



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.

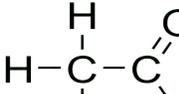
Question number	Answer	Notes	Marks
1 (a) (i)	argon	ALLOW Ar	1
(ii)	nitrogen	ALLOW N ₂ /N	1
(iii)	hydrogen	ALLOW H ₂ /H	1
(b)	climate change/global warming /oceans becoming more acidic	ALLOW greenhouse effect ALLOW effects of global warming e.g. melting of polar ice caps/flooding/wild fires IGNORE acid 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 ÷ 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)	<p>C fluorine</p> <p>A is incorrect as astatine is black B is incorrect as bromine is brown D is incorrect as iodine is dark grey</p>		1
(b)	<p>A astatine</p> <p>B is incorrect as bromine is a liquid C is incorrect as chlorine is a gas D is incorrect as fluorine is a gas</p>		1
(c)	<p>An explanation that links the following four points</p> <p>M1 fluorine is more reactive than chlorine ORA</p> <p>M2 the outer shell is closer to the nucleus in fluorine / fluorine has fewer shells / fluorine has a smaller atomic radius ORA</p> <p>M3 there is a stronger attraction to the nucleus for an electron in fluorine ORA</p> <p>M4 so fluorine accepts an electron more readily ORA</p>	<p>ALLOW reactivity decreases down the group ORA</p> <p>ALLOW a fluorine atom is smaller than a chlorine atom ORA</p> <p>ALLOW there is less shielding in fluorine ORA</p>	4
(d) (i)	$2\text{Li} + \text{Cl}_2 \rightarrow 2\text{LiCl}$	<p>ALLOW multiples or fractions</p> <p>IGNORE state symbols even if incorrect</p> <p>ACCEPT $2\text{Li}^+\text{Cl}^-$</p> <p>REJECT any charges on Li or Cl_2</p>	1

(ii)	<p>A description that refers to the following five points</p> <p>Test for lithium ions</p> <p>M1 flame test</p> <p>M2 red (flame)</p> <p>Test for chloride ions</p> <p>M3 add nitric acid</p> <p>M4 add silver nitrate (solution)</p> <p>M5 white precipitate</p>	<p>ACCEPT description of flame test</p> <p>ALLOW crimson/scarlet</p> <p>REJECT brick red/orange red</p> <p>M2 dep on M1</p> <p>REJECT incorrect acid e.g. HCl or H₂SO₄ for M3 only</p> <p>ALLOW acidified silver nitrate for M3 and M4</p> <p>M5 dep on addition of silver nitrate</p>	5
			Total 12

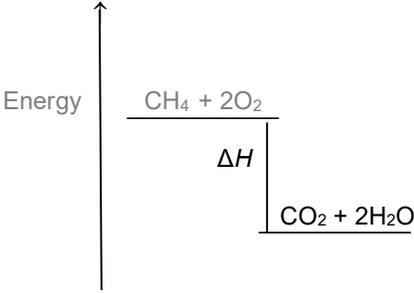
Question number	Answer	Notes	Marks
4 (a)	M1 bright/white light OR bright/white flame M2 white powder/solid/ash	ALLOW white smoke ALLOW grey powder /solid/ash REJECT white precipitate	2
(b)	A description that refers to the following two points M1 magnesium/Mg loses two electrons/becomes 2.8 M2 oxygen/O 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)	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^{(-)}$	ALLOW $2\text{Cl}^- - 2\text{e}^{(-)} \rightarrow \text{Cl}_2$ ALLOW multiples or fractions IGNORE state symbols even if incorrect	1
			Total 11

Question number	Answer	Notes	Marks
5 (a) (i)	<p>M1 $\frac{40.0}{12}$ $\frac{6.7}{1}$ $\frac{53.3}{16}$</p> <p>M2 3.33 6.7 3.33</p> <p>AND 1 2 1</p>	<p>0 marks for division by atomic numbers or upside-down calculation</p> <p>ALLOW any number of sig figs except 1</p> <p>ACCEPT alternative methods</p>	2
(ii)	<p>CH₃COOH</p> <p>OR</p> 	<p>ACCEPT HCOOCH₃</p> <p>OR</p> 	1
(b) (i)	<p>2HCOOH + Na₂CO₃ → 2HCOONa + CO₂ + H₂O</p> <p>M1 CO₂ + H₂O</p> <p>M2 HCOONa and equation correctly balanced</p>	<p>IGNORE numbers in front of CO₂ and/or H₂O if only M1 scored</p> <p>REJECT NaCOOH</p> <p>ALLOW NaHCOO</p>	2
(ii)	bubbles/ fizzing/ effervescence	<p>IGNORE gas given off</p> <p>ALLOW sodium carbonate disappears/dissolves</p>	1
(c) (i)	propyl methanoate	<p>spelling must be correct</p> <p>ALLOW propyl formate</p>	1
(ii)	reversible reaction	<p>ALLOW reaction which goes both ways</p> <p>IGNORE equilibrium</p>	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		1		
(d)	(i)	condensation (polymerisation)		1		
	(ii)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">M1 $\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ </td> <td style="width: 50%; padding: 5px;">M2 $\text{HO}-\text{CH}_2\text{CH}_2-\text{OH}$ </td> </tr> </table>	M1 $\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$	M2 $\text{HO}-\text{CH}_2\text{CH}_2-\text{OH}$	ALLOW $\text{HOOCCH}_2\text{CH}_2\text{COOH}$ for M1 ALLOW $\text{HOCH}_2\text{CH}_2\text{OH}$ for M2 REJECT $\text{OH}-\text{C}$ once only	2
M1 $\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$	M2 $\text{HO}-\text{CH}_2\text{CH}_2-\text{OH}$					
				Total 12		

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

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

(ii)	 <p data-bbox="365 583 893 640">M1 horizontal line to show products in correct position and correctly labelled</p> <p data-bbox="365 672 909 730">M2 vertical line in correct position and labelled $\Delta H / -890$ (kJ/mol)</p>	<p data-bbox="995 672 1266 787">ACCEPT double headed arrow or arrow pointing from reactants level to products level</p> <p data-bbox="995 819 1258 903">REJECT arrow pointing from products level to reactants level</p> <p data-bbox="995 934 1274 1018">IGNORE any attempts at including activation energy</p> <p data-bbox="995 1050 1266 1192">If endothermic reaction shown M2 can be awarded for correct arrow/line labelled $\Delta H / +890$ (kJ/mol)</p>	2
			Total 11

