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Mark Scheme (Results)

Summer 2023

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.

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Question number	Answer	Notes	Marks
1 (a) (i)	silicon	**ALLOW** Si	1
(ii)	magnesium	**ALLOW** Mg	1
(iii)	bromine	**ALLOW** mercury / Hg **ALLOW** Br / Br_2 **REJECT** bromide / Br^-	1
(iv)	2,8,5 / 2.8.5	**ACCEPT** diagram showing electron configuration	1
(v)	Na_2S	**ALLOW** $Na^+{}_2S^{2-}$	1
(b)	An explanation that links the following two points **M1** full outer shell / 8 electrons in outer shell / (electron configuration) 2.8 **M2** (so) does not need to lose or gain (or share) electrons / $e^{(-)}$		2
			Total 7

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Question number	Answer	Notes	Marks
2 (a)	**B** (carbon dioxide) A is incorrect as there is more argon in the atmosphere than carbon dioxide C is incorrect as there is more nitrogen in the atmosphere than carbon dioxide D is incorrect as there is more oxygen in the atmosphere than carbon dioxide		1
(b) (i)	**B** (decomposition) A is incorrect as this is not an addition reaction C is incorrect as this is not an oxidation reaction D is incorrect as this is not a substitution reaction		1
(ii)	**C** (green to black) A is incorrect as copper(II) carbonate is not blue B is incorrect as copper(II) carbonate is not blue and copper(II) oxide is not orange D is incorrect as copper(II) oxide is not orange		1
(iii)	$CuCO_3 \rightarrow CuO + CO_2$	**ALLOW** multiples **IGNORE** state symbols even if incorrect	1
(c)	**M1** (volume of oxygen =) 100 – 27 **OR** 73 (cm^3) **M2** (volume of air at start =) 280 + 100 **OR** 380 (cm^3) **M3** 73 ÷ 380 × 100 **OR** 19.2 (%) **M4** 19 (%)	correct answer with or without working scores 4 **ALLOW** ECF throughout Use of 280 gives an answer of 26 scores 3 Alternative method **M1** (volume of air left=) 280 + 27 **OR** 307 (cm^3) **M2** 307 ÷ 380 x 100 **OR** 80.8 (%) **M3** 100 – 80.8 **OR** 19.2 **M4** 19 (%)	4

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(d)	An explanation that links two of the following three points **M1** carbon dioxide is a greenhouse gas **AND** **M2** (that causes) climate change / global warming / global temperature rise **OR** **M3** melting of polar icecaps / flooding / wildfires / sea levels rising	 **ACCEPT** description of greenhouse effect e.g. carbon dioxide traps heat / infra-red rays in the atmosphere **ALLOW** oceans becoming more acidic / less basic /pH decreasing **REJECT** reference to the ozone layer for **M2** or **M3** **IGNORE** reference to acid rain	2
			Total 10

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<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>3 (a)</td><td>$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

M1 both formulae correct

M2 balancing of correct formulae</td><td>**ACCEPT** CH_3CH_2OH

M2 dep on **M1** but if C_2H_6O given no **M1** but allow **M2** for correct balancing

IGNORE state symbols even if incorrect

ALLOW multiples and fractions</td><td>2</td></tr>
<tr><td>(b) (i)</td><td><table><tr><th></th><th>Hydration</th><th>Fermentation</th></tr><tr><td>Reagents</td><td>ethene and steam</td><td>aqueous glucose</td></tr><tr><td>Catalyst</td><td>phosphoric acid</td><td>enzymes in yeast</td></tr><tr><td>Temperature in ^oC</td><td>300</td><td>30</td></tr><tr><td>Pressure in atmospheres</td><td>60 – 70</td><td>1</td></tr></table></td><td>**ACCEPT** H_3PO_4
If formula alone must be correct, but if name given and formula incorrect ignore formula

ALLOW sulphuric acid / H_2SO_4

ACCEPT any temperature between 20 and 40 inclusive

ACCEPT any pressure between 60 and 70 inclusive</td><td>3</td></tr>
</table>

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(ii)	An explanation that links one advantage and one disadvantage advantage: **M1** uses low(er) pressure / atmospheric pressure / 1 atm **M2** so less energy needed / less costly equipment / safer **OR** **M1** uses low(er) temperature **M2** so less energy / heat needed **OR** **M1** glucose /sugar cane is a natural resource /is renewable **M2** whereas ethene obtained from crude oil /ethene is non-renewable / ethene is a finite resource **OR** **M1** yeast is a natural resource **M2** whereas phosphoric acid is a manufactured catalyst disadvantage: **M3** fermentation is slow(er) **M4** fermentation is less efficient /so hydration is more efficient **OR** **M3** ethanol is impure **M4** so ethanol needs to be purified ORA **OR** **M3** growing sugar cane takes up land **M4** that can be used to grow food crops	**IGNORE** cheaper /less costly alone **IGNORE** cheaper /less costly **ALLOW** **M3** fermentation is a batch process **M4** whereas hydration is a continuous process (so more efficient) **IGNORE** reference to yield	

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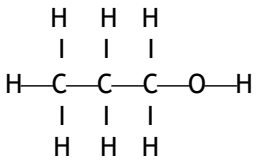
(c)		An explanation that links the following two points **M1** oxygen would oxidise / react with ethanol / alcohol **M2** which would produce ethanoic acid / CH_3COOH **OR** **M1** fermentation needs to be anaerobic **M2** so ethanol / alcohol will be formed / otherwise only carbon dioxide and water would form	 **ALLOW** acetic acid / vinegar **IGNORE** carboxylic acid	
(d)	(i)	**M1** $\frac{60.0}{12}$ $\frac{13.3}{1}$ $\frac{26.7}{16}$ **M2** 5.0 13.3 1.67 **M3** $\frac{5.0}{1.67}$ $\frac{13.3}{1.67}$ $\frac{1.67}{1.67}$ **OR** 2.99 7.96 1	0 marks for division by atomic numbers or upside-down calculation **ALLOW** any number of sig figs except 1 apart from 5 in **M2** and **M3** **ACCEPT** alternative methods	3
	(ii)		Bond between O and H must be shown **ACCEPT** structure of propan-2-ol	1
				Total 15

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Question number	Answer	Notes	Marks
4 (a)	pipette		1
(b)	**M1** (colour in potassium hydroxide) yellow **M2** (colour in sulfuric acid) red	 **ALLOW** pink	2
(c)	to see the colour (change more) clearly (at the end-point) OWTTE		1
(d)	to mix the solutions (more thoroughly) OWTTE	**ALLOW** to speed up the reaction between the acid and alkali OWTTE	1
(e)	titres/results within (+ or −) 0.2 (cm^3 of each other)	**ALLOW** within 0.1 **REJECT** > 0.2 or < 0.1	1
(f)	**M1** $n(H_2SO_4)$ = 0.0150 × 0.180 **or** 0.0027(0) (mol) **M2** n(KOH) = 0.0027(0) × 2 **or** 0.0054(0) (mol) **M3** conc^n = (0.0054(0) ÷ 0.0250) = 0.216 (mol/dm^3)	correct answer with or without working scores 3 answer to **M1** × 2 answer to **M2** ÷ 0.0250 **ALLOW** any number of sig figs except 1 common answers: 0.108 and 0.054 scores 2	3
(g)	An explanation that links the following two points **M1** an H^+ ion is a proton **M2** the OH^- (ion) reacts / bonds with the H^+ (ion) (to form water)	 **ALLOW** donates a proton / H^+ (ion) to the OH^- **IGNORE** accepts a proton	2
			Total 11

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Question number	Answer	Notes	Marks
5 (a)	**M1** add sodium hydroxide (to the copper(II) sulfate solution) **M2** blue precipitate (forms) **OR** **M1** flame test **M2** blue-green (flame)	**ALLOW** potassium hydroxide or aqueous ammonia No **M1** if any incorrect reagent added **IGNORE** qualifiers e.g. pale / dark etc. **M2** dep on addition of a correct alkali **ACCEPT** description of flame test **ALLOW** green **M2** dep on flame	2
(b)	An description that refers to any three from **M1** copper ions are positively charged / cations / Cu^{2+} (ions) **M2** and are attracted to / travel to the negative electrode / cathode **M3** where they accept electrons **M4** and become (copper) <u>atoms</u>	 **ALLOW M1** and **M3** for a fully correct half equation i.e. $Cu^{2+} + 2e \rightarrow Cu$	3
(c)	pink solid / deposit / coating / metal	**ACCEPT** pink-brown / orange-brown / brown / orange / red-brown **REJECT** red **REJECT** precipitate	1
(d) (i)	relights a glowing splint		1
(ii)	$2H_2O \rightarrow 4H^+ + O_2 + 4e^{(-)}$ **M1** $O_2 + e^{(-)}$ **M2** equation fully correct	$4OH^- \rightarrow 2H_2O + O_2 + 4e^{(-)}$ scores 1 **IGNORE** state symbols even if incorrect **IGNORE** any numbers in front of $O_2 + e^{(-)}$ and any other species	2
(iii)	electrons are lost	**ALLOW** H_2O / water loses electrons	1
			Total 10

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Question number	Answer	Notes	Marks
6 (a) (i)	sulfuric acid / H_2SO_4	**ACCEPT** hydrochloric acid / HCl and nitric acid / HNO_3 / phosphoric acid / H_3PO_4	1
(ii)	distinctive / sweet / fruity smell	**ACCEPT** an oily layer forms (on the surface)	1
(iii)	methyl ethanoate	spelling must be correct	1
(b) (i)	C—O and O—H		1
(ii)	An explanation that links the following two points **M1** the same (two) bonds / C—O and O—H are broken and formed **M2** energy needed to break bonds equals energy released when bonds form (so overall enthalpy change is 0)	**ALLOW** ecf if wrong bonds in (i) **IGNORE** the same number of bonds are broken and formed	2
			Total 6

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Question number	Answer	Notes	Marks
7 (a)	reduces the capacity of blood to transport oxygen round the body OWTTE	**ALLOW** carbon monoxide /it binds with haemoglobin	1
(b)	An explanation that links the following two points **M1** no effect **M2** as increases rate of forward reaction and rate of backward reaction **equally**	 **M2** dep on **M1** or missing	2
(c) (i)	An explanation that links the following two points **M1** yield decreases **M2** as (forward) reaction is endothermic (so equilibrium shifts to the LHS / reactants side)	 **ALLOW** backward /reverse reaction is exothermic **M2** dep on **M1** or missing **IGNORE** references to Le Chatelier	2
(ii)	An explanation that links the following two points **M1** yield increases **M2** as there are fewer moles / molecules (of gas) on the left-hand side / there are 2 mol on LHS and 4 mol on RHS (so equilibrium shifts to the RHS / products side) ORA	 **M2** dep on **M1** or missing **IGNORE** references to Le Chatelier	2
(d)	 **M1** $n(H_2) = 6.6 \times 10^6 \div 2$ **OR** 3.3×10^6 (mol) **M2** $n(CH_4) = 3.3 \times 10^6 \div 3$ **OR** 1.1×10^6 (mol) **M3** vol(CH_4) = $1.1 \times 10^6 \times 24$ **OR** 26 400 000 (dm^3) **M4** 2.6×10^7	correct answer with or without working scores 4 **ACCEPT** 3 300 000 **ACCEPT** 1 100 000 **M2** × 24 **ACCEPT** 2.64×10^7 **ALLOW** ECF throughout common answers: $7.9(2) \times 10^7$ scores 3 5.28×10^7 scores 3 1.584×10^8 scores 2	4
			Total 11

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