Mark Scheme (Results)

Summer 2023

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

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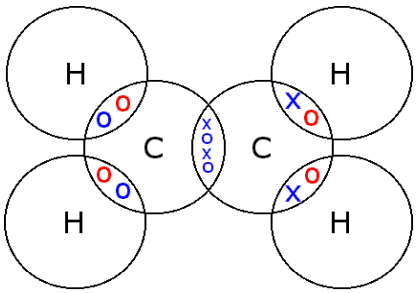
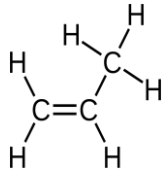
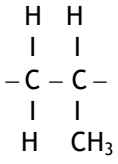
General Marking Guidance

- 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) (i)	<u>fractional</u> distillation		1
(ii)	chromatography		1
(iii)	simple distillation	**ACCEPT** distillation	1
(b)	**M1** A mixture of copper(II) oxide and copper(II) sulfate can be separated by first dissolving the copper(II) sulfate in distilled water. **M2** The copper(II) oxide is then removed by filtering **M3** Some of the water from the copper(II) sulfate solution is then removed by evaporating **M4** A pure sample of hydrated copper(II) sulfate is then obtained by crystallisation	 **ACCEPT** filtration **ACCEPT** evaporation **ACCEPT** simple distillation **ACCEPT** crystallising	4
			Total 7

Question number	Answer	Notes	Marks
2 (a) (i)	(hydrated) iron(III) oxide / Fe_2O_3	**IGNORE** iron oxide **REJECT** iron(II) oxide	1
(ii)	**D** oxidation A is incorrect as it is not a combustion reaction B is incorrect as it is not a decomposition reaction C is incorrect as it is not a neutralisation reaction		1
(iii)	zinc	**ALLOW** Zn	1
(b) (i)	$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$	**ALLOW** multiples and fractions **IGNORE** state symbols even if incorrect	1
(ii)	(squeaky) pop with lighted splint/lit with a (Bunsen) flame	**IGNORE** just 'burns with a squeaky pop' **REJECT** use of glowing splint	1
(c) (i)	displacement	**ACCEPT** redox /oxidation **and** reduction	1
(ii)	pink-brown /pink (solid)	**ACCEPT** pink / brown / orange alone or in combinations eg orange-brown **ALLOW** red-brown **REJECT** red **IGNORE** copper	1
(d)	iron is less reactive/lower in the reactivity series (than magnesium) ORA	**IGNORE** just 'iron is not reactive enough' with no comparison	1
			Total 8

Question number	Answer	Notes	Marks
3 (a)	**Type of bonding** **Type of structure** (X) covalent simple molecular (Y) **M1** covalent **M2** giant (covalent) (Z) **M3** ionic **M4** giant (ionic) <u>lattice</u>	 **ALLOW** giant molecular /giant covalent lattice **ACCEPT** macromolecular **ALLOW** (ionic) lattice **IGNORE** 'giant' alone	4
(b)	An explanation that links the following points **M1** (X has) weak intermolecular forces / weak forces between molecules **M2** (so) little energy needed to overcome the forces/separate the molecules / the forces require little energy to break	 **ALLOW** weak intermolecular bonds / weak bonds between molecules **IGNORE** less energy **REJECT** any reference to weak covalent bonds or covalent bonds being broken or ionic bonds for both marks. **REJECT** intermolecular forces between atoms/bonds for both marks	2
			Total 6

Question number	Answer	Notes	Marks
4 (a) (i)	Any two from **M1** same general formula **M2** same functional group **M3** each member differs from the next by CH_2 **M4** similar chemical properties / (chemical) reactions **M5** trend/change/increase in physical properties	**IGNORE** references to a specific homologous series **ALLOW** same chemical properties / (chemical) reactions **ACCEPT** named physical property e.g. trend in boiling points **REJECT** same / similar physical properties	2
(ii)	 **M1** two shared pairs of electrons between two carbon atoms **M2** shared pair of electrons between each hydrogen and the carbon it is bonded to	**ACCEPT** any combination of dots and crosses **ACCEPT** with or without shells drawn **IGNORE** inner shells on carbon atoms **REJECT** if non-bonding electrons shown on carbon **REJECT** if non-bonding electrons shown on hydrogen	2
(b) (i)	There are twice as many hydrogen atoms as carbon atoms (in every alkene) OWTTE	**ACCEPT** general formula is C_nH_{2n} **ACCEPT** it is the lowest whole number ratio of atoms in alkenes	1
(ii)	**M1**  **M2** 	**ALLOW** methyl group to be shown as $-CH_3$ rather than fully displayed **IGNORE** brackets and n **REJECT** structure without extension bonds	2

Question number	Answer	Notes	Marks
4 (c) (i)	**M1** (molecular formula) C_4H_6		2
	M2 (empirical formula) C_2H_3		
(ii)	An explanation that links the following three points		3
	M1 made up of carbon/C and hydrogen/H (atoms)	**REJECT** carbon and hydrogen molecules in **M1**	
	M2 only	**M2** dep on mention of just carbon and hydrogen in **M1**	
	M3 contains (two) C=C / (carbon-carbon) double bonds	**ALLOW** contains a (carbon-carbon) double bond	
(iii)	A description that refers to the following two points		2
	M1 add bromine water	**REJECT** add bromine for **M1**	
	M2 (bromine water) decolourised / turns (from orange/yellow to) colourless	**M2** dep on reference to bromine in **M1** **IGNORE** incorrect initial colour **REJECT** if reference to uv being needed for reaction to take place	
			Total 14

Question number	Answer	Notes	Marks
5 (a) (i)	Any two from: **M1** effervescence/fizzing/bubbles **M2** lithium becomes smaller/disappears **M3** moves (across the surface)	 **IGNORE** hydrogen / gas formed **ALLOW** lithium dissolves **IGNORE** melts / forms a ball / flame	2
(ii)	**M1** (solution turns) yellow **M2** (solution is) an alkali/alkaline	 **ACCEPT** lithium hydroxide / hydroxide ions / OH^- ions formed **ALLOW** basic	2
(b)	A description that refers to the following five points **M1** flame test **M2** red (flame) **M3** add (dilute hydrochloric) acid **M4** (pass/bubble) gas/carbon dioxide into limewater **M5** (limewater) turns cloudy/milky / white ppt forms	 **ACCEPT** description of flame test **IGNORE** 'burning' **ACCEPT** crimson **REJECT** brick-red **ACCEPT** nitric or sulfuric acid **REJECT** if additional incorrect reagent given eg silver nitrate **M4** dep on acid in **M3** **M5** dep on use of limewater No **M4** or **M5** if limewater added directly to the solution	5
(c)	**M1** <u>electrostatic</u> attraction **M2** between oppositely charged ions	 **ACCEPT** between anions/negative ions and cations/positive ions **REJECT** implication of covalent bonding for M2	2
			Total 11

Question number	Answer	Notes	Marks
6 (a) (i)	$Pb(NO_3)_2(aq) + 2KCl(aq) \rightarrow PbCl_2(s) + 2KNO_3(aq)$	**ALLOW** upper case letters for state symbols	1
(ii)	Pb^{2+} **and** NO_3^-		1
(iii)	**M1** 207 + (14 + 16 × 3) × 2	Correct answer without working scores	2
	M2 331	**ALLOW** ECF on **M1** if other multiples of atomic masses <u>added together</u> eg 207 + 14 + (16 x 3) = 269 for 1 mark **REJECT** use of atomic numbers for both marks	
(b) (i)	all points plotted correctly to the nearest grid line		1
(ii)	point at 2.9 cm/6.0 cm^3 circled	**ALLOW** ecf from incorrect plotting	1
(iii)	**M1** best fit straight line through first four points ignoring the anomalous point		2
	M2 horizontal straight line through last three points	**ALLOW** max (1) if lines do not cross or meet, or if a smooth curve is drawn, avoiding the anomalous point	
(iv)	Any two from		2
	M1 precipitate not allowed to settle	**ACCEPT** height measured too soon	
	M2 height (of precipitate) measured incorrectly eg reference to parallax when measuring height		
	M3 more than 2 cm^3 (of lead(II) nitrate) added / (total volume of lead(II) nitrate added was) more than 6 cm^3	**ALLOW** too much lead(II) nitrate added	
(v)	no precipitate as no lead(II) nitrate added OWTTE		1
(vi)	value read from graph where lines cross	no mark if lines do not cross/meet or if there aren't two lines eg a curve is drawn	1
			Total 12

Question number	Answer	Notes	Marks
7 (a)	**M1** (number of protons) 53 **M2** (number of neutrons) (127 − 53 =) 74		2
(b)	**M1** 79 × 52.8 + 81 × 47.2 **OR** 7994.4 **M2** 7994.4 ÷ 100 **OR** 79.944 **M3** 79.9	correct answer without working scores 3 79.944 without working scores 2 **M3** dep on use of 79 & 81 in calculation	3
(c)	**M1** (amount of $AlCl_3$ =) 26.7 ÷ 133.5 **OR** 0.2(00) (mol) **M2** (amount of Cl_2 =) $\frac{0.2(00) \times 3}{2}$ **OR** 0.3(00) (mol) **M3** (mass of Cl_2 =) 0.3(00) × 71 = 21.3 (g) OR **M1** 213g of Cl_2 produces 267g of $AlCl_3$ **M2** (mass of Cl_2 =) $\frac{26.7}{267}$ × 213 **M3** = 21.3 (g)	correct answer without working scores 3 **ALLOW** ECF on **M1**, as long as an attempt has been made to find moles **ALLOW** ECF on **M2** **ALLOW** any number of sig figs except 1	3

(d)	An explanation which links six of the following points Pair 1 **M1** no reaction / no change (in colour) / stays yellow or orange **M2** bromine cannot displace chlorine / bromine does not react with chloride ions <u>to produce chlorine</u> **M3** therefore chlorine is more reactive than bromine Pair 2 **M4** turns brown **M5** bromine displaces iodine / bromine reacts with iodide ions <u>to produce iodine</u> **M6** therefore bromine is more reactive than iodine **M7** the overall order of reactivity is chlorine > bromine > iodine ORA	 **ACCEPT** it stays any stated colour Penalise incorrect use of -**ine** and -**ide** **ACCEPT** $Br_2 + KCl \rightarrow Br_2 + KCl$ or ionic equation **ACCEPT** "bromine cannot displace chlorine because it is less reactive" OWTTE for **M2** and **M3** **ACCEPT** combinations that include brown eg red-brown Penalise incorrect use of -**ine** and -**ide** **ACCEPT** $Br_2 + 2KI \rightarrow I_2 + 2KBr$ or ionic equation **ACCEPT** "bromine displaces iodine because it is more reactive" OWTTE for **M5** and **M6** **IGNORE** references to reactivity up/down the group	6
			Total 14

Question number	Answer	Notes	Marks
8 (a) (i)	to allow the heat (energy) to be distributed evenly (throughout the water) OWTTE	**ACCEPT** so the temperature is the same (throughout the water)	1
(ii)	to avoid some of the liquid/fuel/pentanol evaporating OWTTE		1
(b)	<table><tr><td>Initial temperature of water in °C</td><td>15.9</td></tr><tr><td>Final temperature of water in °C</td><td>50.9</td></tr><tr><td>Temperature change in °C</td><td>35.0</td></tr></table>	PENALISE answer not to nearest 0.1 °C once only **ALLOW** ecf on initial temperature Correct values transposed scores (1)	2
(c) (i)	**M1** (Q =) 100 × 4.2 × 35 (J) **M2** 14 700 (J)	Correct answer of 14 700 without working scores 2 **ALLOW** 15 000 (J) only if **M1** is scored	2
(ii)	**M1** (mass of pentanol =) 90.11 − 89.75 **OR** 0.36 (g) **M2** (amount of pentanol =) 0.36 ÷ 88 **OR** 0.0041 (mol) **M3** 14 700 ÷ 0.0041 **OR** 3 600 000 (J/mol) **M4** 3 600 000 ÷ 1000 **OR** 3600 (kJ/mol) **M5** (ΔH =) − 3600 (kJ/mol)	Correct answer without working scores 5 **ALLOW** ecf on incorrect mass **REJECT** 0.004 (which gives final answer of −3675) **ALLOW** ecf as long as there has been an attempt to calculate moles of pentanol **ALLOW** any SF except 1 SF	5
(d)	$C_5H_{11}OH + 7.5O_2 \rightarrow 5CO_2 + 6H_2O$ **M1** all formulae correct **M2** balancing of correct formulae	**ALLOW** multiples **M2** dep on **M1** **IGNORE** state symbols even if incorrect	2
			Total 13

Question number	Answer	Notes	Marks
9 (a) (i)	**B** 4 A is incorrect as there are not 3 different elements in $Na_2SO_4.7H_2O$ C is incorrect as there are not 5 different elements in $Na_2SO_4.7H_2O$ D is incorrect as there are not 10 different elements in $Na_2SO_4.7H_2O$		1
(ii)	**D** 28 A is incorrect as there is not a total of 10 atoms in $Na_2SO_4.7H_2O$ B is incorrect as there is not a total of 22 atoms in $Na_2SO_4.7H_2O$ C is incorrect as there is not a total of 27 atoms in $Na_2SO_4.7H_2O$		1
(b) (i)	A description that refers to the following two points **M1** heat the sodium sulfate (again) **M2** (repeat) until there is no further change in mass	 **ACCEPT** 'heat to constant mass' for both marks	2
(ii)	An explanation that links the following two points **M1** to cool the (water) vapour **M2** so it condenses / forms liquid/water	 **ACCEPT** steam	2
(iii)	A description that refers to the following two points **M1** heat (the water) / measure the boiling point **M2** (if it) boils at 100 ºC (it is pure water) / boiling point is 100 °C	 **ALLOW** find the freezing point /melting point? **REJECT** evaporate **ALLOW** freezes/ melts at 0ºC **IGNORE** chemical test even if incorrect	2

(c)	**M1** mass of Na_2SO_4 (= 19.38 – 15.83) = 3.55 (g) **M2** mass of H_2O (= 23.88 – 19.38) = 4.50 (g) **M3** amount of Na_2SO_4 (= 3.55 ÷ 142) = 0.025 (mol) **M4** amount of H_2O (= 4.50 ÷ 18) = 0.25 (mol) **M5** x (= 0.25 ÷ 0.025) = 10 OR **M1** mass of Na_2SO_4 (= 19.38 – 15.83) = 3.55 (g) **M2** mass of H_2O (= 23.88 – 19.38) = 4.50 (g) **M3** mass of water combined with 1 mole of sodium sulfate = $\frac{142}{3.55} \times 4.50 = 180$ (g) **M4** moles of H_2O = 180 ÷ 18 **M5** therefore, x = 10	Correct answer without working scores 5 **ALLOW** ECF from incorrect **M1** **ALLOW** ECF from incorrect **M2** **ALLOW** an integer ECF on **M3** & **M4** **ACCEPT** alternative correct methods	5
			Total 13

Question number	Answer	Notes	Marks
10 (a) (i)	**M1** 0.0036 moles of HCl react with 0.0018 moles of Zn **M2** mass of Zn that reacts is 0.0018 x 65 = 0.117 (g) (which is less than 1.3 g, so zinc is in excess) ***OR*** **M1** moles of zinc that can react with 0.0036 moles of HCl = 0.0036 / 2 = 0.0018 (mol) **M2** moles of Zn present = 1.3 ÷ 65 = 0.02 (mol) (which is more than 0.0018, so zinc is in excess) ***OR*** **M1** amount of zinc = 1.3 ÷ 65 = 0.02 (mol) **M2** amount of HCl that can react = 2 x 0.02 = 0.04 (mol) (which is greater than 0.0036, so zinc is in excess)	ALLOW 0.234 g is less than 1.3g, so zinc in excess for (1)	2
(ii)	**M1** curve starting at origin and steeper than curve A **M2** curve levelling off at same volume as curve A /at 40 cm^3		2
(b) (i)	An explanation that links any of the following four points **M1** curve B is less steep (than curve A) **M2** (because) the particles have less <u>kinetic</u> energy **M3** so there are fewer successful collisions per unit time/less frequent successful collisions **M4** so rate of reaction is slower / reaction takes longer to complete **M5** no change in reacting quantities, so final volume is unchanged	**ALLOW** particles move more slowly **ACCEPT** less frequent collisions that exceed activation energy **ACCEPT** reverse argument throughout	4

(ii)	An explanation that links two of the following points **M1** only half the moles (of hydrochloric acid) used / (hydrochloric acid) concentration is halved **M2** (so) only half the volume/20 cm^3 of hydrogen/gas produced **M3** hydrochloric acid is less concentrated so curve is less steep	If M1 and M2 are not scored, allow (1) mark for the idea that less HCl produces less hydrogen	2
(c)	A description that refers to the following two points **M1** (a catalyst) provides an alternative pathway/route **M2** with a lower activation energy	**IGNORE** general statements about catalysts increasing rate / not being used up	2
			Total 12

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