



Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 2CR

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Summer 2022

Question Paper Log Number XXXXX*

Publications Code 4CH1_2CR_2206_MS

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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)	P neutron Q proton R electron		3
(ii)	nucleus	ALLOW nuclei	1
(b)	boron	ALLOW B	1
			Total 5

Question number	Answer	Notes	Marks
2 (a)	M1 dissolving M2 diffusion	Answers can be in either order IGNORE dilution	2
(b) (i)	A 3 B is incorrect as there are not 4 different types of atoms in KMnO_4 C is incorrect as there are not 6 different types of atoms in KMnO_4 D is incorrect as there are not 7 different types of atoms in KMnO_4		1
(ii)	($M_r = 39 + 55 + 16 \times 4 =$) 158		1
(c)	(something that) gives oxygen (to another substance)/takes/gains electrons (from another substance) OWTTE	ALLOW oxygen donor ALLOW electron acceptor ALLOW (something that) causes another substance to be oxidised/to lose electrons OWTTE ALLOW (something that) is reduced (in a reaction) ALLOW increases the oxidation number (of another species) OWTTE	1
			Total 5

Question number	Answer	Notes	Marks
3 (a) (i)	B C ₄ H ₁₀ A is incorrect as C ₂ H ₅ is not the molecular formula of an alkane C is incorrect as CH ₂ CH ₂ is the structural formula of an alkene D is incorrect as CH ₃ CH ₂ CH ₃ is the structural formula of an alkane		1
(ii)	C C ₃ H ₈ A is incorrect as CH ₂ is not a molecular formula but is an empirical formula of an alkene B is incorrect as the empirical formula of C ₂ H ₆ is CH ₃ D is incorrect as the empirical formula of C ₄ H ₁₀ is C ₂ H ₅		1
(b) (i)	substitution		1
(ii)	CH ₄ + Br ₂ → CH ₃ Br + HBr	ALLOW multiples IGNORE state symbols even if incorrect	1
(c) (i)	M1 y (= 220 ÷ 44) = 5 M2 z (= 108 ÷ 18) = 6		2
(ii)	M1 C ₅ H ₁₂ M2 x = 8	ALLOW ECF in (ii) from incorrect values of y and z in (i) to score M1 the answer must be the formula of an alkane	2
(d)	An explanation including one of the following pairs M1 carbon monoxide/CO is produced M2 (carbon monoxide) is toxic/poisonous /reduces the capacity of the blood to carry oxygen OWTTE OR M1 carbon/soot M2 causes asthma/bronchitis/respiratory problems OWTTE	M2 dep on M1 ACCEPT prevents blood from carrying oxygen ALLOW correct explanation in terms of haemoglobin e.g. prevents haemoglobin from carrying oxygen	2
			Total 10

Question number	Answer	Notes	Marks
4 (a)	<p>An explanation of properties that includes five of the following points</p> <p>M1 conducts electricity</p> <p>M2 (because the) delocalised electrons can move/flow (through structure)</p> <p>M3 malleable/ductile</p> <p>M4 (because) layers of cations/atoms</p> <p>M5 layers/cations/atoms can slide/slip/move over each other</p> <p>M6 high melting point</p> <p>M7 (because) strong (electrostatic) attraction between cations and delocalised electrons</p>	<p>reason must be linked to correct property</p> <p>IGNORE references to cost/reactivity/hardness/strength/shiny</p> <p>If any mention of ions/atoms moving cannot score M2</p> <p>ALLOW explanations of malleable/ductile</p> <p>ALLOW sheets/rows</p> <p>IGNORE high boiling point</p> <p>ALLOW giant metallic lattice/strong bonds between cations and delocalised electrons /strong metallic bonds</p> <p>Max 4 if any mention of intermolecular forces/covalent/ionic bonding</p>	5
(b) (i)	copper ion Cu^{2+} sulfate ion SO_4^{2-}	ALLOW $\text{Cu}^{+2}\text{SO}_4^{-2}$	1
(ii)	effervescence/bubbles/fizzing	IGNORE oxygen/gas	1
(iii)	relights a glowing splint		1
(iv)	<p>$2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^{(-)}$</p> <p>OR</p> <p>$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^{(-)}$</p> <p>M1 all formulae correct</p> <p>M2 balancing of correct formulae</p>		2
			1

(v)	(OH ⁻ ions/they) are present in/come from water OWTTE	ACCEPT (some) water molecules dissociate to give OH ⁻ ions OWTTE ALLOW because copper sulfate solution/it contains water/is aqueous REJECT because copper sulfate/solution is alkaline	Total 11
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Question number	Answer	Notes	Marks
5 (a) (i)	glucose → ethanol + carbon dioxide	ACCEPT fully correct chemical equation IGNORE yeast	1
(ii)	yeast	IGNORE zymase/enzymes	1
(iii)	M1 30 °C M2 anaerobic conditions / absence of air/oxygen	ACCEPT any value between 20 and 40 inclusive IGNORE yeast IGNORE room temperature Answers can be in any order	2
(b) (i)	B CH ₃ COOC ₄ H ₉ A is incorrect as this is propyl ethanoate C is incorrect as this is butyl propanoate D is incorrect as this is ethyl butanoate		1
(ii)	sweet/fruity/distinctive smell OWTTE		1
(iii)	perfumes/(food) flavourings/solvents	IGNORE (food) colourings ACCEPT any other appropriate use eg emulsifiers	1
(c) (i)	(atom/group of atoms in a compound that) determines its chemical properties/reactions OWTTE	ALLOW (atom/group of atoms that) determines which homologous series a compound is in OWTTE	1
(ii)	circle around $\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{O}-\text{H} \end{array}$		1

	<p>(iii) M1 $\frac{60.00}{12}$ $\frac{4.44}{1}$ $\frac{35.56}{16}$</p> <p>M2 $\frac{5.(00)}{2.2225}$ $\frac{4.44}{2.2225}$ $\frac{2.2225}{2.2225}$</p> <p>OR 2.25 2 1</p> <p>M3 2.25 x 4 2 x 4 1 x 4 = 9:8:4</p>	<p>If upside down/use atomic numbers scores 0</p> <p>ALLOW rounding of 2.2225 but should show at least 2 dp</p> <p>ALLOW other correct methods eg</p> <p>M1 Mr (of aspirin) = 180</p> <p>M2 9x12 or 108 8x1 or 8 4x16 or 64</p> <p>ALL 3 needed for M2</p> <p>M3 $\frac{108}{180} \times 100 = 60 \%$</p> <p>$\frac{8}{180} \times 100 = 4.44 \%$</p> <p>$\frac{108}{180} \times 100 = 35.56 \%$</p> <p>ALL 3 needed for M3</p>	<p>3</p> <p>Total 12</p>
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Question number	Answer	Notes	Marks
6 (a)	(results that are) within 0.2(0) (cm ³) of each other	ACCEPT other values if less than 0.2	1
(b)	<p>An explanation that links two of the following pairs of points</p> <p>M1 a pipette should have been used instead of measuring cylinder/to measure the sodium hydroxide solution</p> <p>M2 a pipette is more precise/a measuring cylinder is less precise</p> <p>M3 methyl orange/phenolphthalein/litmus should have been used instead of universal indicator</p> <p>M4 methyl orange/phenolphthalein/litmus would give a clear/sharp colour change/end-point /universal indicator would not give a clear/sharp colour change/end-point</p> <p>M5 use white tile (under conical flask)</p> <p>M6 easier to see colour change (at end point) OWTTE</p>	<p>ALLOW a pipette is more accurate/ a measuring cylinder is less accurate ALLOW pipette would give exactly 25 cm³</p> <p>ALLOW universal indicator would give a range of colours ALLOW methyl orange/ phenolphthalein/litmus only have two colours/ are one colour in acid and one in alkali (colours given for a named indicator do not need to be correct)</p> <p>ALLOW easier to see colour change with methyl orange/ phenolphthalein/litmus</p>	4

(c)	<p>M1 amount of NaOH = $\frac{25.0 \times 1.50}{1000}$ OR 0.0375 (mol)</p> <p>M2 amount of H₂SO₄ = $\frac{0.0375}{2}$ OR 0.01875 (mol)</p> <p>M3 volume of H₂SO₄ = $\frac{(0.01875 \times 1000)}{(0.600)}$ = 31.25 (cm³)</p>	<p>correct answer without working scores 3</p> <p>ALLOW ECF throughout</p> <p>ALLOW 2, 3 or 4 sig figs throughout</p> <p>Penalise use of 1 sig fig once only</p> <p>62.5/125 scores 2</p> <p>ACCEPT alternative methods</p>	3
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(d)	<p>A description that refers to four of the following</p> <p>M1 heat the solution</p> <p>M2 to evaporate some of the water/ to form a saturated solution/ to crystallisation point</p> <p>M3 leave the solution to cool / leave the solution for (more) crystals to form</p> <p>M4 filter off the crystals</p> <p>M5 suitable method of drying the crystals</p>	<p>ALLOW boil Max 1 mark if solution evaporated to dryness</p> <p>If solution left to partially evaporate without heating only M4 and M5 can be awarded</p> <p>leave solution to cool and (then) filter off crystals scores M3 and M4 ALLOW decant off solution IGNORE references to washing</p> <p>e.g. dry between filter papers/dry in a warm oven/ leave to dry REJECT hot oven or direct heating with Bunsen burner M5 DEP on crystals having been formed No M5 if crystals are washed after drying</p>	<p>4</p> <p>Total 12</p>
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Question number	Answer	Notes	Marks
7 (a)	(i) reversible (reaction) / reaction that goes both ways OWTTE	IGNORE references to equilibrium	1
	(ii) increases the rate of reaction / speeds up the reaction	REJECT to increase yield ALLOW to reach equilibrium faster IGNORE provides an alternative pathway with lower activation energy	1
(b)	(i) M1 yield decreases M2 (forward) reaction is exothermic/ backward reaction is endothermic	IGNORE references to rate and Le Chatelier throughout ACCEPT (when temperature increased equilibrium shifts in) endothermic direction which is (from right) to left M2 DEP M1 correct or missing	2 2
	(ii) M1 yield increases M2 there are fewer moles (of gas) on the right-hand side/product side / there are more moles (of gas) on the left-hand side/there are 4 moles of reactants and 2 moles of product/ OWTTE	ALLOW molecules for moles M2 DEP M1 correct or missing	

7 (c)	<div data-bbox="381 321 792 472"> <p>Energy</p> <div> <div>N₂ + 3H₂</div> <div>ΔH</div> <div>2NH₃</div> </div> </div> <p>M1 horizontal line labelled with N₂ + 3H₂</p> <p>M2 horizontal line showing 2NH₃ in correct position</p> <p>M3 vertical line in correct position and labelled ΔH / -92 (kJ/mol)</p>	<p>IGNORE any horizontal axis/labels IGNORE any attempts at including activation energy</p> <p>ALLOW nitrogen and hydrogen</p> <p>ALLOW ammonia</p> <p>If not balanced or words reactants and products on horizontal lines in correct position scores 1 out of 2</p> <p>ACCEPT double headed arrow or arrow pointing from reactants level to products level REJECT arrow pointing from products level to reactants level If endothermic reaction can score M1 and M3</p>	3
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7	(d) (i)	<p>M1 amount of nitrogen = $(48 \div 24 =) 2$ (mol)</p> <p>M2 amount of hydrogen = $(120 \div 24 =) 5$ (mol)</p> <p>M3 2.5 mol of hydrogen to 1 mol of nitrogen (which is less than 3 so nitrogen is in excess) OR 2 mol of nitrogen needs 6 mol of hydrogen (so not enough hydrogen to react with the nitrogen)</p>	3
	(ii)	<p>ACCEPT alternative methods</p> <p>correct answer without working scores 3</p> <p>ALLOW ECF from (i)</p> <p>ALLOW 3.3</p> <p>use of 3.3 gives 79.2</p> <p>use of 79.2 gives 15.84</p> <p>ALLOW ECF from M2</p> <p>ACCEPT 120 dm³ of hydrogen gives $2 \times 120 \div 3$ OR 80 (dm³ of ammonia) for M1 and M2</p> <p>ALLOW max 2 for use of 48 dm³ of nitrogen giving 96 dm³ of ammonia and final answer of 19.2 (dm³)</p>	3
			Total 15

