Pearson Edexcel

Mark Scheme (Results)

January 2023

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)	7		1
(b)	any value ≥4 but <7		1
(c)	0	ALLOW Group 8	1
(d)	3		1

(Total for Question 1 = 4 marks)

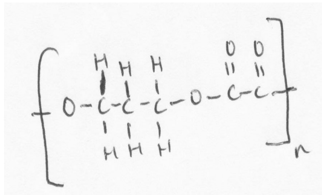
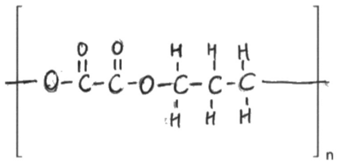
Question number	Answer	Notes	Marks
2 (a)	temperature	ALLOW volume/amount of solvent IGNORE concentration IGNORE stirring	1
(b) (i)	F → G → B → D → H → C → A → E **M1** G in correct place **M2** H C A in correct places		2
(ii)	**M1** mass of dry salt (= 78.1 − 60.5 =) 17.6 (g) **M2** solubility = (17.6 × 2) = 35.2 (g per 100 g of water)	ALLOW ECF from M1 correct answer with no working scores 2	2

(Total for Question 2 = 5 marks)

Question number	Answer	Notes	Marks
3 (a)	**M1** calculating heat energy in kJ/g = ($3.28 \times 10^5 \div 10\,000$) **OR** 32.8 **M2** calculating heat energy in kJ/mol = (M1 × 12) OR 393.6 **M3** = 394 OR 3.94×10^2 kJ/mol OR **M1** calculating amount of carbon = $10\,000 \div 12$ OR 833.3 **M2** calculating heat energy in kJ/mol = ($3.28 \times 10^5 \div$ M1) OR 393.6 **M3** = 394 OR 3.94×10^2 kJ/mol	IGNORE sign M3 subsumes M2 IGNORE sign M3 subsumes M2 correct answer with no working scores 3	3
(b) (i)	**M1** $\frac{600}{20\,000} \times 100$ OR $\frac{0.6}{20} \times 100$ **M2** = 3 (%)	ALLOW ECF from incorrect conversion of units in M1 correct answer with no working scores 2	2
(ii)	**M1** mol of sulfur = $600 \div 32$ **OR** 18.75 **M2** vol SO_2 = M1 × 24 **OR** 450 (dm^3) **M3** = 450 000 OR 4.5×10^5 (cm^3)	ALLOW ECF from incorrect A_r in M1 ALLOW ECF M2 (dm^3) × 1000 M3 subsumes M2 correct answer with no working scores 3	3
(iii)	acid rain	IGNORE any effects	1

(Total for Question 3 = 9 marks)

Question number	Answer	Notes	Marks
4 (a) (i)	The correct answer is **D** a structural formula **A** is incorrect because CH_3CH_2OH is not a displayed formula **B** is incorrect because CH_3CH_2OH is not an empirical formula **C** is incorrect because CH_3CH_2OH is not a molecular formula		1
(ii)	Any two from the following: **M1** same general formula **M2** each member differs from the next by CH_2 **M3** same functional group **M4** similar chemical properties/reactions **M5** trend/gradation in physical properties OWTTE	ACCEPT named physical property eg boiling point	2
(iii)	alcohol(s)		1
(iv)	propan-1-ol	ALLOW 1-propanol ALLOW propanol	1
(b) (i)	explanation including **M1** condensation (polymerisation) **M2** because water also produced/eliminated/removed/lost	ALLOW small molecule also produced/ eliminated/removed/ lost	2

	(ii)	 OR  **M1** correct ester linkage shown **M2** rest of repeat unit fully correct	M2 DEP M1	2

(Total for Question 4 = 9 marks)

Question number	Answer	Notes	Marks
5 (a)	2.8.5		1
(b)	**M1** formula of phosphide ion is P^{3-} **M2** charges on three calcium/Ca^{2+} ions balance / cancel out charges on two phosphide/P^{3-} ions OWTTE	ALLOW P^{-3} ALLOW charge on phosphide ion is 3-/-3 ALLOW reference to three calcium atoms each lost two electrons /(total of) six electrons which were gained by two phosphorus atoms (to attain full outer shells) OWTTE Any reference to sharing of electrons/covalent bonding scores 0	2
(c) (i)	$Ca_3(PO_4)_2$ + **8** C → Ca_3P_2 + **8** CO		1
(ii)	explanation including **M1** (carbon acts as a) reducing agent **M2** (because) calcium phosphate/$Ca_3(PO_4)_2$ loses oxygen	ALLOW (because) carbon gains oxygen / is oxidised ALLOW carbon removes oxygen from calcium phosphate/$Ca_3(PO_4)_2$ IGNORE references to reactivity series / displacement reactions M2 DEP M1 correct or missing	2
(d)	$Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$ **M1** all formulae correct **M2** correct balancing	M2 DEP M1 ALLOW multiples and fractions	2

(e)	explanation including **M1** giant (ionic) structure **M2** strong forces of attraction between oppositely charged ions **M3** which require a lot of (heat/thermal) energy to break/overcome	ACCEPT giant (ionic) lattice ACCEPT between Ca^{2+} and P^{3-} ACCEPT between positive and negative ions ALLOW strong ionic bonds IGNORE more energy 0 marks if any mention of covalent bonds, intermolecular forces or molecules	3

(Total for Question 5 = 11 marks)

Question number	Answer	Notes	Marks
6 (a) (i)	explanation including **M1** carbon above iron in reactivity series **M2** so carbon can remove oxygen from iron(III) oxide	ALLOW carbon is more reactive than iron ACCEPT reverse arguments ALLOW carbon can reduce iron(III)oxide ALLOW carbon can displace iron (from iron(III) oxide)	2
(ii)	electricity not been discovered OWTTE	IGNORE electrolysis not discovered	1
(b) (i)	explanation including **M1** ions **M2** can move	If refs to electrons moving then scores 0 M2 DEP M1	2
(ii)	The correct answer is **C** Na^+ **A** is incorrect because H^+ ions not present in molten sodium chloride **B** is incorrect because Cl^- ion is not a cation **D** is incorrect because OH^- ion not present in molten sodium chloride		1
(iii)	explanation including **M1** water/moisture reacts with sodium **M2** to produce hydrogen (which ignites/burns/reacts in oxygen/air causing the small explosions)		2
(iv)	**M1** (anode) $2Cl^- \rightarrow Cl_2 + 2e^{(-)}$ **M2** (cathode) **(2)**$Na^+ + (2)e^{(-)} \rightarrow (2)Na$	ACCEPT $2Cl^- - 2e^{(-)} \rightarrow Cl_2$ both half-equations correct but order reversed scores 1	2

Question number	Answer	Notes	Marks
6 (c)	explanation including **M1** outer electron in potassium (atom) is further away (from nucleus) **M2** outer electron in potassium (atom) less strongly attracted by nucleus OWTTE **M3** so (outer) electron more easily lost OWTTE	ALLOW reverse arguments ALLOW potassium (atom) has more (electron) shells than lithium (atom) ALLOW potassium (atom) larger than lithium (atom) ALLOW potassium has greater atomic radius	3

(Total for Question 6 = 13 marks)

Question number	Answer	Notes	Marks
7 (a)	to (more) easily/clearly see the colour change (at end point) OWTTE		1
(b)	**M1** litmus **M2** blue **OR** **M1** methyl orange **M2** yellow **OR** **M1** phenolphthalein **M2** pink	M2 DEP M1 ALLOW purple ALLOW orange ALLOW any other suitable indicator and correct final colour	2
(c)	Description including any five from the following **M1** rinse/wash the conical flask (with distilled/deionised water) **M2** (repeat titration/experiment) adding sodium hydroxide (from burette) slowly/dropwise (near end point) **M3** swirling flask **M4** record initial and final volume burette reading (at end point) /record volume sodium hydroxide added (at end point) **M5** repeat until obtain concordant results **M6** find mean/average (of concordant results)	 REJECT if rinsed/washed using solution IGNORE names of indicators and any colour changes ALLOW shaking/stirring ALLOW reference to subtraction of initial and final readings ALLOW results within 0.2 cm^3 (or less)	5
(d) (i)	moles of NaOH = $\frac{(0.350 \times 18.80)}{(1000)}$ = 0.00658	ACCEPT 6.58×10^{-3}	1
(ii)	amount of HNO_3 = 0.00658	ALLOW ECF from (i)	1
(iii)	conc. of HNO_3 = $\frac{0.00658 \times 1000}{25.0}$ = 0.263(2)	ALLOW ECF from (ii) If not divided by 1000 in (i) do not penalise if not multiplied by 1000 in (iii) ALLOW 2, 3 or 4 sig figs throughout Penalise use of 1 sig fig once only	1

(Total for Question 7 = 11 marks)

Question number	Answer	Notes	Marks
8 (a)	diagram including the following **M1** horizontal lines showing energy levels labelled $N_2 + O_2$ and 2NO **M2** level of 2NO /products above level of $N_2 + O_2$ /reactants **M3** ΔH correctly shown between reactants and products and labelled **M4** activation energy correctly shown and labelled	ALLOW vertical line with/without arrowheads If single arrowhead must point from level of reactants to level of products Must be from level of reactants to top of "hump" ALLOW vertical line with/without arrowheads If single arrowhead must point from level of reactants to top of "hump" IGNORE any label on a horizontal axis If diagram for exothermic reaction drawn can score M1 M3 M4	4
(b) (i)	{944 + (3 × 436) =} 2252	IGNORE any sign	1
(ii)	{6 × 391 =} 2346	IGNORE any sign	1

(iii)	**M1** difference between (i) and (ii) expected value = 94
	
	M2 − 94
		IGNORE any sign
		
		ALLOW ECF from (i) and (ii)
		
		If (ii) > (i) sign should be −
		
		If (i) > (ii) sign should be +
			2

(Total for Question 8 = 8 marks)
(Total for Paper = 70 marks)

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