



Mark Scheme (Results)

January 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)	X evaporating Y condensing Z freezing	ALLOW evaporation ALLOW condensation	3
(b)	M1 solid particles vibrate about a fixed position M2 gas particles move randomly	REJECT do not move ALLOW gas particles move rapidly/quickly/freely	2
			Total 5

Question number	Answer	Notes	Marks
2 (a) (i)	nitrogen	ALLOW N ₂ IGNORE N	1
(ii)	argon	ALLOW Ar	1
(iii)	carbon dioxide	ALLOW CO ₂ /H ₂ O(g)/water vapour/CH ₄ /methane	1
(b) (i)	brown/red-brown/orange-brown	ALLOW orange IGNORE red ALLOW rusty/rust coloured (looks like)rust/rusted	1
(ii)	M1 (change in length of column =) 84 – 69 OR 15 (mm) M2 $\frac{15 \times 100}{84} = 17.86/17.9 (=18)$	M2 subsumes M1 Working must be shown to score M2 Ecf for M2 eg 18/84 x100 =21.4 REJECT 17.85/17.8 as wrongly rounded	2
(iii)	not all the oxygen in the sample of air had reacted with the iron wool OWTTE /not enough iron wool	ALLOW there is water vapour in the column of air/changes in temperature / pressure / location ALLOW Reaction incomplete/reaction too slow	1
			Total 7

Question number	Answer	Notes	Marks										
3 (a)	<table><tr><td>structural formula</td><td>CH₃CH₂CH₂CH₃</td></tr><tr><td>name</td><td>butane</td></tr><tr><td>molecular formula</td><td>C₄H₁₀</td></tr><tr><td>empirical formula</td><td>C₂H₅</td></tr><tr><td>general formula</td><td>C_nH_{2n+2}</td></tr></table> 1 mark for each correct answer	structural formula	CH ₃ CH ₂ CH ₂ CH ₃	name	butane	molecular formula	C ₄ H ₁₀	empirical formula	C ₂ H ₅	general formula	C _n H _{2n+2}		4
structural formula	CH ₃ CH ₂ CH ₂ CH ₃												
name	butane												
molecular formula	C ₄ H ₁₀												
empirical formula	C ₂ H ₅												
general formula	C _n H _{2n+2}												
(b) (i)	M1 (compounds with the) same molecular formula	ALLOW same numbers of each atom ALLOW different arrangement of atoms	2										
(ii)	M2 (but with) different structural/displayed formulae		2										
(i)	M1 displayed formula of butane H H H H H C C C H H H H H M2 displayed formula of methylpropane H H H H C C C H H H H H C H H												
(c) (i)	HBr	REJECT incorrect case letters Ignore name	1										
(ii)	D substitution A is incorrect as it is not an addition reaction B is incorrect as it is not a decomposition reaction C is incorrect as it is not a neutralisation reaction		1										
(iii)	ultraviolet (radiation)	ACCEPT UV (radiation) ALLOW ultraviolet/UV light/sunlight	1										
(d) (i)	2C ₂ H ₆ + 7O ₂ → 4CO ₂ + 6H ₂ O M1 all formulae correct M2 balancing of correct formulae	ALLOW multiples and fractions M2 dep on M1	2										
(ii)	An explanation that links the following points M1 carbon monoxide/CO (is the gas produced) M2 (carbon monoxide) limits the capacity of the blood/haemoglobin to carry oxygen OWTTE	M2 dep on M1	2										
			Total 15										

Question number	Answer	Notes	Marks
4 (a)	Any two from M1 concentration of solution A M2 concentration of solution B M3 volume of solution B	ALLOW amount of solution B Ignore apparatus	2
(b) (i)	all points plotted correctly to the nearest grid line		1
(ii)	anomalous point at 25°C circled	ALLOW ecf from incorrect plotting	1
(iii)	smooth curve of best fit ignoring the anomalous point	ALLOW Ecf if 35,130 circled	1
(iv)	Any one from M1 temperature was higher than 25°C M2 started the timer too late /stopped the timer too early/took reading too early	ALLOW ecf from incorrect anomalous result circled so 35,130 gives slower as temp<35/timer stopped too late	1
(v)	M1 vertical line on graph drawn to curve from 55°C M2 value obtained from candidate's graph	ALLOW extra point at 55°C on curve expected value 115 to 117 s	2
(c)	M1 $\frac{1}{156}$ OR 0.00641 M2 6.41×10^{-3}	ALLOW use of value from graph ALLOW 6.4×10^{-3}	2
(d)	An explanation that links the following three points M1 rate (of reaction) increases M2 (mean) kinetic energy of particles increases M3 more successful collisions per second/unit time/ more frequent successful collisions	ALLOW reaction is faster/ speeds up ALLOW particles move faster IGNORE vibrate more /faster ALLOW more frequent collisions having energy $\geq$ activation energy	3
			Total 13

Question number	Answer	Notes	Marks																												
5 (a) (i)	5/five		1																												
(ii)	46		1																												
(iii)	M1 hydrocarbons contain only carbon and hydrogen (atoms) M2 methanoic acid/it contains oxygen (as well as hydrogen and carbon)	REJECT molecules	2																												
(b) (i)	M1 (electrostatic) attraction between nuclei M2 (and the) shared pair of electrons OR M1 (electrostatic) attraction between shared pair(s) of electrons M2 and nuclei	Must be plural Must be plural	2																												
(ii)	M1 3 pairs of electrons for 3 single bonds M2 2 shared pairs for one C=O double bond M3 rest of molecule fully correct (lone pairs on oxygen atoms must be shown)	ALLOW any combination of dots and crosses M3 dep on M1 and M2 correct	3																												
(c)	- divide percentages by relative atomic masses - divide results by smallest value to obtain ratio - write empirical formula Example calculation <table> <tr> <td>M1</td> <td>C</td> <td>H</td> <td>O</td> </tr> <tr> <td></td> <td><u>52.2</u></td> <td><u>13.0</u></td> <td><u>34.8</u></td> </tr> <tr> <td></td> <td>12</td> <td>1</td> <td>16</td> </tr> <tr> <td>M2</td> <td><u>4.35</u></td> <td><u>13.0</u></td> <td><u>2.175</u></td> </tr> <tr> <td></td> <td>2.175</td> <td>2.175</td> <td>2.175</td> </tr> <tr> <td>OR</td> <td>2</td> <td>6</td> <td>1</td> </tr> <tr> <td>M3</td> <td>C₂H₆O</td> <td></td> <td></td> </tr> </table>	M1	C	H	O		<u>52.2</u>	<u>13.0</u>	<u>34.8</u>		12	1	16	M2	<u>4.35</u>	<u>13.0</u>	<u>2.175</u>		2.175	2.175	2.175	OR	2	6	1	M3	C ₂ H ₆ O			0 marks if division by atomic numbers or upside-down calculation ACCEPT symbols in any order	3
M1	C	H	O																												
	<u>52.2</u>	<u>13.0</u>	<u>34.8</u>																												
	12	1	16																												
M2	<u>4.35</u>	<u>13.0</u>	<u>2.175</u>																												
	2.175	2.175	2.175																												
OR	2	6	1																												
M3	C ₂ H ₆ O																														
Total 12																															

Question number	Answer	Notes	Marks
6 (a) (i)	B bromine A is incorrect as astatine is a solid at room temperature C is incorrect as chlorine is a gas at room temperature D is incorrect as fluorine is a gas at room temperature		1
(ii)	C dark grey A is incorrect as solid iodine is not black B is incorrect as solid iodine is not dark brown D is incorrect as solid iodine is not purple		1
(iii)	M1 test with (damp blue) litmus paper M2 bleaches/turns white	ALLOW Universal indicator paper/ pH paper ACCEPT turns red and then bleaches	2
(b)	M1 $71.2 \times 35 + 28.8 \times 37$ OR 3557.6 M2 $\frac{71.2 \times 35 + 28.8 \times 37}{100}$ OR $\frac{3557.6}{100}$ OR 35.576 M3 35.6	Correct answer without working scores 3 M2 subsumes M1 35.5 without working scores 0	3
(c)	An explanation that links the following four points M1 add chlorine (solution) to sodium iodide (solution) M2 solution turns brown M3 iodine/I ₂ is displaced M4 (so) chlorine is more reactive (than iodine) ORA	ALLOW mix the two solutions ALLOW iodine/I ₂ is formed REJECT incorrect use of iodide or chloride once only	4 Total 11

Question number	Answer	Notes	Marks
7 (a)	M1 (bright) white flame/light M2 white powder/solid (formed)	ALLOW white smoke/ash ALLOW grey powder REJECT white precipitate	2
(b) (i)	gives out/releases heat (energy)/thermal energy	IGNORE energy alone	1
(ii)	$2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3$	ALLOW multiples and fractions	1
(iii)	An explanation that links two of the following pairs of points M1 aluminium/Al gains oxygen so is oxidised M2 iron oxide/Fe_2O_3 loses oxygen so is reduced OR M1 aluminium/Al is oxidised and iron oxide/Fe_2O_3 is reduced M2 as aluminium/Al gains oxygen and iron oxide/Fe_2O_3 loses oxygen	ACCEPT aluminium loses electrons so is oxidised ACCEPT iron ions/Fe^{3+} ions gain electrons so are reduced ACCEPT aluminium loses electrons and iron ions/Fe^{3+} ions gain electrons ALLOW answers in terms of change in oxidation number	2
(c) (i)	An explanation that links the following two points M1 to allow air/oxygen to enter the crucible OWTTE M2 so that oxygen can react with the magnesium		2
(ii)	A description that refers to the following points M1 heat the crucible again and reweigh M2 repeat until constant mass	Heat and reweigh to constant mass scores 2	2
			Total 10

Question number	Answer	Notes	Marks
8 (a) (i)	(thermal) decomposition		1
(ii)	M1 amount of $\text{PbCO}_3 = \frac{5.34}{267} = 0.02(00)$ (mol) M2 mass of $\text{PbO} = 0.02(00) \times 223 = 4.46$ (g)	Correct answer without working scores 2 ACCEPT alternative methods	2
(b) (i)	M1 diagram showing delivery tube going into test tube containing liquid	REJECT if sealed with a bung	2
(ii)	M2 limewater labelled (limewater) turns cloudy/milky	ALLOW white precipitate (ii) dep on mention of limewater in either (i) or (ii)	1
(c)	An explanation that links six of the following points M1 silicon dioxide has a giant (covalent) structure M2 covalent bonds are (very) strong M3 (in silicon dioxide) many covalent bonds need to be broken M4 a large amount of energy/more energy is required to break the bonds in silicon dioxide M5 carbon dioxide has a simple molecular structure/is a simple molecule M6 the forces between the molecules/intermolecular forces (in carbon dioxide) are weak M7 very little energy/less energy is needed to overcome the forces between the molecules/intermolecular forces (in carbon dioxide)	No M3 or M4 if reference to intermolecular forces in silicon dioxide No M6 or M7 if any reference to weak covalent bonds or breaking of covalent bonds in carbon dioxide Accept bonds between molecules weak A statement such as 'more energy is needed to break the bonds in silicon dioxide than to overcome the forces between the molecules/intermolecular forces (in carbon dioxide)' scores M4 and M7	6
			Total 12

Question number	Answer	Notes	Marks
9 (a) (i)	$\text{Zn (s)} + 2\text{HNO}_3(\text{aq}) \rightarrow \text{Zn}(\text{NO}_3)_2(\text{aq}) + \text{H}_2(\text{g})$	ACCEPT upper case letters	1
(ii)	effervescence/bubbles/fizzing	IGNORE gas produced /given off IGNORE hydrogen produced / given off ALLOW colourless solution formed/gets hot/exothermic reaction/zinc dissolves IGNORE crystals form	1
(b) (i)	so all the nitric acid reacts/is neutralised		1
(ii)	A description which refers to the following five points M1 filter off the excess zinc M2 heat the solution until crystals form M3 leave the solution to cool (and crystallise) M4 pour/filter off excess liquid (to obtain crystals) M5 leave (crystals) to dry	 ALLOW heat until the solution is saturated/ heat until crystals form on the end of a glass rod/heat to evaporate some of the water IGNORE washing ALLOW any method of drying that avoids excess heat e.g. filter paper, a desiccator, a warm oven If heated to dryness only M1 can be scored If solution is not heated only M1, M4 and M5 can be scored	5
(c)	$2\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} \rightarrow 2\text{ZnO} + 4\text{NO}_2 + \text{O}_2 + 12\text{H}_2\text{O}$ M1 all formulae correct M2 balancing of correct formulae	 M2 dep on M1	2
			Total 10

Question number	Answer	Notes	Marks						
10 (a)	M1 so that the solid/ammonium nitrate dissolves more quickly M2 so that the temperature is even throughout the solution OWTTE	IGNORE speed up reaction ALLOW heat transfers evenly (throughout the solution)	2						
(b)	<table><tr><td>initial temperature of distilled water in °C</td><td>23.4</td></tr><tr><td>minimum temperature of solution in °C</td><td>19.4</td></tr><tr><td>temperature change in °C</td><td>4.0</td></tr></table>	initial temperature of distilled water in °C	23.4	minimum temperature of solution in °C	19.4	temperature change in °C	4.0	must be to 1 dp ALLOW ecf on incorrect minimum temperature	2
initial temperature of distilled water in °C	23.4								
minimum temperature of solution in °C	19.4								
temperature change in °C	4.0								
(c) (i)	M1 ($Q =$) $50 \times 4.2 \times 3.9$ (J) M2 ($Q =$) 819/820 (J)	answer of 819 or 820 without working scores 2 ALLOW use of 4.0 giving an answer of 840	2						
(ii)	- find moles of NH_4NO_3 - division of Q by moles - conversion to kJ/mol - answer with correct sign M1 (amount of $\text{NH}_4\text{NO}_3 =$) $2.8 \div 80$ OR 0.035 (mol) M2 $819 \div 0.035$ OR 23 400 (J/mol) M3 $23\,400 \div 1000$ OR 23.4 (kJ/mol) M4 ($\Delta H =$) +23.4/+23 (kJ/mol)	correct answer without working scores 4 use of 820 gives 23 429 use of 800 gives 22 857 use of 840 gives 24 000 use of 820 gives 23.4 use of 800 gives 22.9 use of 840 gives 24.0	4						
(d)	A description that refers to the following points M1 add sodium hydroxide (solution to the ammonium nitrate and warm) M2 test the gas/ammonia evolved with (damp) red litmus paper/(damp) universal indicator paper M3 (red litmus) turns blue/ (universal indicator) turns blue/purple	M2 and M3 dep on M1 No M2 or M3 if solution tested with litmus/ universal indicator paper	3						

(e)	An explanation that links the following points M1 the temperature increases/rises M2 so the reaction is exothermic		2
			Total 15

