Mark Scheme (Results)

January 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.

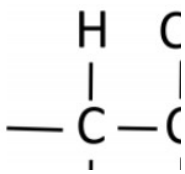
Question number	Answer	Notes	Marks
1 (a) (i)	particles should be close together and should fill from the bottom of the box, most particles should touch with a minimum of 2 random rows of particles	ALLOW particles filling the whole box IGNORE the size of the particles REJECT a regular arrangement	1
(ii)	solid		1
(b)	solid to liquid melting solid to gas sublimation	 ALLOW subliming	2
(c)	An explanation that links the two points. M1 (particles / molecules have) more (kinetic) energy M2 can overcome / break the (intermolecular) forces/forces (between water molecules)	ALLOW hot water has more (kinetic) energy ALLOW (particles / molecules) move faster IGNORE vibrate more ALLOW can overcome / break the bonds (between water molecules) OR to break away from one another OR to escape more easily IGNORE references to collisions, activation energy or rate of reaction	2
			Total for question = 6

Question number	Answer	Notes	Marks
2 (a)	**B** (Cl_2) A is not the correct answer as the symbol O is for atoms of oxygen not molecules C is not the correct answer as HCl is a compound D is not the correct answer as H_2O is a compound		1
(b)	**C** (filtration) A is not the correct answer as crystallisation is not used to separate an insoluble solid from a liquid B is not the correct answer as evaporation will not separate an insoluble solid from a liquid D is not the correct answer as simple distillation is used to separate a solvent from a solution		1
(c)	fractional distillation	REJECT distillation REJECT simple distillation	1
(d) (i)	**D** ($X(s) \rightarrow X(aq)$) A is not the correct answer as (l) is not the correct final state symbol B is not the correct answer as (g) Is not the final state symbol C is not the correct answer as the state symbols are the wrong way round		1
(ii)	**C** (diffusion) A is not the correct answer as boiling does not occur in the beaker B is not the correct answer as condensing does not occur in the beaker D is not the correct answer as sublimation does not occur in the beaker		1
(iii)	M1 potassium / K^+ M2 sulfate / SO_4^{2-}	potassium sulfate scores 2 K_2SO_4 scores 2 KSO_4 alone scores 1 ALLOW in either order If name correct ignore incorrect formula	2
			Total for question = 7

Question number	Answer	Notes	Marks
3 (a) (i)	argon / Ar		1
(ii)	**C** (nitrogen) A is not correct because nitrogen is more abundant than carbon dioxide methane or oxygen B is not correct because nitrogen is more abundant than methane D is not correct because nitrogen is more abundant than oxygen		1
(b) (i)	(hydrated) iron (III) oxide	REJECT other oxidation states ALLOW Fe_2O_3 IGNORE iron oxide	1
(ii)	(neon) has a full outer shell (of electrons)	ALLOW (neon) is unreactive / inert /has 8 electrons in the outer shell ALLOW (neon) does not lose or gain (or share) electrons	1
(iii)	M1 75 – 30 **OR** 45 (mm) M2 (45 ÷ 75 × 100) = 60(%)	ALLOW ecf from M1 correct answer of 60% without working scores 2 answer of 40% without working scores 1	2
		Total for question = 6	

Question number	Answer	Notes	Marks
4 (a)	M1 baseline has been drawn in ink M2 and will therefore interfere with / contaminate the results M3 the water level is above A/the baseline M4 and therefore A will mix with/dissolve in the water	ALLOW baseline is not drawn in pencil ALLOW will move up the paper / will get mixed up with A / will produce other colours /affect results / will smudge /ink is soluble ALLOW water level is too high / A is under water ALLOW A will wash off the paper IGNORE references to lid	4
(b) (i)	M1 one spot about ¼ of the way between the baseline and the top of the paper / solvent front and one spot about ½ way M2 the lower spot labelled yellow and the higher spot labelled blue	ALLOW answers that show solvent front	2
(ii)	the blue food colouring/it is more soluble (in water) ORA as long as yellow food colouring is referred to	IGNORE blue colour/it travels further up the paper	1
			Total for question = 7

Question number	Answer	Notes	Marks
5 (a) (i)	copper	ALLOW Cu REJECT copper(II) /Cu^{2+}	1
(ii)	magnesium cannot displace itself	ALLOW magnesium does not react with magnesium sulfate /magnesium ions /Mg^{2+} IGNORE magnesium does not react with magnesium /itself	1
(b) (i)	magnesium /Mg aluminium /Al X copper /Cu	ALLOW 1 mark if aluminium and X are swapped. If copper(II) instead of copper 1 mark only	2
(ii)	zinc / iron	ALLOW all other valid answers	1
(c)	An explanation that links the two points M1 magnesium /Mg (is the reducing agent) M2 magnesium /Mg donates electrons (causing Al^{3+} ions to be reduced)	ALLOW magnesium / Mg gives (away) / loses electrons (causing Al^{3+} to be reduced) /Al^{3+} gains electrons No M2 if reference to aluminium/Al instead of aluminium ions/Al^{3+} IGNORE Mg is oxidised M2 dep on M1	2
			Total for question = 7 marks

Question number	Answer	Notes	Marks
6 (a)	**B** (chloroethene) A is not correct as the monomer has a double bond C is not correct as the monomer has two carbons D is not correct as the monomer has two carbons		1
(b)		Extension bonds do not need to go through the brackets	1
(c)	M1 (M_r of chloroethene) = 62.5 M2 2490000 ÷ 62.5 = 39 840		2
(d)	A discussion which refers to any 4 of the following points M1 polymers/poly(propene) will remain in landfill indefinitely OWTTE M2 (as they) are inert /unreactive/do not biodegrade/do not decompose M3 burning produces greenhouse gases / CO_2 M4 reference to climate change /global warming M5 burning produces toxic gases	ALLOW reference to running out of landfill sites OWTTE ALLOW carbon monoxide /CO /hydrogen chloride/HCl Max 3 if any reference to the ozone layer	4
(e)	M1 1:1:3 / 31 800 ÷ 10 600 M2 $CHCl_3$	ALLOW other evidence of working ALLOW the atoms in any order Answer of $CHCl_3$ without working scores 2	2
			Total for question = 10

Question number			Answer	Notes	Marks
7	(a)		X contains oxygen /OH	ALLOW hydrocarbons only contain hydrogen and carbon (atoms) REJECT oxygen molecules or hydrogen and carbon molecules	1
	(b)		W		1
	(c)		V		1
	(d)		$CH_2{=}CHCH_2CH_3$	ALLOW $CH_2CHCH_2CH_3$	1
	(e)		M1 same molecular formula M2 different displayed / structural formulae	ALLOW same numbers of C and H atoms ALLOW different arrangement of atoms	2
	(f)	(i)	$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$ M1 C_4H_9Br as product M2 rest of the equation correct	 ALLOW polysubstitution M2 dep on M1	2
		(ii)	**C** (substitution) A is not the correct answer because alkanes do not undergo addition reactions B is not the correct answer as this is not a combustion reaction D is not the correct answer as this reaction is not thermal decomposition		1
	(g)		A description that refers to any 3 from M1 nitrogen and oxygen (from air) M2 react at the high temperatures (in a car engine) M3 forming oxides of nitrogen M4 which react with/dissolve in water forming nitric acid /HNO_3 /acid rain	 REJECT mention of petrol contains nitrogen for M1 only M2 dep on mention of nitrogen and oxygen ALLOW NO_x or named oxides of nitrogen M4 dep on M3	3
					Total for question = 12

Question number			Answer	Notes	Marks
8	(a)	(i)	M1 NaCl M2 $MgCl_2$ M3 Mg_3N_2	Penalise once only for incorrect case or superscript numbers ALLOW symbols reversed e.g. N_2Mg_3 ALLOW correct charges on ions e.g $Mg^{2+}(Cl^-)_2$	3
		(ii)	magnesium oxide	Spelling must be correct	1
		(iii)	83	IGNORE units	1
	(b)	(i)	M1 lithium changes (from 2.1) to 2 M2 oxygen changes (from 2.6) to 2.8	ALLOW (two) lithium (atoms) lose one electron ALLOW oxygen (atom) gains two electrons No marks if mention of sharing electrons	2
		(ii)	An explanation that links the three points M1 strong (electrostatic) forces of attraction M2 between oppositely charged ions M3 which require a lot of energy to break	ALLOW strong ionic bonds IGNORE more energy 0 marks if any mention of covalent bonds, intermolecular forces or molecules	3
					Total for question = 10

Question number	Answer	Notes	Marks
9 (a)	M1 (electrostatic) attraction between nuclei M2 and shared pair(s) of electrons OR M1 (electrostatic) attraction between shared pair(s) of electrons M2 and nuclei	must be plural must be plural	2
(b)	An explanation that links any 3 from M1 the boiling points increase (down the group/from F to Br) M2 because the intermolecular forces get stronger M3 as (molecular) mass / size / number of electrons /(electron) shells increases M4 so more energy needed to separate the molecules/break the intermolecular forces	No M2, M3 or M4 if any mention of breaking covalent/ionic bonds	3
(c)	An explanation that links any five from M1 the structure is in layers M2 there are weak forces between the layers (of atoms) M3 which can slide (over one another making it soft) M4 each carbon / atom makes three covalent bonds M5 (one) delocalised electron (per carbon / atom) M6 (delocalised) electrons flow / move / are mobile (to conduct electricity)	 ALLOW sheets /rows REJECT intermolecular forces/molecules/ions REJECT ionic bonds REJECT molecules/ions	5
			Total for question = 10

Question number			Answer	Notes	Marks
10	(a)	(i)	measuring cylinder	ALLOW burette / pipette /syringe REJECT gas syringe	1
	(b)	(i)	M1 Q = m × c × ΔT M2 ΔT = 2880 ÷ (50 × 4.2) M3 ΔT = 13.7(1) °C M4 (maximum temp = 13.7(1) + 21.(0) =) 34.7 (°C)	 M2 subsumes M1 ALLOW ecf from M3 ALLOW any number of sig fig except 1 in M3 and M4 Correct answer without working scores 4	4
	(b)	(ii)	thermal energy/heat lost (to the atmosphere / surroundings)	IGNORE energy lost	1
	(b)	(iii)	M1 2880 ÷ 1000 OR 2.880 kJ M2 2.880 ÷ 0.05(00) M3 -57.6kJ/mol OR M1 2880 ÷ 0.05(00) OR 57 600J M2 57 600 ÷ 1000 M3 -57.6 kJ/mol	 ALLOW ecf from M1 ALLOW any number of sig fig except 1 in M3 ALLOW ecf from M1 ALLOW any number of sig fig except 1 in M3 Correct answer without working scores 3	3
					Total for question = 9

Question number	Answer	Notes	Marks
11 (a) (i)	M1 so all the nitric acid reacts/is neutralised AND M2 therefore the solution only contains magnesium nitrate OR M3 if acid is still present it will contaminate the crystals OWTTE	ALLOW so the excess magnesium can be removed by filtration	2
(ii)	M1 moles of Mg that reacts = 0.0250 ÷ 2 **OR** 0.0125 M2 mass of Mg that reacts = 0.0125 x 24 **OR** 0.3 (g) M3 mass of Mg remaining = 0.45 (g) OR M1 moles of Mg = 0.0250 ÷ 2 **OR** 0.0125 M2 moles of Mg remaining = 0.75 ÷ 24 – 0.0125 **OR** 0.03125 – 0.0125 **OR** 0.01875 M3 mass of Mg remaining (= 0.01875 x 24) = 0.45 (g)	ALLOW M1 × 24 ALLOW 0.75 - M2 ALLOW 0.03125 – M1 ALLOW M2 x 24 Correct answer without working scores 3 0.15 (g) scores 2	3
(iii)	M1 filter off the excess magnesium M2 heat the solution until crystals first start to 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

(b)	M1 tangent drawn (at 40 s) M2 change in volume of hydrogen ÷ change in time M3 correct answer between 2.75 and 3.75 (cm^3/s) inclusive	If no tangent drawn allow 1 mark for 240 ÷ 40 = 6 (cm^3/s)	3
			Total for question = 13

Question number			Answer	Notes	Marks
12	(a)	(i)	to make sure all the water is given off/evaporates	ALLOW to make sure the reaction is complete	1
		(ii)	5.2(0 g)		1
		(iii)	0.9(0 g)		1
		(iv)	M1 moles of $BaCl_2$= 5.2 ÷ 208 OR 0.025 M2 moles of H_2O = 0.9 ÷ 18 OR 0.05(0) M3 0.05(0) ÷ 0.025 = 2	ALLOW ecf from (ii) ALLOW ecf from (iii) ALLOW ecf from M1 and M2 as long as the answer is an integer Correct answer without working scores 3	3
	(b)		M1 (measure the) boiling point M2 100°C	ALLOW freezing point ALLOW 0°C for freezing point	2
	(c)	(i)	reversible	ALLOW the reaction goes in both directions IGNORE equilibrium	1
		(ii)	M1 add water to anhydrous copper sulfate M2 which turns (from white) to blue	ALLOW white copper sulfate M2 dep on mention of anhydrous/white copper sulfate Max 1 mark if incorrect starting colour	2
		(iii)	M1 moles of water = 0.02 x 5 **OR** 0.1 M2 molecules of water = 6×10^{22}	ALLOW ecf from M1 Correct answer without working scores 2 1.2×10^{22} scores 1	2
					Total for question = 13

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