Mark Scheme (Results)

Summer 2023

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

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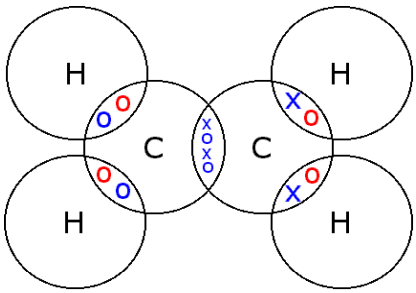
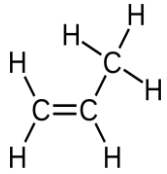
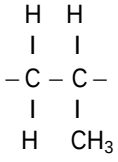
General Marking Guidance

- 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)	 ALLOW giant molecular /giant covalent lattice ACCEPT macromolecular	4
	(Z) M3 ionic M4 giant (ionic) <u>lattice</u>	ALLOW (ionic) lattice IGNORE 'giant' alone	
(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:		2
	M1 effervescence/fizzing/bubbles	IGNORE hydrogen / gas formed	
	M2 lithium becomes smaller/disappears	ALLOW lithium dissolves	
	M3 moves (across the surface)	IGNORE melts / forms a ball / flame	
(ii)	M1 (solution turns) yellow		2
	M2 (solution is) an alkali/alkaline	ACCEPT lithium hydroxide / hydroxide ions / OH^- ions formed ALLOW basic	
(b)	A description that refers to the following five points		5
	M1 flame test	ACCEPT description of flame test IGNORE 'burning'	
	M2 red (flame)	ACCEPT crimson REJECT brick-red	
	M3 add (dilute hydrochloric) acid	ACCEPT nitric or sulfuric acid REJECT if additional incorrect reagent given eg silver nitrate	
	M4 (pass/bubble) gas/carbon dioxide into limewater	M4 dep on acid in M3	
	M5 (limewater) turns cloudy/milky / white ppt forms	M5 dep on use of limewater No M4 or M5 if limewater added directly to the solution	
(c)	M1 <u>electrostatic</u> attraction		2
	M2 between oppositely charged ions	ACCEPT between anions/negative ions and cations/positive ions REJECT implication of covalent bonding for M2	
			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 $207 + (14 + 16 \times 3) \times 2$	Correct answer without working scores	2
	M2 331	ALLOW ECF on M1 if other multiples of atomic masses added together 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 =) $\frac{26.7}{267} \times 213$ 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 °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 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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