Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 2C

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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.

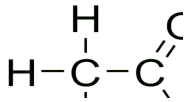
Question number	Answer	Notes	Marks
1 (a) (i)	argon	**ALLOW** Ar	1
(ii)	nitrogen	**ALLOW** N_2/N	1
(iii)	hydrogen	**ALLOW** H_2/H	1
(b)	climate change/global warming /oceans becoming more acidic	**ALLOW** greenhouse effect **ALLOW** effects of global warming e.g. melting of polar ice caps/flooding/wild fires **IGNORE** acid rain **REJECT** references to ozone layer	1
(c)	**M1** bubble/pass/add the gas/carbon dioxide into limewater **M2** (limewater) turns cloudy/milky	 **ALLOW** white precipitate **M2** dep on mention of limewater **REJECT** addition of extra reagents for both marks	2
			Total 6

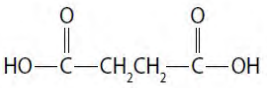
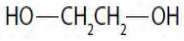
Question number	Answer	Notes	Marks
2 (a) (i)	**M1** (X) measuring cylinder **M2** (Y) pipette	 **ALLOW** graduated pipette	2
(ii)	(volume measurement with Y is) more precise ORA	**ALLOW** (volume measurement with Y is) more accurate ORA **ALLOW** (Y gives) a (more) exact volume /exactly 25 cm^3	1
(b) (i)	yellow		1
(ii)	there is no clear end point/ colour change is gradual (at the end point)/no sharp colour change OWTTE	**ALLOW** it has a range of colours	1
(c)	**M1** moles of $HNO_3 = \frac{21.5 \times 0.6(00)}{1000}$ **OR** 0.0129 **M2** moles of $Ba(OH)_2 = 0.0129 \div 2$ **OR** 0.00645 **M3** conc. of $Ba(OH)_2 = \frac{0.00645 \times 1000}{25} = 0.258$ (mol/dm^3)	correct answer with or without working scores 3 **ALLOW** ecf on **M2** **ACCEPT** alternative methods 0.516 scores 2 1.032 scores 2 **ALLOW** 2 sig figs correctly rounded throughout Penalise rounding to 1 sig fig once only	3
(d)	barium sulfate is insoluble /does not dissolve /forms a precipitate		1
			Total 9

Question number	Answer	Notes	Marks
3 (a)	**C** fluorine A is incorrect as astatine is black B is incorrect as bromine is brown D is incorrect as iodine is dark grey		1
(b)	**A** astatine B is incorrect as bromine is a liquid C is incorrect as chlorine is a gas D is incorrect as fluorine is a gas		1
(c)	An explanation that links the following four points **M1** fluorine is more reactive than chlorine ORA **M2** the outer shell is closer to the nucleus in fluorine / fluorine has fewer shells / fluorine has a smaller atomic radius ORA **M3** there is a stronger attraction to the nucleus for an electron in fluorine ORA **M4** so fluorine accepts an electron more readily ORA	 **ALLOW** reactivity decreases down the group ORA **ALLOW** a fluorine atom is smaller than a chlorine atom ORA **ALLOW** there is less shielding in fluorine ORA	4
(d) (i)	$2Li + Cl_2 \rightarrow 2LiCl$	**ALLOW** multiples or fractions **IGNORE** state symbols even if incorrect **ACCEPT** $2Li^+Cl^-$ **REJECT** any charges on Li or Cl_2	1

(ii)	A description that refers to the following five points Test for lithium ions **M1** flame test **M2** red (flame) Test for chloride ions **M3** add nitric acid **M4** add silver nitrate (solution) **M5** white precipitate	 **ACCEPT** description of flame test **ALLOW** crimson/scarlet **REJECT** brick red/orange red **M2** dep on **M1** **REJECT** incorrect acid e.g. HCl or H_2SO_4 for **M3** only **ALLOW** acidified silver nitrate for **M3** and **M4** **M5** dep on addition of silver nitrate	5
			Total 12

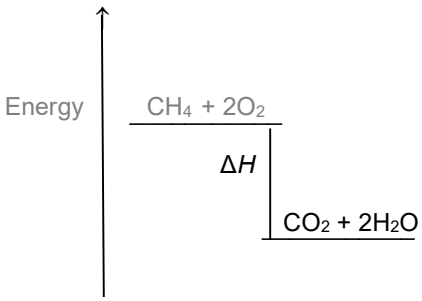
Question number	Answer	Notes	Marks
4 (a)	**M1** bright/white light **OR** bright/white flame **M2** white powder/solid/ash	 **ALLOW** white smoke **ALLOW** grey powder /solid/ash **REJECT** white precipitate	2
(b)	A description that refers to the following two points **M1** magnesium/Mg loses two electrons/becomes 2.8 **M2** oxygen/O gains two electrons/becomes 2.8	 **ACCEPT** magnesium gives two electrons to oxygen for **M1** and **M2** Both marks can be scored from diagrams showing correct electronic configurations of the ions.	2
(c) (i)	magnesium is more reactive/higher in the reactivity series (than carbon)/magnesium is a better reducing agent (than carbon) ORA	**ALLOW** carbon cannot displace magnesium	1
(ii)	An explanation that links the following four points **M1** (magnesium) has delocalised electrons **M2** electrons can move **M3** (magnesium chloride) can only conduct when molten/in solution **OR** (magnesium chloride) cannot conduct when solid **M4** ions are free to move	 **REJECT** reference to ions or atoms moving for **M2** ions are free to move when (magnesium chloride) is molten/in solution scores **M3** and **M4** **REJECT** reference to electrons moving for **M4**	4
(d) (i)	magnesium ions/ Mg^{2+} gains electrons	**ALLOW** electrons are gained **REJECT** magnesium /Mg gains electrons **REJECT** reference to loss or gain of oxygen	1
(ii)	$2Cl^- \rightarrow Cl_2 + 2e^{(-)}$	**ALLOW** $2Cl^- - 2e^{(-)} \rightarrow Cl_2$ **ALLOW** multiples or fractions **IGNORE** state symbols even if incorrect	1
			Total 11

Question number	Answer	Notes	Marks
5 (a) (i)	**M1** $\frac{40.0}{12}$ $\frac{6.7}{1}$ $\frac{53.3}{16}$	0 marks for division by atomic numbers or upside-down calculation	2
	M2 3.33 6.7 3.33 **AND** 1 2 1	**ALLOW** any number of sig figs except 1 **ACCEPT** alternative methods	
(ii)	CH_3COOH **OR** 	**ACCEPT** $HCOOCH_3$ **OR** 	1
(b) (i)	$2HCOOH + Na_2CO_3 \rightarrow 2HCOONa + CO_2 + H_2O$		2
	M1 $CO_2 + H_2O$	**IGNORE** numbers in front of CO_2 and/or H_2O if only **M1** scored	
	M2 HCOONa **and** equation correctly balanced	**REJECT** NaCOOH **ALLOW** NaHCOO	
(ii)	bubbles/ fizzing/ effervescence	**IGNORE** gas given off **ALLOW** sodium carbonate disappears/dissolves	1
(c) (i)	propyl methanoate	spelling must be correct **ALLOW** propyl formate	1
(ii)	reversible reaction	**ALLOW** reaction which goes both ways **IGNORE** equilibrium	1

	(iii)	forward and backward reactions occur at the same rate OWTTE **OR** concentrations of reactants and products remain constant/stay the same/do not change	 **ALLOW** amounts/moles/ratios of reactants and products remain constant **REJECT** concentrations of reactants and products are equal/the same	1
(d)	(i)	condensation (polymerisation)		1
	(ii)	**M1**  **M2** 	**ALLOW** $HOOCCH_2CH_2COOH$ for **M1** **ALLOW** $HOCH_2CH_2OH$ for **M2** **REJECT** OH—C once only	2
				Total 12

Question number	Answer	Notes	Marks
6 (a)		correct answer with or without working scores 4	4
	M1 (moles of TiO_2 =) $\frac{20 \times 10^6}{80}$ **OR** 2.5×10^5 (mol)	**ACCEPT** 250 000 (mol)	
	M2 (moles of Cl_2 =) 2.5×10^5 x 2 **OR** 5.0×10^5 (mol)	**ACCEPT** 500 000 (mol)	
	M3 (vol of Cl_2 =) $5.0 \times 10^5 \times 24$ **OR** 12 000 000 (dm^3)		
	M4 1.2×10^7 (dm^3)	**ALLOW** ecf on **M2** and **M3** 6 x 10^6 scores 3 3 x 10^6 scores 3 6 000 000 scores 2 3 000 000 scores 2 2.083 x 10^4 scores 3	
(b)	An explanation that links the following two points **M1** argon is unreactive/inert **M2** (so argon) will not react with/oxidise the magnesium **OR** oxygen (in air) will react with/oxidise the magnesium	**ALLOW** argon will not react with/oxidise titanium **OR** oxygen (in air) will react with/oxidise the titanium	2
(c)	An explanation that links the following three points **M1** in pure titanium all atoms are the same size **OR** layers/atoms can slide over each other (making it soft /malleable) **M2** the alloy has atoms of different sizes **M3** (which disrupts the structure so that) atoms/layers do not/harder to slide over each other (making it stronger) OWTTE	all marks can be awarded from labelled diagrams **ALLOW** cations/ions /particles in place of atoms throughout **REJECT** mention of molecules once only	3
			Total 9

Question number	Answer	Notes	Marks
7 (a)	carbon	**ALLOW** soot **ALLOW** copper(II) oxide /copper oxide/CuO **REJECT** copper(I) oxide	1
(b)	**M1** (amount of ethanol) = 0.92 ÷ 46 **OR** 0.02(0) (mol) **M2** (−)18.2 ÷ 0.02(0) = (−)910 (kJ/mol)	 **ALLOW** alternative methods	2
(c)	Any 2 from **M1** heat (energy)/ thermal energy was lost (to the surroundings/apparatus) **M2** incomplete combustion (of ethanol) **M3** the ethanol was impure/ethanol evaporates		2
(d) (i)	 **M1** ∑ bonds broken = 4 x C–H + 2 x 498 **M2** ∑ bonds formed = 2 x 805 + 4 x 463 **OR** 3462 **M3** 4 x C–H + 996 − 3462 = − 890 **M4** C–H = 1576 ÷ 4 = 394 (kJ/mol)	correct answer with or without working scores 4 **ALLOW** 2 x 498 **OR** 996 seen **ALLOW** ecf throughout 839 without working scores 3 616.5/617 without working scores 3	4

(ii)	 **M1** horizontal line to show products in correct position and correctly labelled **M2** vertical line in correct position and labelled ΔH/− 890 (kJ/mol)	**ACCEPT** double headed arrow or arrow pointing from reactants level to products level **REJECT** arrow pointing from products level to reactants level **IGNORE** any attempts at including activation energy If endothermic reaction shown **M2** can be awarded for correct arrow/line labelled ΔH/+890 (kJ/mol)	2
			Total 11

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