



Mark Scheme (Results)

January 2022

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

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General Marking Guidance

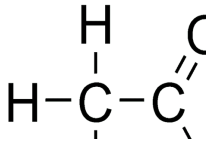
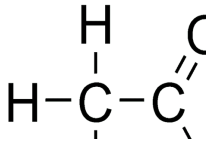
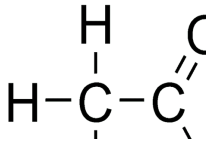
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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.

Question number	Answer	Notes	Marks
1 (a)	M1 oxygen M2 water / water vapour	ALLOW air ALLOW moisture ALLOW answers in either order	2
(b) (i)	iodine		1
(ii)	methane		1
(iii)	gold		1
			Total 5

Question number	Answer	Notes	Marks
2 (a)	M1 heated M2 fractionating M3 boiling point(s)	ALLOW boiled IGNORE vapourised/evaporated ACCEPT fractional distillation ACCEPT boiling temperature(s) IGNORE melting point(s)/low density	3
(b)	road surfacing / roofing	ALLOW roads	1
(c) (i)	pentane		1
(ii)	$(M_r = 5 \times 12 + 12 \times 1 =) 72$		1

Question number	Answer	Notes	Marks
2 (d)	<p>M1 alumina / silica</p> <p>M2 any temperature in the range 600 - 700 °C inclusive</p>	<p>ACCEPT aluminium oxide / silicon dioxide / Al₂O₃ / SiO₂ / zeolite(s) / aluminosilicate(s)</p>	2
(e)	<p>(C₁₀H₂₂ → C₄H₁₀) + C₂H₄ + C₄H₈</p> <p>M1 C₂H₄</p> <p>M2 C₄H₈</p>	<p>alkenes can be in either order</p> <p>ALLOW 1 mark for C₆H₁₂ / 2C₃H₆ / C₃H₆ + C₃H₆</p> <p>ALLOW correct displayed formulae</p>	2
			Total 10

Question number	Answer	Notes	Marks
3 (a)	<p>A description that includes six of the following points</p> <p>M1 use the pipette to add (25 cm³ of) potassium hydroxide (solution) to the (conical) flask</p> <p>M2 add a few drops of methyl orange (to the flask)</p> <p>M3 add sulfuric acid to the burette and record the initial burette reading</p> <p>M4 add sulfuric acid (from the burette) to the flask, swirling (continuously)</p> <p>M5 until the (methyl orange) indicator turns red/orange</p> <p>M6 take the final burette reading and find volume of acid added (by finding difference between initial and final burette readings)</p> <p>M7 repeat (the titration) adding the acid dropwise near the end-point / repeat (the titration) to obtain concordant results</p>	<p>ALLOW fill burette with sulfuric acid to "0" mark</p> <p>ALLOW shaking (gently) / stirring</p> <p>ALLOW take final burette reading only if previously filled burette to "0" mark</p> <p>ACCEPT repeat (the titration) to obtain results within 0.2 cm³ of each other</p>	6
(b) (i)	<p>M1 0.0250×0.240 OR $\frac{25.0 \times 0.240}{1000}$</p> <p>M2 0.006(00)</p>	<p>correct answer without working scores 2</p> <p>If no division by 1000 giving an answer of 6 award 1 mark</p>	2
(ii)	(0.006 ÷ 2 =) 0.003	ALLOW ECF from (i)	1
(iii)	<p>M1 $\frac{0.003(00) \times 1000}{15.00}$</p> <p>M2 0.2(00)</p>	<p>ALLOW ECF from (ii)</p> <p>correct answer without working scores 2</p> <p>answer to (ii) ÷ 15.00 scores 1</p> <p>do not penalise not multiplying by 1000 in (iii) if they have not divided by 1000 in (i)</p>	2
Total 11			

Question number	Answer	Notes	Marks								
4 (a)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; padding: 5px;">structural formula</td> <td style="padding: 5px;">CH_3COOH</td> </tr> <tr> <td style="padding: 5px;">name</td> <td style="padding: 5px;">ethanoic acid</td> </tr> <tr> <td style="padding: 5px;">empirical formula</td> <td style="padding: 5px;">CH_2O</td> </tr> <tr> <td style="padding: 5px;">displayed formula</td> <td style="padding: 5px; text-align: center;">  </td> </tr> </table>	structural formula	CH_3COOH	name	ethanoic acid	empirical formula	CH_2O	displayed formula		<p>1 mark for each correct answer</p> <p>ALLOW acetic acid</p> <p>Must show O-H bond</p>	3
structural formula	CH_3COOH										
name	ethanoic acid										
empirical formula	CH_2O										
displayed formula											
(b) (i)	<p>M1 potassium dichromate(VI)</p> <p>M2 (dilute) sulfuric acid</p>	<p>VI not essential for the mark ACCEPT sodium dichromate(VI) ALLOW $\text{K}_2\text{Cr}_2\text{O}_7$</p> <p>ALLOW concentrated sulfuric acid ALLOW H_2SO_4</p> <p>ACCEPT reagents in either order</p>	2								
(ii)	<p>B orange to green</p> <p>A is incorrect as the colour does not change from green to orange C is incorrect as the colour does not change from red to yellow D is incorrect as the colour does not change from yellow to red</p>		1								

Question number	Answer	Notes	Marks
4 (c) (i)	alcohols are flammable/might catch fire/might ignite	<p>ACCEPT esters/mixture are/is flammable/might catch fire/might ignite</p> <p>ALLOW alcohol/ester/ carboxylic acid might evaporate</p>	1
(ii)	<p>C methyl propanoate</p> <p>A ethyl methanoate is not the correct name of the compound</p> <p>B methyl ethanoate is not the correct name of the compound</p> <p>D propyl methanoate is not the correct name of the compound</p>		1
			Total 8

Question number	Answer	Notes	Marks
5 (a) (i)	(produces) acid rain	ALLOW any detrimental effect of acid rain e.g. kills fish, damages limestone buildings	1
(ii)	<ul style="list-style-type: none"> • M1 find moles of sulfur • M2 multiply moles by 24 • M3 answer in standard form <p>Example calculation</p> <p>M1 $6.4 \times 10^6 \div 32$ OR $2.0 \times 10^5 / 200\,000$</p> <p>M2 $2.0 \times 10^5 \times 24 / 200\,000 \times 24 / 4\,800\,000$</p> <p>M3 4.8×10^6</p>	<p>ALLOW ECF as long as an attempt has been made to calculate moles</p> <p>Correct answer without working scores 3</p> <p>4 800 000 (dm³) without working scores 2</p>	3
(b) (i)	<p>An explanation that links the following two points</p> <p>M1 provides an alternative (reaction) pathway/route</p> <p>M2 with a lower activation energy OWTTE</p>	<p>ACCEPT so more particles/collisions have energy greater than the activation energy</p> <p>ALLOW lowers the energy needed to start the reaction</p>	2
(ii)	fewer moles (of gas) on RHS (than on LHS)	<p>ALLOW 3 moles (of gas) on LHS and 2 moles (of) gas on RHS</p> <p>ALLOW fewer moles of product/SO₃ (gas) (than of reactants/SO₂ and O₂ (gas))</p> <p>ALLOW molecules in place of moles</p> <p>IGNORE references to rate</p>	1
(iii)	as yield is approximately 98% /very high (it is not necessary to increase the pressure) OWTTE	ALLOW reference to reaction rate (already high enough) as catalyst used OWTTE	1

Question number	Answer	Notes	Marks
5 (c)	<p>M1 $\text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$</p> <p>M2 $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$</p>	ALLOW multiples	2
(d)	<p>M1 $(2 \times 14 \div 132) \times 100$</p> <p>M2 21.21 (%)</p>	<p>ALLOW any number of sig figs except 1</p> <p>ALLOW ECF from M1 as long as 132 used correctly</p> <p>Correct answer without working scores 2</p>	2
			Total 12

Question number	Answer	Notes	Marks
6 (a)	<p>A description that refers to the following three points</p> <p>M1 filter</p> <p>M2 wash the precipitate/solid/lead(II) bromide /residue (with distilled water)</p> <p>M3 dry with filter paper/in a (warm) oven</p>	<p>ALLOW leave to dry or any other suitable method</p> <p>REJECT direct heating e.g. with a Bunsen burner</p> <p>If description relates to preparation of a soluble salt allow 1 mark only for M3 for a suitable method of drying the solid</p>	3
(b)	<p>M1 solid lead(II) bromide does not conduct electricity</p> <p>M2 because ions cannot move/are in fixed positions</p>	<p>ALLOW lead(II) bromide only conducts when molten</p> <p>ALLOW when lead(II) bromide is solid no electricity/current flow(s) through the circuit/lamp</p> <p>REJECT reference to (delocalised) electrons /atoms cannot move in solid</p>	2

Question number	Answer	Notes	Marks
6 (c) (i)	brown vapour/gas/fumes (of bromine)	ALLOW orange/orange-brown	1
(ii)	<p>An explanation that links the following four points</p> <p>M1 bromide ions are negatively charged / Br^-</p> <p>M2 (so bromide ions/they) are attracted to the positive electrode</p> <p>M3 (at the positive electrode) bromide ions/they lose/give up electron(s) (to form bromine atoms)</p> <p>M4 (bromine atoms) join in pairs to form bromine molecules/Br_2 OWTTE</p>	<p>Penalise incorrect use of ide/ine once only</p> <p>ALLOW bromide ions are anions</p> <p>ALLOW anode</p> <p>ALLOW bromide ions are oxidised ALLOW $\text{Br}^- \rightarrow \text{Br} + \text{e}^{(-)}$</p> <p>ALLOW $\text{Br} + \text{Br} \rightarrow \text{Br}_2$</p> <p>$2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^{(-)}$ scores M1 M3 and M4</p>	4
(d)	<p>$\text{Pb}^{2+}(\text{l}) + 2\text{e}^{(-)} \rightarrow \text{Pb}(\text{s})$</p> <p>M1 formulae and balancing correct</p> <p>M2 both state symbols correct</p>	<p>ALLOW $\text{Pb}(\text{l})$</p> <p>ALLOW multiples and fractions</p> <p>ALLOW M2 ECF if charge on lead ion and/or balancing are incorrect</p>	2
			Total 12

Question number	Answer	Notes	Marks
7 (a)	gives out thermal energy/heat (energy)		1
7 (b)	<ul style="list-style-type: none"> • M1 expression for Σ bond energies of reactants/bonds broken • M2 expression for Σ bond energies of products/bonds made or evaluation • M3 correct equation linking M1, M2 and value of ΔH • M4 evaluation of Cl-Cl bond energy <p>Example calculation</p> <p>M1 (Σ bond energies of reactants =) $436 + X$</p> <p>M2 (Σ bond energies of products =) 2×431 OR $862(\text{kJ})$</p> <p>M3 $- 184 = 436 + X - 862$ OR $X = - 184 + 862 - 436$</p> <p>M4 $X = 242 (\text{kJ/mol})$</p>	<p>Correct answer without working scores 4</p> <p>ACCEPT E(Cl- Cl) or any suitable symbol or expression for X</p> <p>ALLOW M3 ECF if 431 for M2</p> <p>If not used (-)184 in M3 can only score M1 M2</p> <p>M3 subsumes M1 M2</p> <p>ALLOW M4 ECF on M3 as long as M3 involves 436, X, 862 (or 431) and (-)184</p>	4

Question number	Answer	Notes	Marks
7 (c)	<p>An explanation that links the following three points</p> <p>M1 energy needed to break bonds / bond-breaking is endothermic</p> <p>M2 energy given out when bonds are formed / bond-forming is exothermic</p> <p>M3 energy given out is greater than energy needed (so exothermic) OWTTE</p>	<p>ALLOW energy is absorbed/taken in</p> <p>ALLOW energy is released</p> <p>M3 DEP M1 M2</p> <p>more energy released when new bonds are formed (in products) than is needed to break the bonds (in reactants) OWTTE scores M1 M2 M3</p> <p>If any contradictory statements max 1</p>	3
(d)	<p>M1 horizontal line to show products below reactants and to the right of reactants and labelled 2HCl</p> <p>M2 vertical line from H₂ + Cl₂ level to 2HCl/products level and labelled enthalpy change/ΔH/ -184</p> <p>M3 curve with hump/peak shown on diagram going up from H₂ + Cl₂ line and ending at 2HCl/products line</p> <p>M4 vertical line from H₂ + Cl₂ level to top of hump level and labelled activation energy/E_a</p>	<p>ALLOW products for 2HCl</p> <p>ACCEPT double headed arrow or arrow pointing from H₂ + Cl₂ level to 2HCl/products level</p> <p>REJECT arrow pointing from 2HCl/products level to H₂ + Cl₂ level</p> <p>ACCEPT double headed arrow or arrow pointing from H₂ + Cl₂ level to top of hump</p> <p>REJECT arrow pointing from top of hump to H₂ + Cl₂ level</p> <p>If endothermic diagram shown, can score M2 M3 (peak/hump must be above products line) and M4</p>	4
			Total 12

