks
9 (a) (i)	M1 $\text{Ca}^{2+}$ M2 $\text{NO}_3^-$	Max 1 for use of incorrect subscripts, case	2
(ii)	M1 (calcium nitrate) has a giant ionic structure /lattice M2 strong electrostatic forces / attraction M3 between oppositely charged ions /negative and positive ions / anions and cations M4 which take a lot of energy to overcome (the forces) / break the bonds	ALLOW strong ionic bonds No M2 or M3 if reference to sharing of electrons or intermolecular forces IGNORE more energy /heat	4
(iii)	$2\text{Ca}(\text{NO}_3)_2 \rightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$	ALLOW fractions and multiples	1
(b)	Any 2 from M1, M2 and M3 <b>flame test</b> M1 do a flame test M2 sodium chloride and sodium sulfate give a yellow flame M3 calcium chloride and calcium bromide give an orange-red flame Any 4 from M4 to M8 <b>halide ion test</b> M4 add acidified silver nitrate / add nitric acid and silver nitrate M5 calcium bromide / bromide ions gives a cream precipitate M6 calcium chloride / sodium chloride /chloride ions give a white precipitate <b>sulfate ion test</b> M7 add acidified barium chloride / barium nitrate M8 sodium sulfate / sulfate ions gives a white precipitate	ALLOW description of flame test ALLOW sodium (ions) ALLOW orange/brick-red ALLOW calcium (ions) REJECT any extra incorrect reagent for M4 REJECT hydrochloric or sulfuric acid for M4 M5 and M6 dep on silver nitrate in M4 REJECT any extra incorrect reagent for M7 ALLOW any named acid except sulfuric acid M8 dep on barium chloride / barium nitrate in M7	6
Total for question = 13			

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

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

Question number	Answer	Notes	Marks
11 (a) (i)	all 9 points plotted $\pm$ 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  M2 polystyrene / it reduces heat (energy) / thermal energy gain / transfer from surroundings OWTTE	ALLOW poor conductor (of heat)  ALLOW polystyrene / it does not absorb heat / stops heat entering (the cup)  REJECT heat loss (to surroundings)	2
(ii)	the student forgot to stir the mixture	ALLOW took the temperature reading too soon  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 ( $\Delta T =$ ) 20.8 – 15.3 OR 5.5 ( $^{\circ}\text{C}$ )  M2 ( $Q = 100 \times 4.2 \times 5.5 =$ ) 2 310 (J)	Answer of 2310 scores 2  ALLOW ecf if incorrect temperature change  IGNORE any sign given	2
(d)	M1 moles of $\text{NaHCO}_3 = 7.0 \div 84$ OR 0.0833  M2 $3\,200 \div 0.0833$ OR 38 400 (J)  M3 $38\,400 \div 1000$ OR 38.4 (kJ/mol)  M4 +38.4 (kJ/mol)  OR  M1 moles of $\text{NaHCO}_3 = 7.0 \div 84$ OR 0.0833  M2 $3\,200 \div 1\,000$ OR 3.20 (kJ)  M3 $3.20 \div 0.0833$ OR 38.4 (kJ/mol)  M4 +38.4 (kJ/mol)		4

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



