Mark Scheme (Results)

Summer 2023

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

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2023
Question Paper Log Number P71952A
Publications Code 4CH1_2C_2306_MS

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)	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

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

(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

<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

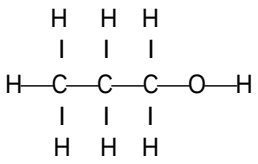
ALLOW multiples and fractions</td><td>2</td></tr>
<tr><td>(b) (i)</td><td><table><tr><th></th><th>Hydration</th><th>Fermentation</th></tr><tr><td>Reagents</td><td>ethene and steam</td><td>aqueous glucose</td></tr><tr><td>Catalyst</td><td>phosphoric acid</td><td>enzymes in yeast</td></tr><tr><td>Temperature 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>

(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	4

(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	2
(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

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

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

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

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

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom