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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.

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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**

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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 x 30.8) + (205 x 69.2) **OR** 20438.4 **M2** 20438.4 ÷ 100 **OR** 204.384 **M3** 204.4	 **ACCEPT** 4, 5 or 6 sig fig **ACCEPT** 5 or 6 sig fig (203 x 0.308) + (205 x 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**

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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_2O_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)	$C_{12}H_{26}$ --> C_7H_{16} + C_2H_4 + C_3H_6 **M1** C_2H_4 **M2** C_3H_6	**ACCEPT** answers in either order	2 Exp
			Total 8

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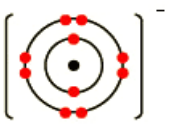
Question number	Answer	Notes	Marks
4 (a)	Any two of the following observations. **M1** (sodium) floats/moves on surface (of water) **M2** (sodium) melts/forms a ball **M3** (sodium) gets smaller/disappears **M4** (sodium forms) white trail	 **ALLOW** dissolves **IGNORE** references to flame/heat released /temperature increases **IGNORE** fizzing /effervescence	2 Exp
(b) (i)	$2Li + F_2 \rightarrow 2LiF$	**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 Li^+ $[2]^+$ **M2** correct electron arrangement of fluoride ion  fluoride ion 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

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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**

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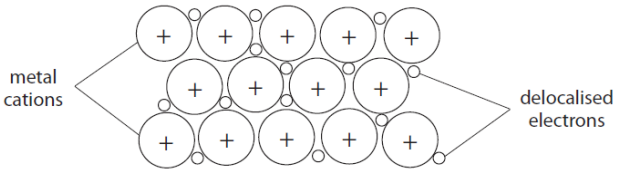
Question number	Answer	Notes	Marks
5 (a) (i)	A labelled diagram showing **M1** at least three rows of at least three cations/atoms in a regular arrangement **M2** surrounded by (delocalised) electrons Example of diagram  	Max 1 if no labels Minimum requirement for 2 marks is + signs on atoms and electrons 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

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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)	$2O^{2-} \rightarrow O_2 + 4e^{(-)}$ **M1** correct formulae of products **M2** balancing of correct formulae	**ACCEPT** multiples and fractions **M2** dep on **M1**	2 Exp **Total 10**

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Question number	Answer	Notes	Marks
6 (a) (i)	pipette		1 CI
(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

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(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*(NaOH) = 0.0250 x 0.800 or 0.02(00) **M2** conc = (0.02 ÷ 0.0215) **M3** 0.930	 answer to **M1** ÷ 0.0215 **ALLOW** any number of sig fig except 1	
		ALLOW ecf on **M2**	
			Total 13

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Question number	Answer	Notes	Marks
7 (a) (i)	sulfuric acid	**IGNORE** references to concentration **ALLOW** H_2SO_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** ∑ C-C + 5C-H + C-O + O-H + 3O=O **OR** ∑ 346 + (5 x 412) + 358 + 463 + (3 x 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** ∑ 4C=O + 6O-H **OR** ∑ (4 x 743) + (6 x 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

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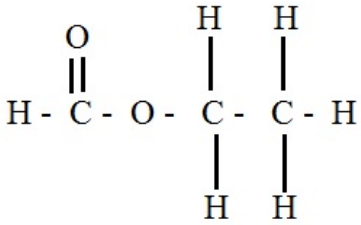
Question number	Answer	Notes	Marks
7 (c) (i)	ethyl methanoate	**ALLOW** ethyl formate **ALLOW** words written without gap	1 Grad
(ii)	**M1** ester linkage O || −C−O− **M2** rest of molecule correct  Structural formula of ethyl formate or ethyl methanoate	**M2** dep on **M1**	2 Exp
(iii)	**M1** forward 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 CO_2 • multiply amount in moles of CO_2 by molar volume • evaluation of answer in cm^3 Example calculation **M1** n(HCOOH) = 2.3 ÷ 46 **or** 0.05(0) **M2** $n(CO_2)$ = 0.05(0) ÷ 2 **or** 0.025 **M3** (volume of CO_2) = 0.025 x 24 **or** 0.025 x 24000 **M4** 600 (cm^3)	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

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			Total 16

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