



Mark Scheme (Results)

November 2020

Pearson Edexcel International GCSE
In Chemistry (4CH1) Paper 2CR

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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)	M1 A test tube / boiling tube M2 B evaporating basin M3 C measuring cylinder M4 D (top-pan) balance	ALLOW evaporating dish/crystallising dish ALLOW (weighing) scale(s) ALLOW weighing machine	4 Grad
(b)	C A is incorrect as a test tube cannot measure a volume of liquid B is incorrect as an evaporating basin cannot measure a volume of liquid D is incorrect as a balance measures mass not volume		1 Comp
			Total 5

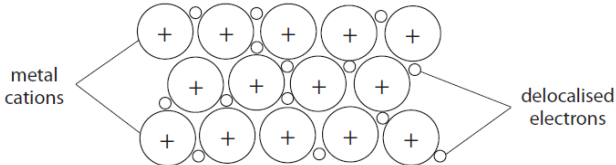
Question number	Answer	Notes	Marks
2 (a)	A 3 B is incorrect as there are not 6 electrons in the outer shell of a thallium atom C is incorrect as there are not 13 electrons in the outer shell of a thallium atom D is incorrect as 81 is the total number of electrons in a thallium atom not the number in the outer shell		1 Comp
(b)	B 78 A is incorrect as there are not 3 electrons in a thallium ion C is incorrect as 81 is the number of electrons in a thallium atom not a thallium ion D is incorrect as there are not 84 electrons in a thallium ion		1 Comp

Question number	Answer	Notes	Marks
2 (c) (i)	M1 (number of protons) 81 M2 (number of neutrons) 124	ACCEPT eighty-one ACCEPT one hundred and twenty-four	2 Cl
(ii)	- calculate sum of mass numbers multiplied by percentage abundances - divide answer by 100 - give answer to one decimal place Example calculation M1 $(203 \times 30.8) + (205 \times 69.2)$ OR 20438.4 M2 $20438.4 \div 100$ OR 204.384 M3 204.4	ACCEPT 4, 5 or 6 sig fig ACCEPT 5 or 6 sig fig $(203 \times 0.308) + (205 \times 0.692)$ OR 204.384 with or without working scores M1 and M2 Correct answer to 1 d.p. with or without working scores 3 marks	3 Exp
			Total 7

Question number	Answer	Notes	Marks
3 (a)	(i) M1 (bitumen) (surfacing) roads/(surfacing) roofs M2 (gasoline) petrol / fuel for cars/vehicles	ALLOW other suitable uses ALLOW other suitable uses e.g. fuel for cooking	2 Exp
	(ii) An explanation that links the following two points M1 column is cooler near the top than at the bottom ORA M2 gasoline has a lower boiling point than bitumen (so is collected nearer the top) ORA	ACCEPT column cool near the top and hot at the bottom ACCEPT temperature decreases up the column ORA ACCEPT gasoline has a low boiling point (so is collected near the top) and bitumen has a high boiling point (so is collected near the bottom)	2 Exp
(b)	(i) M1 alumina/silica (catalyst) M2 600 – 700 (°C)	ACCEPT Al ₂ O ₃ / SiO ₂ /aluminium oxide /silicon dioxide /aluminosilicate(s) /zeolite(s) ACCEPT range or any value within the range ACCEPT correct temperatures in other units	2 Exp
	(ii) $C_{12}H_{26} \rightarrow C_7H_{16} + C_2H_4 + C_3H_6$ M1 C ₂ H ₄ M2 C ₃ H ₆	ACCEPT answers in either order	2 Exp
			Total 8

Question number	Answer	Notes	Marks
4 (a)	Any two of the following observations. M1 (sodium) floats/moves on surface (of water) M2 (sodium) melts/forms a ball M3 (sodium) gets smaller/disappears M4 (sodium forms) white trail	ALLOW dissolves IGNORE references to flame/heat released /temperature increases IGNORE fizzing /effervescence	2 Exp
(b) (i)	$2\text{Li} + \text{F}_2 \rightarrow 2\text{LiF}$	ALLOW multiples or fractions IGNORE state symbols even if incorrect	1 Exp
(ii)	M1 flame test M2 red (flame)	ALLOW description of flame test ALLOW crimson /scarlet REJECT orange-red/ brick red	2 Exp
(iii)	M1 correct electron arrangement of lithium ion  lithium ion $\text{Li}^+ [2]^+$ M2 correct electron arrangement of fluoride ion  fluoride ion $\text{F}^- [2,8]^-$ M3 correct charges on both ions (with or without brackets)	ACCEPT any combination of dots and crosses IGNORE empty second shell Inner electron shell required to score M2 M3 not dep on M1 and M2 correct	3 Exp

Question number	Answer	Notes	Marks
4 (c)	An explanation that links three of the following four points M1 the outer electron is further from the nucleus in potassium / potassium has more shells/ potassium has larger atomic radius ORA M2 there is more shielding (by the inner shells) in potassium ORA M3 there is less attraction between the outer electron and the nucleus in potassium ORA M4 (so outer) electron (in potassium) more easily lost ORA	ALLOW potassium atom is bigger than a sodium atom outer electron needs to be mentioned at least once in the answer for full marks Max 2 if no mention of outer electron in the answer	3 Exp Total 11

Question number	Answer	Notes	Marks
5 (a) (i)	A labelled diagram showing M1 at least three rows of at least three cations/atoms in a regular arrangement M2 surrounded by (delocalised) electrons Example of diagram 	Max 1 if no labels Minimum requirement for 2 marks is + signs on atoms and electrons labelled or shown as e⁻	2 Exp
(ii)	An explanation that links the following two points M1 delocalised electrons M2 flow/are mobile/move/are free to move	IGNORE free electrons/ sea of electrons M2 dep on mention of electrons Any mention of ions/atoms moving scores 0	2 Exp
(b)	Any two of the following properties M1 low density M2 does not react with drink M3 malleable	ALLOW lightweight IGNORE light IGNORE less dense ALLOW does not corrode/non-toxic IGNORE does not rust ALLOW easy to bend/ easy to shape IGNORE references to cost IGNORE can be recycled IGNORE any irrelevant properties e.g. high melting/boiling point/ good conductor/ductile	2 Exp

Question number	Answer	Notes	Marks
5 (c) (i)	aluminium/it is more reactive/higher in the reactivity series than carbon ORA	ALLOW aluminium is too reactive/too high in the reactivity series	1 Grad
(ii)	electrons are gained (by aluminium ion/ Al^{3+})	ACCEPT oxidation state of aluminium/Al is decreased/ changes from +3 to 0 REJECT aluminium/Al gains electrons IGNORE references to loss of oxygen	1 Exp
(iii)	$2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^{(-)}$ M1 correct formulae of products M2 balancing of correct formulae	ACCEPT multiples and fractions M2 dep on M1	2 Exp
			Total 10

Question number	Answer	Notes	Marks
6 (a) (i)	pipette		1 Cl
(b) (i)	M1 (colour in NaOH) pink M2 (colour in HCl) colourless/no colour	ACCEPT magenta ALLOW red IGNORE clear 1 mark for two correct colours in the wrong order	2 Grad
(ii)	There is no clear (colour change at the) end point/ difficult to determine which shade of green is pH 7 OWTTE	ALLOW it has a range of colours	1 Exp

Question number	Answer	Notes	Marks
6 (c) (i)	A description that makes reference to the following two points M1 add 21.5 cm ³ of hydrochloric acid M2 to 25 cm ³ of sodium hydroxide solution	0 marks if mention of adding indicator ALLOW repeat the titration without indicator for 1 mark ALLOW the following alternative method M1 add activated charcoal (to absorb the indicator) M2 filter (to remove the activated charcoal and indicator) M2 dep on M1	2 Exp

(ii)	A description that makes reference to the following four points M1 heat the solution to evaporate some of the water/ to form a saturated solution/ to crystallisation point M2 leave the solution to cool /leave the solution for (more) crystals to form M3 filter off the crystals M4 suitable method of drying the crystals	Max 1 mark if solution evaporated to dryness If solution left to partially evaporate without heating only M3 and M4 can be awarded IGNORE references to washing e.g. dry between filter papers/dry in a warm oven/ leave to dry REJECT hot oven or direct heating with Bunsen burner No M4 if crystals are washed after drying	4 Exp
6 (d)	- calculate the amount, in moles, of NaOH - divide amount in moles by volume in dm³ - evaluation to obtain correct answer	correct answer without working scores 3 marks	3 Exp
	Example calculation M1 $n(\text{NaOH}) = 0.0250 \times 0.800$ or $0.02(00)$ M2 $\text{conc} = (0.02 \div 0.0215)$ M3 0.930	answer to M1 $\div 0.0215$ ALLOW any number of sig fig except 1	
		ALLOW ecf on M2	
			Total 13

Question number	Answer	Notes	Marks
7 (a) (i)	sulfuric acid	IGNORE references to concentration ALLOW H ₂ SO ₄ REJECT sulfurous acid	1 Grad
(ii)	D orange to green A is incorrect as the solution is not colourless at the start of the reaction B is incorrect as the solution is not green at the start or orange at the end of the reaction C is incorrect as the solution is not colourless at the end of the reaction		1 Comp
(b) (i)	- show the expression for the sum of the bond energies for the breaking of bonds - evaluation to give answer in kJ Example calculation M1 $\sum \text{C-C} + 5\text{C-H} + \text{C-O} + \text{O-H} + 3\text{O=O}$ OR $\sum 346 + (5 \times 412) + 358 + 463 + (3 \times 496)$ M2 4715 (kJ)	correct answer without working scores 2 - 1 mark for each error	2 Exp
(ii)	- show the expression for the sum of the bond energies for the forming of bonds - evaluation to give answer in kJ Example calculation M1 $\sum 4\text{C=O} + 6\text{O-H}$ OR $\sum (4 \times 743) + (6 \times 463)$ M2 5750 (kJ)	correct answer without working scores 2 - 1 mark for each error IGNORE any signs in (i) and (ii)	2 Exp
(iii)	(4715 – 5750 =) – 1035 (kJ/mol)	minus sign must be included ACCEPT – 1040 (kJ/mol) ALLOW ecf on answers to (i) and (ii) If answers to (i) and (ii) are reversed allow max 3 and ecf on (iii)	1 Exp

Question number	Answer	Notes	Marks
7 (c) (i)	ethyl methanoate	ALLOW ethyl formate ALLOW words written without gap	1 Grad
(ii)	M1 ester linkage $\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{O}- \end{array}$ M2 rest of molecule correct $\begin{array}{ccccccc} & \text{O} & & \text{H} & & \text{H} & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{O} & - \text{C} & - & \text{C} & - \text{H} \\ & & & & & & \\ & & & \text{H} & & \text{H} & \end{array}$ Structural formula of ethyl formate or ethyl methanoate	M2 dep on M1	2 Exp
(iii)	M1 forward and reverse reactions occur at the same rate OWTTE M2 concentrations of reactants and products remain constant		2 Exp
(d)	- calculate amount in moles of HCOOH - use equation to find amount in moles of CO₂ - multiply amount in moles of CO₂ by molar volume - evaluation of answer in cm³ Example calculation M1 $n(\text{HCOOH}) = 2.3 \div 46$ or $0.05(0)$ M2 $n(\text{CO}_2) = 0.05(0) \div 2$ or 0.025 M3 (volume of CO₂) = 0.025×24 or 0.025×24000 M4 600 (cm³)	correct answer without working scores 4 No ecf from M1 and M2 if mass or M_r multiplied by 24 /24000 ALLOW ecf from M3 0.6, 1200 and 2400 score 3 1.2 and 2.4 score 2	4 Exp

			Total 16
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