

Question Number	Correct Answer	Reject	Mark
1 (a)	<p>EITHER (consideration of kinetics)</p> <p>Rate of reaction increases (1)</p> <p>As collisions are more frequent / increases frequency of collisions / more collisions per second</p> <p>IGNORE Just 'more collisions' or just 'more successful collisions' (1)</p> <p>OR (if assumes an equilibrium reaction)</p> <p>Yield increases / eq'm shifts to RHS (1)</p> <p>Since fewer moles of gas / no moles of gas / fewer molecules of gas (on RHS) (1)</p> <p>MUST AWARD MARKS BY ONLY CONSIDERING ONE OF THE ROUTES – CANNOT score full marks via one mark from each route if 'MIX UP' KINETICS AND EQUILIBRIUM ARGUMENTS</p> <p>Eg Rate increases, so yield of product increases scores (1)</p>		2

Question Number	Correct Answer	Reject	Mark
1 (b)	<p>[FIRST, CHECK THE FINAL ANSWER IF ANSWER = 3.1 (tonnes), award 3 marks]</p> <p>EITHER</p> <p>1 tonne C₆H₅ONa : 180/116 tonnes C₆H₄(OH)(CO₂H) (1)</p> <p>2.5 tonnes C₆H₅ONa : (180/116) x 2.5 (tonnes) C₆H₄(OH)(CO₂H) at 100% yield (1) (= 3.879 tonnes)</p> <p>So actual yield = (180/116) x 2.5 x 79/100 (3.06) = 3.1 (tonnes) (1)</p> <p>OR</p> <p>Moles C₆H₅ONa (= 2.5 x 10⁶ ÷ 116) = 21 551.7 (mol) (1)</p> <p>Moles C₆H₅ONa (79% yield) (= 21 551.7 x 0.79) = 17025.8 (mol) (1)</p> <p>Mass C₆H₅ONa (= 17025.8 x 180 = 3064644 g = 3.06 tonnes) = 3.1 (tonnes) to 2SF (1)</p> <p>Correct answer TO 2 SF, no working (3)</p> <p>Can work in g (instead of tonnes) until final answer</p> <p>So final answer of 3.06 (tonnes) scores M1 and M2 only</p> <p>Award only (1) mark for 3.07 (tonnes) without working</p>	g	3

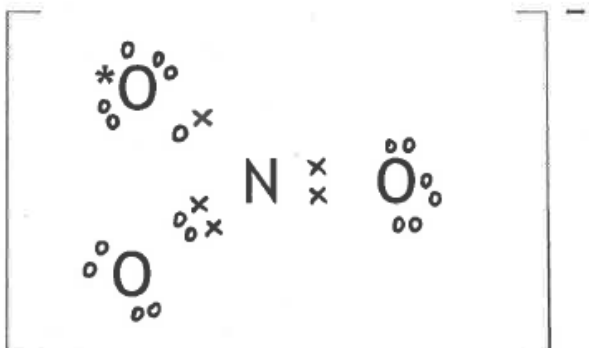
Question Number	Correct Answer	Reject	Mark
1 (c)	<p>Esterification / acylation / ethanoylation ALLOW 'acetylation'</p> <p>OR</p> <p>'(nucleophilic) addition-elimination'</p> <p>BOTH words (addition and elimination) are needed for this option</p> <p>IGNORE 'Condensation'</p> <p style="text-align: right;">(1)</p> <p>CH₃COCl / ethanoyl chloride OR (CH₃CO)₂O / ethanoic anhydride</p> <p style="text-align: right;">(1)</p> <p>ALLOW</p> <p>CH₃COOH / ethanoic acid (in presence of H₂SO₄)</p> <p>Correct displayed / skeletal formulae</p> <p>IGNORE</p> <p>JUST 'acid anhydride' / 'acid chloride'</p>		2

Question Number	Acceptable Answers	Reject	Mark
2(a)	<p>1st Mark Mol CuO = $(5.60/79.5) = 0.07044 / 0.0704 / 0.070 / 0.07$ (1)</p> <p>2nd Mark Mol of nitric acid = $(50 \times 2.50/1000) = 0.125$ (1)</p> <p>3rd Mark Reacting ratio = 2: 1 and nitric acid less than double moles of copper oxide/ Reacting ratio = 2: 1 and copper oxide more than half of moles of nitric acid</p> <p>OR moles acid needed to react with all CuO = $(2 \times 0.070 =) 0.140$ which is more than 0.125</p> <p>OR 0.125 mol nitric acid can only react with 0.0625 mol CuO (1)</p>		3

Question Number	Acceptable Answers	Reject	Mark
2(b)	<p>1st Mark Moles product = $0.5 \times 0.125 = 0.0625$ (1)</p> <p>Allow TE from moles HNO₃</p> <p>2nd Mark Theoretical yield = $(0.0625 \times 295.6 =)$ 18.475 g (1)</p> <p>Allow ECF on multiplying moles product by 295.6</p> <p>3rd Mark % yield = $(12.52/18.475 \times 100) = 67.767 / 67.8 / 68$ (1)</p> <p>Alternative route for 2nd and 3rd Marks mol product = $(12.52 / 295.6) = 0.04235$ (1)</p> <p>% yield = $(0.04235/0.0625 \times 100 = 67.767 / 67.8/ 68$ (1)</p> <p>TE from (a)</p> <p>If moles of product taken as 0.125, final answer = 33.88% which scores (2)</p> <p>TE for calculation based on moles of copper(II) oxide which gives an answer between 60.128% and 60.506% max(2)</p>	<p>4.24% scores (0) overall</p>	3

Question Number	Acceptable Answers	Reject	Mark
2(c)	Some product remains in solution/ some product does not crystallize Allow loss of material on transferring, if explained, such as Crystals remain in / on filter paper 'Spitting' (of solution on heating) IGNORE References to impure reactants	Incomplete reaction Just experimental error 'solution evaporates'	1

Question Number	Acceptable Answers	Reject	Mark
2(d)(i)	Covalent bond: (shared pair of electrons using) one electron from each atom (1) Dative covalent bond: (shared pair of electrons using) two electrons from same atom (1)		2

Question Number	Acceptable Answers	Reject	Mark
2(d)(ii)	Double bond between N and one oxygen atom (1) Single bond between N and O* (1) Dative single bond between N and one O atom (1)  Max 2 if any lone pair electrons are missing from any of the three oxygen atoms.		3

Question Number	Acceptable Answers	Reject	Mark				
	In (a) any units given must be correct. Penalise incorrect units once only. Ignore SF except 1 SF in (i), (iii) and (iv). Penalise once only						
3 (a) (i)	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Volume Added/cm³</td> <td>25(.00)</td> <td>24.6(0)</td> <td>24.5(0)</td> </tr> </table> <p style="text-align: center;">24.55 (cm³)</p> <p>Allow 24.6 (cm³)</p>	Volume Added/cm ³	25(.00)	24.6(0)	24.5(0)	<p>24.70</p> <p>24.60</p>	1
Volume Added/cm ³	25(.00)	24.6(0)	24.5(0)				

Question Number	Acceptable Answers	Reject	Mark
3 (a) (ii)	<p>NaOH + HCl → NaCl + H₂O</p> <p>Ignore state symbols even if incorrect</p>		1

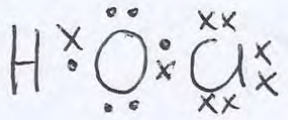
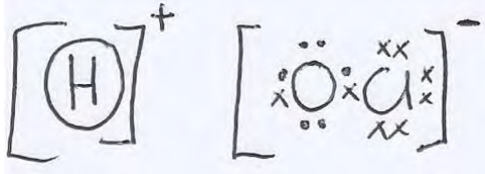
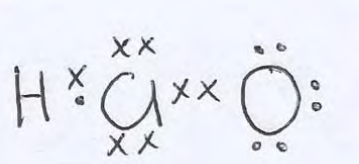
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3 (a) (iii)	<p>Number of moles of NaOH</p> <p>= $\frac{(24.55 \times 2.5)}{1000} = 6.1375 \times 10^{-2} = 0.061375(\text{mol})$</p> <p style="padding-left: 150px;">OR $6.14 \times 10^{-2} = 0.0614$</p> <p style="padding-left: 150px;">OR $6.1 \times 10^{-2} = 0.061$</p> <p>Allow TE from 20(a)(i)</p>	<p>0.0613</p> <p>0.06</p>	1

Question Number	Acceptable Answers	Reject	Mark
3 (a) (iv)	<p>$6.1375 \times 10^{-2} / 0.061375 / 6.14 \times 10^{-2} / 0.0614 / 0.061(\text{mol})$</p> <p>Allow TE = answer to (a)(iii)</p>		1

Question Number	Acceptable Answers	Reject	Mark
3 (a) (v)	<p>Multiply by 4 and by 36.5 (1)</p> <p>Using 6.1375×10^{-2} gives 8.96075 = 8.96 (g)</p> <p>OR</p> <p>Using 6.14×10^{-2} gives 8.9644 = 8.96(g)</p> <p>OR</p> <p>Using 6.1×10^{-2} gives 8.906 = 8.91(g)</p> <p>Answer to 3 SF (1)</p> <p>Correct answer without working score (2)</p> <p>Allow TE from (a)(iv)</p> <p>ALLOW one mark for correct answer to 3SF where the multiplication by 4 has been omitted, e.g.</p> <p>$(6.1375 \times 10^{-2} \times 36.5 = 2.2401875 =) 2.24(g)$ (1)</p>		2

Question Number	Acceptable Answers	Reject	Mark
3 (a) (vi)	<p>The statement is valid as 8.96 ~9/very close</p> <p>Allow appropriate comment from answer to (a)(v)</p> <p>e.g 2.24 is not valid because it is too far away from 9g.</p>	Just 'not valid / valid'	1

Question Number	Acceptable Answers	Reject	Mark
3 a(vii)	<p>(Too) corrosive</p> <p>Damages eyes/burns (skin)/caustic</p> <p>Ignore</p> <p>Dangerous/Strong/Too concentrated</p>	<p>Just 'Harmful/Irritant/Toxic/Hazardous'</p> <p>Acid</p>	1

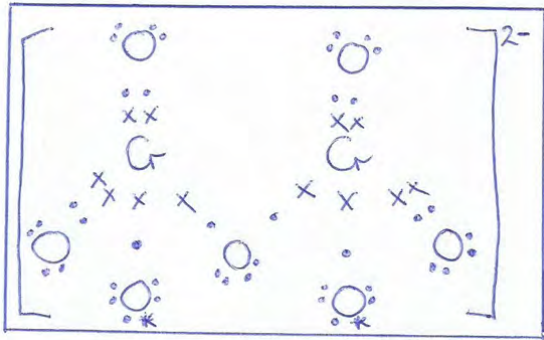
Question Number	Acceptable Answers	Reject	Mark
20 (b)	 <p>Allow all dots or all crosses</p> <p>ALLOW ionic dot and cross</p>  <p>Or dative covalent bond from chlorine</p> 		1

Question Number	Acceptable Answers	Reject	Mark
20 (c)	<p>HCl + HOCl → H₂O + Cl₂ (1) Ignore state symbols even if incorrect</p> <p>Chlorine is toxic/poisonous (1) Allow fumes are toxic Ignore references to smell or colour</p>	Just 'Harmful/irritant/dangerous/hazardous'	2

Question Number	Acceptable Answers	Reject	Mark
3 (d) (i)	$(2\text{NaOH} + \text{Cl}_2 \rightarrow \text{NaCl} + \text{NaClO} + \text{H}_2\text{O})$ $\begin{matrix} 0 & & -1 & +1 \end{matrix}$ <p>All oxidation numbers correct (1)</p> <p>Type: Disproportionation (1)</p> <p>Allow phonetic spellings</p> <p>Allow redox and disproportionation</p> <p>Second mark consequential on the first except if</p> <p>(i) all the oxidation numbers are zero (ii) the plus sign is missing, (iii) first two oxidation numbers are correct and the third one is positive</p> <p>If all the elemental oxidation numbers are given correctly then both marks are available</p>	Just redox	2

Question Number	Acceptable Answers	Reject	Mark
3 (d) (ii)	Heat/increase temperature ALLOW (more) concentrated NaOH	Just 'warm' / 'excess NaOH' Acid	1

Question Number	Acceptable Answers	Reject	Mark
3 (d) (iii)	$3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$ <p>OR</p> $3\text{Cl}_2 + 6\text{OH}^- \rightarrow 5\text{Cl}^- + \text{ClO}_3^- + 3\text{H}_2\text{O}$ <p>Formula of NaClO₃ / ClO₃⁻ (1)</p> <p>Rest of equation correct (1)</p> <p>Ignore state symbols even if incorrect</p>		2

Question Number	Acceptable Answers	Reject	Mark
4 (a)	 <p>The correct number of dots and crosses around both chromium atoms (1)</p> <p>All the oxygen atoms to have the correct number of bonds and the lone pairs (1)</p> <p>The extra 2 electrons from the potassium on the oxygen(s) (1)</p>	Both * on the same oxygen	3

Question Number	Acceptable Answers	Reject	Mark
4 (b) (i)	<p>$(n = 14.71 \div 294.2 =) 0.0500 \text{ (mol)}$ (1)</p> <p>$(c = 0.0500 \div 0.25 =) 0.200 \text{ (mol dm}^{-3}\text{)}$ (1) Allow TE on incorrect M_r value</p> <p>Allow use of 294 Correct answer without working scores (2) Allow 1SF</p> <p>If units are given then they must be correct</p>		2

Question Number	Acceptable Answers	Reject	Mark
4	(0.00250 x 6 =) 0.0150 (mol)		2
(b) (ii)	(0.0150 x 166 = 2.49 (g)) (1)		
	2.6 ≤ value ≤ 5.0 (g) (1)		
	TE for suitable mass to use on incorrect calculation		
	Suitable mass must be between 0.10 g more than the calculated value but less than or equal to double the calculated value		
	Allow 1 SF for the suitable mass		

Question Number	Acceptable Answers	Reject	Mark
4	(0.00260 x 2 =) 0.00520 (mol) (1)		2
(b) (iii)	(V=0.00520 ÷ 0.16 x 1000 =) 32.5 (cm ³) / 0.0325 dm ³ (1)		
	Allow answer without working (2)		
	Volume must be at least 3 SF		

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4	Percentage error large with a small mass/ Mass is only to 1 SF (1)	Just 'mass is not accurate'	2
(b) (iv)		Reference to concentration.	
	No repeats possible (1)		

Question Number	Acceptable Answers	Reject	Mark
4 (c) (i)	$\text{Cl}^- \rightarrow \frac{1}{2}\text{Cl}_2 + \text{e}^{(-)}$ OR $\text{Cl}^- - \text{e}^{(-)} \rightarrow \frac{1}{2}\text{Cl}_2$ Ignore state symbols even if wrong Allow multiples Allow $2\text{HCl} \rightarrow \text{Cl}_2 + 2\text{e}^{(-)} + 2\text{H}^+$	Reverse equation Iodide equation	1

Question Number	Acceptable Answers	Reject	Mark
4 (c) (ii)	(Gas X) Ammonia / NH_3 Allow ammonia (solution) / NH_3 (aq) (1) (Observation) White smoke / solid ALLOW Dense white fumes/white cloud (1) The observation mark is consequential on the Gas X being correct or a near-miss If name and formula given then both must be correct	Misty fumes/ White gas/ White ppt/ Steamy fumes	2

Question Number	Acceptable Answers	Reject	Mark
4 (d)	Cream ppt / solid ALLOW Off white / pale yellow (1) Cream ppt/AgBr remains in dilute NH_3 but dissolves in conc. NH_3 (1) AgCl dissolves in both dilute and conc. NH_3 (1)	Just yellow/ Just white Just bromide ions	3