Mark Scheme (Results)

Summer 2023

Pearson Edexcel International GCSE
In Chemistry (4CH1) Paper 1CR and Science (Double Award) (4SD0) 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) (ii)	4 11		1 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)		Answer of 6.92 scores 3	3
	M1 $(7.60 \times 6) + (92.4 \times 7)$	ACCEPT $(6 \times 0.076) + (7 \times 0.924)$	
	M2 $692.4 \div 100$ OR 6.924		
	M3 6.92	ALLOW ecf if use of 6 and 7 in calculation	
			Total for question = 8

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>4 (a)</td><td>
<table>
<tr><th>Information</th><th>Gas</th></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>
</td><td></td><td>4</td></tr>
<tr><td>(b) (i)</td><td>copper(II) oxide / CuO / copper oxide forms</td><td>REJECT copper(I) oxide</td><td>1</td></tr>
<tr><td>(ii)</td><td>the volume of a gas changes with temperature / gas expands when hot / heated / gas shrinks when cools OWTTE</td><td></td><td>1</td></tr>
<tr><td>(iii)</td><td>M1 138 – 108 OR 30 (cm^3)

M2 ((30÷138) × 100 =) 21.7</td><td>

ALLOW minimum 2 significant figures

21.7 / 21.74 / 22 scores 2

78.3 / 78.26 / 78 scores 1</td><td>2</td></tr>
<tr><td colspan="4">Total for question = 8</td></tr>
</table>

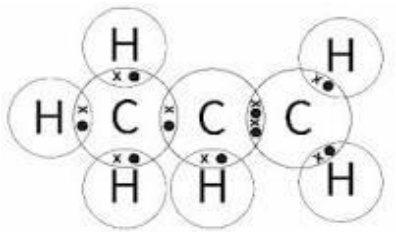
Question number	Answer	Notes	Marks
5 (a) (i)	M1 water M2 oxygen	ALLOW moisture / H_2O ALLOW air / O_2 answers can be in either order	2
(ii)	oxidation	ALLOW oxidisation / oxidising / redox	1
(b) (i)	M1 paint acts as a barrier / layer M2 which prevents air / oxygen / water getting to / reacting with the 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^{3+} ions throughout ALLOW (iron(III) oxide / iron ions / Fe^{3+} ions) takes electrons from aluminium 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 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_2 is / produced /one of the products M3 which reacts with limewater forming calcium carbonate	ALLOW chalky / white precipitate ALLOW carbon dioxide / CO_2 is present ALLOW forming an insoluble product	2
(b) (i)	M1 amount of water = 2.16÷18 **OR** 0.12 mol M2 number of hydrogen atoms (0.12÷0.01)×2 OR 24 M3 formula of alkene = $C_{12}H_{24}$	 ALLOW $12H_2O$ Correct answer of $C_{12}H_{24}$ scores 3 C_6H_{12} 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 ^oC (it is pure water) / boiling point is 100 $^\circ C$	ALLOW find the freezing point /melting point REJECT evaporate ALLOW freezes/ melts at 0^oC	2
(c)	M1 (moles of heptane) = 30 ÷ 100 **OR** 0.3(0) M2 (moles of oxygen) = 0.3(0) × 11 **OR** 3.3 M3 (mass of oxygen) = (3.3 × 32) = 106 (g) OR M1 11 x 32 **OR** 352 (g) of oxygen M2 so mass of oxygen = 352 x 30 ÷ 100 M3 106 (g)	Answer of 106 g OR 105.6 g scores 3 ALLOW M1 × 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_{60} molecule/it) will not react with the blood/medicine (the C_{60} molecule/it) is non-toxic the medicine can fit inside (the C_{60} molecule)	ALLOW any acceptable answer ALLOW it is inert /unreactive	1
			Total for question = 5

Question number	Answer	Notes	Marks
9 (a) (i)	M1 Ca^{2+} M2 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)	$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$	ALLOW fractions and multiples	1
(b)	Any 2 from M1, M2 and M3 **flame test** 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 **halide ion test** 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 **sulfate ion test** 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)	M1 four electrons between carbon 2 and carbon 3 and two electrons between carbon 1 and carbon 2 M2 two electrons between each carbon and hydrogen  	ACCEPT any combination of dots and crosses Max 1 if any extra non-bonding electrons added	2
(ii)	M1 shared pair(s) of electrons M2 attracted to (two) nuclei OR M1 (two) nuclei M2 attracted to shared pair(s) of electrons	 REJECT nucleus. Must be plural for M2 REJECT nucleus. Must be plural for M1	2
(b)	Any two from: M1 cracking M2 heat to / at a temperature of 600-700°C M3 with a catalyst of silica/alumina	 ALLOW a correct cracking equation including propene ALLOW aluminosilicates / aluminium oxide / silicon oxide/Al_2O_3/SiO_2 /zeolites	2
(c) (i)	M1 H H I I – C – C – I I H CH_3 M2 extension bonds, brackets and n to the right	 ALLOW correct repeat unit with or without extension bonds M2 dep on M1	2
(ii)	M1 (poly(propene)) remains for a long time (in landfill) M2 because it is inert/unreactive/non-biodegradable	ALLOW takes up a lot of space ALLOW does not decompose	2

(d)	(i)	M1 $\frac{60}{12}$ $\frac{13.3}{1}$ $\frac{26.7}{16}$ M2 $\frac{5}{1.67}$ $\frac{13.3}{1.67}$ $\frac{1.67}{1.67}$ OR 3:8:1 M3 (36 + 8 + 16 = 60 / 60 ÷ 60 = 1 so molecular formula is) C_3H_8O	C_3H_8O scores 3 atoms can be in any order no marks for upside down calculation or use of atomic numbers ACCEPT alternative methods	3
	(ii)	M1 intermolecular forces in compound X are stronger AND any one from M2 so require more energy to overcome M3 because the M_r / the surface area of the molecule is higher 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) REJECT heat loss (to surroundings)	
(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 (ΔT =) 20.8 − 15.3 **OR** 5.5 (°C) M2 (Q = 100 x 4.2 x 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 $NaHCO_3$ = 7.0 ÷ 84 **OR** 0.0833 M2 3 200 ÷ 0.0833 **OR** 38 400 (J) M3 38 400 ÷ 1000 **OR** 38.4 (kJ/mol) M4 +38.4 (kJ/mol) OR M1 moles of $NaHCO_3$ = 7.0 ÷ 84 **OR** 0.0833 M2 3 200 ÷ 1 000 **OR** 3.20 (kJ) M3 3.20 ÷ 0.0833 **OR** 38.4 (kJ/mol) 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

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