



Mark Scheme (Results)

Summer 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)	<table><tr><th>Description</th><th>Substance</th></tr><tr><td>a good conductor of electricity</td><td>lithium</td></tr><tr><td>an element that is a liquid at room temperature</td><td>bromine</td></tr><tr><td>a substance that can be used to form a polymer</td><td>ethene</td></tr><tr><td>an element that forms a basic oxide</td><td>lithium</td></tr><tr><td>a substance that has a giant covalent structure</td><td>diamond</td></tr></table>	Description	Substance	a good conductor of electricity	lithium	an element that is a liquid at room temperature	bromine	a substance that can be used to form a polymer	ethene	an element that forms a basic oxide	lithium	a substance that has a giant covalent structure	diamond	<p>ALLOW Li</p> <p>ALLOW Br/Br₂ REJECT Br⁻</p> <p>ALLOW C₂H₄</p> <p>ALLOW Li</p>	5
Description	Substance														
a good conductor of electricity	lithium														
an element that is a liquid at room temperature	bromine														
a substance that can be used to form a polymer	ethene														
an element that forms a basic oxide	lithium														
a substance that has a giant covalent structure	diamond														
(b)	<p>A description that refers to the following two points</p> <p>M1 (use damp blue) litmus paper</p> <p>M2 (litmus paper) bleached/turns white</p> <p>Ignore gas/solution</p>	<p>ALLOW universal indicator paper</p> <p>ACCEPT blue litmus paper turns red and then bleached</p> <p>IGNORE gas/solution</p> <p>ALLOW M1 bromide solution M2 turns brown</p> <p>REJECT iodide solution</p> <p>M2 dep on M1</p> <p>Red litmus paper turns blue then bleaches/turns white scores M1 only</p>	2												
Total			7												

Question number			Answer	Notes	Marks
2	(a)	(i)	most reactive Q S R least reactive P		1
		(ii)	R		1
		(iii)	aluminium + hydrochloric acid → aluminium chloride + hydrogen	ALLOW $2\text{Al} + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2$ or multiples or fractions	1
		(iv)	copper/silver/gold	ALLOW platinum or any other metal that does not react with hydrochloric acid ALLOW correct symbol	1
		(v)	explosive/dangerous/violent/unsafe	IGNORE volatile/vigorous	1
	(b)	(i)	heat/thermal energy is given out/released (to the surroundings)	IGNORE energy on its own	1
		(ii)	aluminium is more reactive/ higher in the reactivity series (than iron) ORA	ACCEPT aluminium is a better/stronger reducing agent ALLOW Al	1
		(iii)	An explanation that links the following two points M1 aluminium/Al gains oxygen and iron(III) oxide /Fe ₂ O ₃ loses oxygen M2 (so) aluminium/Al is oxidised and iron(III) oxide /Fe ₂ O ₃ is reduced OR M1 Aluminium/Al gains oxygen so is oxidised M2 Iron(III) oxide/Fe ₂ O ₃ loses oxygen so is reduced	ACCEPT aluminium/Al loses electrons and iron ions/Fe ³⁺ gain electrons for M1 ACCEPT correct changes in oxidation numbers ACCEPT aluminium/Al loses electrons so is oxidised scores for M1 and iron ions/Fe ³⁺ gain electrons so is reduced for M2 REJECT iron loses oxygen for M2	2
					Total 9

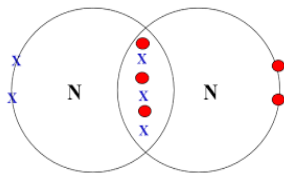
Question number			Answer	Notes	Marks
3	(a)	(i)	2	ALLOW two	1
		(ii)	3	ALLOW three	1
		(iii)	ZF ₂	ALLOW MgF ₂ ALLOW F ₂ Mg ALLOW F ₂ Z REJECT MgFl ₂ Penalise incorrect case or superscripts	1
	(b)		M1 $12 \times 6.0 \times 10^{23}$ M2 7.2×10^{24}	ALLOW ecf if incorrect number of electrons x 6.0×10^{23} ALLOW ecf if /12 ONLY rather than x12 giving $5(.0) \times 10^{22}$	2 4
	(c)		M1 (isotopic masses) 24, 25 and 26 M2 $79.0 \times 24 + 10.0 \times 25 + 11.0 \times 26$ OR 2432 M3 $\frac{79.0 \times 24 + 10.0 \times 25 + 11.0 \times 26}{100}$ OR $\frac{2432}{100}$ OR 24.32 M4 24.3	M2 subsumes M1 ALLOW ecf if incorrect mass numbers used 12.3 scores 3 with working 24.3 without working scores 4 24.32 without working scores 3 M4 scores only if numbers from the table are used.	
	(d)		magnesium	ALLOW Mg	1
Total 10					

Question number			Answer	Notes	Marks
4	(a)	(i)	24		1
		(ii)		correct answer of 194 scores 2	2
			M1 $12 \times 8 + 1 \times 10 + 14 \times 4 + 16 \times 2$ M2 194	No ECF	
	(b)	(iii)	C ₄ H ₅ N ₂ O	ALLOW atoms in any order	1
		(i)	(simple) distillation	REJECT fractional distillation	1
	(c)	(ii)	A description that refers to two of the following points M1 (the condenser/X) cools the (ethanol) vapour M2 so it condenses OR forms liquid (ethanol)		2
			M1 calcium bromide is a giant (ionic) lattice/structure M2 with many/strong electrostatic attractions between (oppositely charged) ions M3 caffeine has a simple molecular structure M4 caffeine has weak intermolecular forces /weak forces between molecules M5 more energy is needed to break the electrostatic attractions (in calcium bromide) than to overcome the intermolecular forces (in caffeine) OWTTE	ALLOW many/strong ionic bonds No M2 if covalent bonds or IMF given here ALLOW simple covalent structure REJECT weak forces between bonds No M5 if reference to breaking covalent bonds No M5 if reference to incorrect bonds	5
			Total 12		

Question number	Answer	Notes	Marks
5 (a) (i)	An explanation that links the following two points	ALLOW dye in place of spot throughout question 5	2
	M1 They will not dissolve/diffuse into the solvent (at the bottom of beaker) OWTTE	ALLOW water	
	M2 so that the dyes can travel up the paper		
	(ii) An explanation that links the following two points		2
	M1 E and H	M2 dep on M1	
	M2 as the dye is/both have a spot at the same level/travelled the same distance/same R _f value		
(iii)	An explanation that links the following two points		2
	M1 The student can only be certain about G containing one dye as only one spot		
	M2 As F is insoluble/not moved (so you cannot tell how many dyes it has) OWTTE		
(b)	M1 distance from baseline to solvent level in mm = 65		3
	M2 distance from baseline to spot/dye in mm = 39	ACCEPT any value between 38 and 41 inclusive	
	M3 (R _f value = $39 \div 65 =$) 0.6	ACCEPT any value between 0.57 and 0.64 M3 not awarded if value is incorrectly rounded	
			Total 9

Question number	Answer	Notes	Marks
6 (a) (i)	Any 2 from M1 effervescence/bubbles/fizzing M2 moves M3 floats M4 disappears/ gets smaller M5 melts/forms a ball/forms a sphere M6 white trail	moves on surface scores M2 and M3 ALLOW dissolves IGNORE heat produced IGNORE flame	2
(ii)	An explanation that links the following two points M1 (the phenolphthalein) turns pink M2 (because) OH ⁻ ions/hydroxide ions are present	Mark independently ALLOW an alkaline solution /an alkali is produced REJECT red or purple IGNORE metal oxide forms	2
(b) (i)	An explanation that links the following two points M1 (to remove) any other ions/chemicals/ impurities/substances/elements (that may be on the wire) M2 (so that) they do not interfere with/mask the colour of the flame/change the flame colour		2
(ii)	C (red) A is incorrect as lithium ions do not give a lilac flame B is incorrect as lithium ions do not give an orange flame D is incorrect as lithium ions do not give a yellow flame		1
(c) (i)	M1 potassium ion K ⁺ M2 aluminium ion Al ³⁺ M3 sulfate ion SO ₄ ²⁻ All three correct 2 marks Any two correct 1 mark	ALLOW Al ⁺³ ALLOW SO ₄ ⁻²	2

(c) (ii)	<p>M1 (mass of water =) $23.7 - 12.9$ OR 10.8</p> <p>M2 (moles of $\text{KAl}(\text{SO}_4)_2$ =) $12.9 \div 258$ OR $0.05(00)$</p> <p>M3 (moles of water =) $10.8 \div 18$ OR $0.6(00)$</p> <p>M4 ($x = 0.6 \div 0.05 =$) 12</p>	<p>correct answer of 12 without working scores 4</p> <p>ALLOW ecf on incorrect mass of water</p> <p>answer to M4 must be a whole number</p> <p>ACCEPT alternative methods</p>	<p>4</p> <p>Total 13</p>
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Question number	Answer	Notes	Marks
7 (a)	<p>D (80 %)</p> <p>A is incorrect as there is not approximately 1 % of nitrogen in the atmosphere B is incorrect as there is not approximately 20 % of nitrogen in the atmosphere C is incorrect as there is not approximately 70 % of nitrogen in the atmosphere</p>		1
(b)	<p>M1 3 pairs of electrons between the two nitrogen atoms</p> <p>M2 rest of molecule fully correct</p> 	<p>ALLOW any combination of dots and crosses</p> <p>M2 dep on M1</p>	2
(c) (i)	<p>$4\text{NO}_2 + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4\text{HNO}_3$</p> <p>M1 all formulae correct</p> <p>M2 balancing of correct formulae</p>	<p>ALLOW multiples and fractions</p> <p>IGNORE state symbols even if incorrect</p> <p>M2 dep on M1</p>	2
(ii)	<p>any one environmental effect of acid rain</p> <p>e.g. acidifies lakes /kills fish /deforestation /damages plants /corrodes marble statues /corrodes buildings</p>	<p>ACCEPT any other environmental effect</p> <p>REJECT ozone layer</p> <p>IGNORE climate change</p>	1
(d) (i)	<p>D (NH₄)₂CO₃</p> <p>A is incorrect as NH₃CO₃ is not the formula of ammonium carbonate B is incorrect as (NH₃)₂CO₃ is not the formula of ammonium carbonate C is incorrect as NH₄CO₃ is not the formula of ammonium carbonate</p>		1

(ii)	<p>A description that refers to the following six points</p> <p>Test for ammonium ions</p> <p>M1 add sodium hydroxide solution (and heat)</p> <p>M2 test the gas/ammonia with (damp) red litmus paper</p> <p>M3 (red litmus) turns blue</p> <p>Test for carbonate ions</p> <p>M4 add (hydrochloric) acid ONLY</p> <p>M5 test the gas/carbon dioxide with limewater</p> <p>M6 (limewater) turns cloudy/milky/white precipitate</p>	<p>ACCEPT universal indicator paper which turns blue/purple for M2 and M3</p> <p>M2 is dependent on M1 OR can be awarded for heating the solution and producing a gas to test</p> <p>M3 can be awarded independently if ammonia gas is correctly tested with correct colour change</p> <p>No M2 and M3 if litmus paper added directly to the solution</p> <p>ACCEPT other acids</p> <p>M5 dependent on gaining M4 by adding acid ONLY to the solution</p> <p>M6 can be awarded independently if a correct limewater test on carbon dioxide gas is carried out</p> <p>No M5 and M6 if limewater added directly to the solution.</p>	<p>6</p> <p>Total 13</p>
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Question number	Answer	Notes	Marks
8 (a) (i)	<p>An explanation that links the following two points</p> <p>M1 (compounds with) the same molecular formula</p> <p>M2 but different structural/displayed formulae</p>	<p>ALLOW same number of carbons and hydrogens/atoms of each element</p> <p>REJECT elements with the same molecular formula</p> <p>REJECT chemical formula for M1</p> <p>ALLOW different structures/arrangements of atoms</p> <p>M2 independent of M1</p>	2
(ii)	<p>M1</p> $ \begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - \text{H} \\ & & & & & & & \\ & \text{H} & & & & & & \text{H} \end{array} $ <p>M2</p> $ \begin{array}{c} \text{H} & & & \text{H} \\ & & & / \\ \text{H} - \text{C} & - & \text{C} & = \text{C} \\ & & & \backslash \\ \text{H} & & \text{H} & \text{H} \\ & & & \\ \text{H} - \text{C} & - & \text{H} \\ \\ \text{H} \end{array} $	<p>Must show all bonds</p> <p>ALLOW cis and trans isomers for both marks</p> <p>REJECT cycloalkanes</p>	2
(b)	<p>A (addition)</p> <p>B is incorrect as this is not a combustion reaction</p> <p>C is incorrect as this is not a decomposition reaction</p> <p>D is incorrect as this is not a substitution reaction</p>		1
(c) (i)	$ \begin{array}{ccccc} & \text{H} & & \text{CH}_3 & \\ & & & & \\ - & \text{C} & - & \text{C} & - \\ & & & & \\ & \text{H} & & \text{H} & \end{array} $	IGNORE brackets and n	1

(ii)	<p>M1 they are inert/unreactive/do not biodegrade/decomposes (very) slowly/running out space</p> <p>M2 they produce toxic fumes/greenhouse gases (when burned)</p>	<p>IGNORE global warming</p>	2
(d)	<p>M1 $y (= 396 \div 44) = 9$</p> <p>M2 $z (= 180 \div 18) = 10$</p> <p>M3 $x = 14$</p>	<p>ALLOW ecf for M3 on incorrect values for M1 and/or M2</p>	3
(e) (i)	<p><u>$C_8H_{18}(l) + 7O_2(g) \rightarrow 5CO(g) + 3C(s) + 9H_2O(l)$</u></p> <p>M1 correct balancing</p> <p>M2 correct state symbols</p>	<p>ACCEPT (g) for H_2O</p>	2
(ii)	<p>M1 carbon monoxide/CO</p> <p>M2 is poisonous/toxic/limits the capacity to carry oxygen in the blood</p>	<p>ALLOW carbon/C</p> <p>ALLOW soot causes respiratory problems</p> <p>ACCEPT correct references to haemoglobin</p> <p>M2 dep on M1</p> <p>IGNORE harmful</p>	2
Total 15			

Question number	Answer	Notes	Marks
9 (a) (i)	carbon dioxide/a gas is given off	IGNORE marble dissolving	1
		IGNORE gas formed	
	(ii) to prevent acid spray from leaving the flask OWTTE	IGNORE to stop solid from escaping	1
	(b) (i) Any two linked pairs from the following:	IGNORE comments linked to rate of reaction	4
	M1 the curve is steep(est) at the start/the loss in mass is fastest at the start		
	M2 because the acid concentration is highest/maximum number of reacting particles	Max 2 marks for M1, M3 and M5	
	OR		
	M3 curves becomes less steep/the loss in mass slows down		
	M4 acid becomes more dilute/less concentrated		
	OR		
	M5 curve levels off/becomes flat/plateaus/the loss in mass stops		
	M6 acid has been used up		
	(ii) M1 curve drawn starting at the origin and below the original curve		2
	M2 curve levels off at 0.27 g + or – half a small square		
	(c) An explanation that links the following three points		3
	M1 the rate of reaction would increase/be faster		
	M2 (because) the smaller marble chips have a greater surface area	IGNORE less chance of collisions	
	M3 (so) there will be more collisions per unit time	ACCEPT more frequent collisions	
		MAX 1 mark if reference to particles having more energy or moving faster	
			Total 11

Question number	Answer			Notes	Marks						
10 (a)	$\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$			IGNORE state symbols even if incorrect	1						
(b)		<table><tr><td>temperature of the acid at the start in °C</td><td>16.0</td></tr><tr><td>highest temperature reached in °C</td><td>32.4</td></tr><tr><td>temperature rise in °C</td><td>16.4</td></tr></table>	temperature of the acid at the start in °C	16.0	highest temperature reached in °C	32.4	temperature rise in °C	16.4		Must be given to 1dp ALLOW ECF from incorrect highest temperature reached ALLOW ECF from an incorrect starting temperature	2
temperature of the acid at the start in °C	16.0										
highest temperature reached in °C	32.4										
temperature rise in °C	16.4										
(c) (i)	M1 $Q = 40 \times 4.2 \times 16.4$ M2 2755 (J)			ACCEPT any number of sig figs except 1	2						
(ii)	<ul style="list-style-type: none">find the amount of magnesium in molesdivide Q by nconvert answer in J/mol to kJ/molanswer including sign to 2sf M1 $n(\text{Mg}) = 0.12 \div 24$ OR 0.005 M2 $Q \div n$ OR $2755 \div 0.005$ OR 551 000 (J/mol) M3 $551\,000 \div 1000$ OR 551 (kJ/mol) M4 – 550 (kJ/mol)			correct answer with minus sign and without working scores 4 ACCEPT use of 2760 or 2800 ALLOW ECF on incorrect answer to (i) and/or M1 ALLOW ECF on incorrect answer to M2 ALLOW ECF on incorrect answer to M3 M4 - to score must be to 2sf and have correct sign Use of 2800 gives an answer of – 560 (kJ/mol)	4						

(d)	<p>An explanation that links the following two points</p> <p>M1 polystyrene is an insulator/poor conductor OWTTE</p> <p>M2 (so) there is less heat loss/more heat retained (compared to the glass beaker)</p>	<p>REJECT no heat loss</p>	<p>2</p> <p>Total 11</p>
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