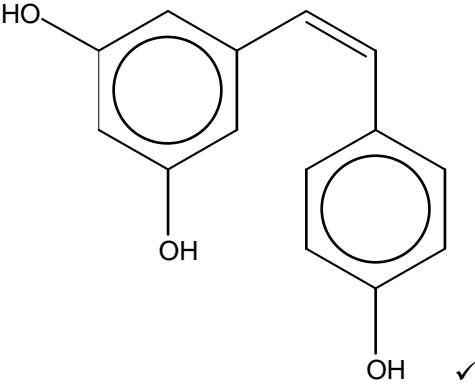
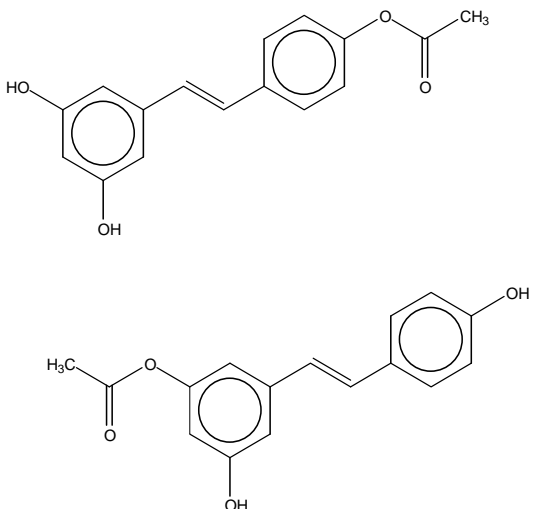


MARK SCHEME

Question			Answer	Mark	Guidance
1	(a)		<p>Two marking points from:</p> <p>non-toxic AW ✓</p> <p>no harmful/severe side effects AW ✓</p> <p>it works (better than standard medicines) AW ✓</p>	2	<p>ALLOW it (compound OR dose) is safe</p> <p>ALLOW it is effective</p>
	(b)	(i)		1	<p>ALLOW structural or skeletal formula for CH=CH</p> <p>skeletal structure must be correct and angular not linear</p> <p>-OH groups must be in correct positions</p>
		(ii)	<p>restricted rotation/twisting OR no free rotation/twisting about C=C bond ✓</p> <p>two different groups on each carbon (of the C=C) ✓</p>	2	<p>DO NOT ALLOW 'double bond' alone</p> <p>ALLOW both groups can be either side of the C=C (<i>can be shown on a diagram</i>)</p>
		(iii)	<p>they have different shapes ✓</p> <p>one would fit (better) into/bind with <u>active site</u> (of enzyme) than the other AW</p> <p>OR</p> <p>only one will form the enzyme-substrate complex / they form enzyme-substrate complexes with different enzymes ✓</p>	2	<p>ALLOW the <u>active site</u> has a specific shape</p> <p>ALLOW they could fit into/bind with different <u>active sites/receptors</u></p>

Question			Answer	Mark	Guidance
1	(c)	(i)	solvent should dissolve solute at higher temperatures AW ✓ solvent should dissolve (almost) no solute OR solute is insoluble at room/lower temperature AW ✓	2	ALLOW when warmed/heated ACCEPT much less soluble IGNORE any reference to crystallisation on evaporation ALLOW crystallises out at low temperatures
	(d)	(i)	(resveratrol has) phenol/phenolic hydroxyl groups ✓ the –OH groups/phenols/resveratrol are acids/are acidic/ is neutralised by NaOH/react with NaOH or hydroxide ions ✓ ions form ✓ QWC: ions / salts are soluble ✓	4	PLEASE ANNOTATE MARKS GIVEN WITH ✓ IGNORE phenol groups/phenols are soluble in water ALLOW salt forms / formula(e) of ion(s) ALLOW ions/salts interact/hydrogen bond/ion-dipole with water molecules
	(d)	(ii)	$\text{C}_{14}\text{H}_{12}\text{O}_3 + 3\text{OH}^- \rightarrow \text{C}_{14}\text{H}_9\text{O}_3^{3-} + 3\text{H}_2\text{O}$ acceptable anion (see Guidance) ✓ all correct as above equation ✓	2	For first marking point: IGNORE any positive metal cation anion must be $\text{C}_{14}\text{H}_9\text{O}_3^{3-}$ ALLOW $\text{C}_{14}\text{H}_9(\text{O}^-)_3$ or $\text{C}_{14}\text{H}_{10}\text{O}_3^{2-}$ or $\text{C}_{14}\text{H}_{11}\text{O}_3^-$
	(e)	(i)	$\text{C}_6\text{H}_5\text{O} / \text{C}_6\text{H}_4\text{OH}$ ✓ positive charge on molecule ✓	2	ALLOW use of phenyl ring in formula for $\text{C}_6\text{H}_4\text{OH}$ with + charge on a ring carbon (also kekule formulae) If both ring and molecular formula given, IGNORE ring
	(e)	(ii)	OH ✓	1	DO NOT ALLOW if charged IGNORE – before OH indicating a group of atoms
	(f)	(i)	ester ✓	1	ALLOW 'esther'

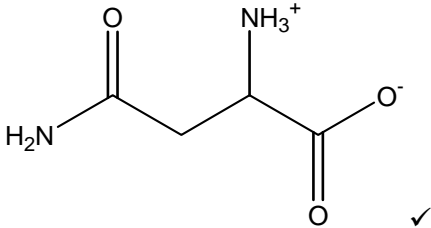
Question			Answer	Mark	Guidance
1	(f)	(ii)	 <p>ethanoyl ($\text{CH}_3\text{C}=\text{O}$) group correct ✓</p> <p>phenyl ring attachment correct (via O- to a correct OH position)✓</p> <p>the two unreacted OH groups in correct position ✓</p>	3	<p>If 2 or 3 correct –OH groups are ethanoylated then award 2 marks</p> <p>ALLOW skeletal formula for ethanoyl group</p> <p>ethanoyl group can be on either ring system</p> <p>if on the left hand side of the double bond it can be in either of the two possible positions</p>
			Total	22	

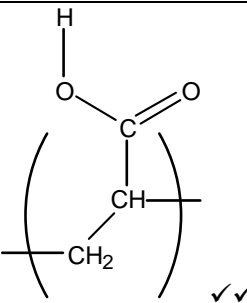
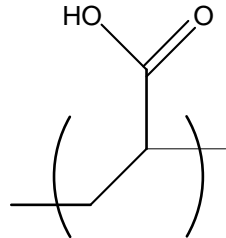
Question			Answer	Mark	Guidance
2	(a)	(i)	$\begin{array}{ccccccc} \text{Br}^- & + & \text{O}_3 & \rightarrow & \text{BrO}_3^- \\ -1 & & 0 & & +5 \ -2 \end{array}$ <p> Br^- -1 AND O_3 0 ✓ Br +5 ✓ O -2 ✓ </p>	3	SIGNS MUST BE BEFORE THE NUMBER
		(ii)	<p>bromide (ion) / Br^- ✓</p> <p>EITHER:</p> <p>(ozone / O_3 has been reduced) because the oxidation state of O has decreased or O has gained electrons ✓</p> <p>OR</p> <p>(bromide (ion) / Br^- has been oxidised) because the oxidation state of Br has increased or Br^- has lost electrons ✓</p>	2	<p>Mark independently</p> <p>ALLOW bromine (1)- ion NOT bromine ion</p> <p>ACCEPT ozone/O_3 has gone from 0 to -2/-6 or has gained electrons</p> <p>ACCEPT bromine/Br^- has gone from -1 to +5 or has lost electrons</p>

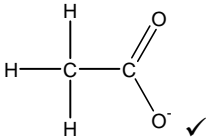
Question			Answer	Mark	Guidance
2	(b)	(i)	<p>Any one of the following methods:</p> <p>Method 1 concentration ✓ iodine ✓ (by) titration (with thiosulfate/suitable reducing agent) ✓</p> <p>Method 2 colour / absorbance ✓ iodine ✓ (by) colorimetry ✓</p> <p>Method 3 acidity/pH ✓ H⁺ ✓ (by) pH meter / titration ✓</p>	3	<p>DO NOT ALLOW the 1st marking point if answer contains 'change' The 'property' stated determines the method used <i>i.e.</i> <i>no mix and match allowed</i></p> <p>Method 1: 'redox titration' scores 2 marks for last 2 marking points if no 2nd answer (substance) is given IGNORE any reference to a 'clock' reaction DO NOT ALLOW iodide ion/I⁻</p> <p>Method 2: ALLOW concentration / transmission for first mark</p> <p>in adaption of method 3: ALLOW concentration (of H⁺) OR conductivity for first mark</p>
		(ii)	<p>BrO₃⁻ = 0 ✓</p> <p>I⁻ = 2 ✓</p> <p>H⁺ = 1 ✓</p>	3	
		(iii)	<p>$k = 2.40 \times 10^{-3} / (0.20 \times 0.10 \times (0.10)^2)$ ✓ = 12 (to 2 sf) ✓</p> <p>mol⁻³ dm⁺⁹ s⁻¹ ✓</p>	3	<p>REMEMBER: if answer = 12 then 2 marks awarded irrespective of working 12.0 scores only 1 mark</p> <p>Ecf for 2nd mark if sf correct</p> <p>NO ECF for UNITS ALLOW numbers only for positive indices ALLOW terms in any order e.g. dm⁹ mol⁻³ s⁻¹</p>

Question			Answer	Mark	Guidance
2	(b)	(iv)	as reactants are used up /as their concentration changes , the rate will change /alter/decrease/get slower ✓ concentrations remain (almost) constant / do not change <i>or</i> rate measured will be for the initial concentrations AW ✓	2	DO NOT ALLOW constant concentration linked to an excess of reactant(s) (this is a CON)
			Total	16	

Question			Answer	Mark	Guidance
3	(a)	(i)	alkene / carbon-carbon double bond ✓ amide ✓	2	double bond alone does NOT score DO NOT ALLOW secondary amide alkene + amine + ketone(carbonyl) = 1 mark
		(ii)	$\text{C}_2\text{H}_3\text{CONH}_2 + \text{H}_2\text{O} + \text{H}^+ \rightarrow \text{C}_2\text{H}_3\text{COOH} + \text{NH}_4^+$ ✓✓ $\text{C}_2\text{H}_3\text{CONH}_2 + \text{OH}^- \rightarrow \text{C}_2\text{H}_3\text{COO}^- + \text{NH}_3$ ✓✓	4	1 mark for each correct product DO NOT ALLOW NH_4OH H₂O as a product in 2 nd equation means max of 3 marks
	(b)	(i)	Propylamine / 1-aminopropane ✓	1	ALLOW 1-propylamine DO NOT ALLOW aminopropane
		(ii)	<i>Any two of the following three answers:</i> NO peak at about $1620\text{-}1680\text{ cm}^{-1}$ indicates NO C=C / alkene present ✓ NO peak at about $1630\text{-}1700\text{ cm}^{-1}$ indicates NO C=O / amide present ✓ NO peak at 3500 cm^{-1} indicates amide gone ✓	2	ALLOW correct wavenumbers without units and a single wavenumber value in the correct range ALLOW peak at $3300\text{-}3500\text{ cm}^{-1}$ indicates amine (indicates N-H bond alone is insufficient)
	(c)	(i)	(NH_2 group) has a lone pair (of electrons) ✓ which can accept a proton / H^+ ✓	2	

Question			Answer	Mark	Guidance
3	(c)	(ii)		1	TAKE CARE + charge has to be on the AMINE group not the AMIDE
		(iii)	non superimposable ✓ mirror image ✓	2	
	(d)	(i)	UUA ✓	1	
		(ii)	Ala-Asn-Val 2 of the 3 acids correct ✓ all correct ✓	2	ALLOW full names for Ala-Asn-Val Ala, Asn and Val MUST be in this order IGNORE lack of dashes and/or small initial letters
			Total	17	

Question			Answer	Mark	Guidance
4	(a)			2	<p>2 marks for correct skeletal formula/structural formula ALLOW if -OH attached to C=O rather than -O-H</p>  <p>1 mark for correct structural formula with acid group as -COOH OR a correct dimer etc. IGNORE brackets</p>
	(b)	(i)	<p>addition ✓</p> <p>C=C bonds on side chains (in different polymer chains) break/open up and form a (covalent) bond/link ✓</p>	2	<p>IGNORE polymerisation, electrophilic, radical nucleophilic is a CON</p>
		(ii)	<p>an alcohol group present ✓</p> <p>any correctly drawn formula with two hydroxyl / -OH groups ✓</p> <p>condensation ✓</p>	3	<p>e.g. HOCH₂CH₂OH</p> <p>ACCEPT the two OH groups attached to the same carbon</p> <p>IGNORE polymerisation ALLOW esterification ALLOW addition AND elimination</p>
		(iii)	<p>(addition) so no atoms/products are wasted OR only ONE product ORA ✓</p>	1	<p>ORA more than ONE product / water is formed in Method 2 ALLOW by-product or co-product formed in Method 2 IGNORE values for atom economy</p>

Question			Answer	Mark	Guidance
4	(c)	(i)	sodium / potassium hydroxide ✓	1	IGNORE strength / alkali ALLOW NaOH / KOH ALLOW hydroxide ALLOW a given metal carbonate. ALLOW suitable metals e.g. Na, K, Mg, etc.
		(ii)		1	ALLOW delocalised carboxylate ion IGNORE any added metal ions ALLOW -CH ₃
		(iii)	<p>crosslinks will prevent chains moving apart (sufficiently to dissolve) / held in position (so it does not dissolve) AW ✓</p> <p>without crosslinks water will force polymer chains apart (and so polymer will dissolve) AW ✓</p>	2	ALLOW without crosslinks water will form intermolecular bonds (hydrogen bonds) with chains/molecules/polymer/ COOH or OH groups
	(d)	(i)	it increased as water was absorbed AW ✓	1	Increase alone is insufficient an explanation is required

Question			Answer	Mark	Guidance
4	(d)	(ii)	<p>Any 6 marking points from the following 7:</p> <p>1. Select orange/red/complementary colour for filter ✓</p> <p>2. Make up/use dye solutions of different known/standard concentrations ✓</p> <p>3. Measure the absorbance/transmission/transmittance of the dye solutions of different known concentrations</p> <p>OR absorbance/transmission/transmittance of the blue dye solution AW ✓</p> <p>4. Plot calibration graph of <u>absorbance(or alternative see 3 above) readings v concentration</u> ✓</p> <p>5. Add the polymer (known mass) to the dye solution and measure the new absorbance ✓</p> <p>6. Repeat/take measurements until no further change in absorbance/transmission / over a period of time AW ✓</p> <p>7. Use the calibration curve to find out how the concentration of the blue dye changes / to find the concentration of the blue dye at different times ✓</p>	6	<p>PLEASE ANNOTATE MARKS GIVEN WITH ✓</p> <p>DO NOT ALLOW 'suitable' filter ALLOW any shade of orange or red</p> <p>QWC: This is not an extra mark absorbance/transmission/transmittance MUST be spelt correctly once to award one of the marking points 3-7 as the QWC mark max mark without correct spelling is thus 5</p> <p>Annotate the QWC mark by ✓ on the correctly spelt word</p> <p>If no correct spelling indicate with X on a mis-spelt word</p>

Question			Answer	Mark	Guidance
4	(e)		<p><i>One marking point from:</i></p> <p>Used packaging consists of many different polymers which need to be <u>sorted</u> / <u>separated</u> first AW ✓</p> <p>Lots of other compounds/additives in plastics used for packaging need to be removed AW ✓</p> <p>Can wash/separate polymer from nappies and then heat to remove absorbed water AW ✓</p>	1	
			Total	20	

Question			Answer	Mark	Guidance
5	(a)	(i)	1.3(0) V ✓	1	IGNORE sign
		(ii)	concentration of OH ⁻ ions in the Ni/Cd <u>battery</u> is greater than/not 1.0 mol dm ⁻³ OR the Ni/Cd <u>battery</u> is not at standard conditions ✓ OR the <u>measured</u> voltage is not done at standard conditions	1	ALLOW temperature change It must be clear that it is the voltage of the battery was not measured at standard conditions rather than the data given in the table
		(iii)	Ni(OH) ₂ + Cd(OH) ₂ → NiO ₂ + Cd + 2H ₂ O ✓	1	IGNORE state symbols ALLOW if 2OH ⁻ is inserted on each side of the equation
	(b)		(it is 'green' because it forms iron(III) oxide/rust as) product which is non-polluting / non toxic / not harmful (to the environment) ✓ they can be put in landfill sites / be more easily disposed of / they do not need special methods of disposal ✓	2	IGNORE any reference to Ni/Cd

Question			Answer		Mark	Guidance					
5	(c)		<p>1. moles of NO_2^- in $1000 \text{ dm}^3 = 6.0 \times 10^{-6} \times 10^3 = 6.0 \times 10^{-3} \checkmark$</p> <p>2. moles of K_2FeO_4 required = $6.0 \times 10^{-3} \times 2 / 3 = 4.0 \times 10^{-3} \checkmark$</p> <p>3. M_r of $\text{K}_2\text{FeO}_4 = 198(.0) \checkmark$</p> <p>4. mass of K_2FeO_4 required = $4.0 \times 10^{-3} \times 198.0 = 0.79(2) \text{ g} \checkmark$</p>		4	<p>The marks are awarded for the working out given in bold.</p> <p>IF FINAL ANSWER IS INCORRECT PLEASE ANNOTATE MARKS GIVEN WITH \checkmark</p> <p>1. moles of nitrate = correct concentration x correct volume in dm^3</p> <p>2. moles of ferrate (K_2FeO_4) = 2/3 x moles of nitrate</p> <p>3. M_r of ferrate (K_2FeO_4) correct to at least 3 sig figs</p> <p>4. mass of ferrate (K_2FeO_4) = ferrate (K_2FeO_4) in $250 \text{ cm}^{-3} \times 198$ Do not allow 0.8 g</p> <p>ecf from 2 and 3</p>					
	(d)	(i)	<table><tr><td>shape of ion</td><td>Octahedral \checkmark</td></tr><tr><td>coordination number of Fe</td><td>6 \checkmark</td></tr><tr><td>colour of ion in water</td><td>Yellow or yellow-brown \checkmark</td></tr></table>	shape of ion	Octahedral \checkmark	coordination number of Fe	6 \checkmark	colour of ion in water	Yellow or yellow-brown \checkmark	3	<p>ALLOW orange or orange-brown</p> <p>DO NOT ALLOW red / brown / red-brown / rusty-brown / rust coloured</p>
shape of ion	Octahedral \checkmark										
coordination number of Fe	6 \checkmark										
colour of ion in water	Yellow or yellow-brown \checkmark										
		(ii)	<p>$\text{Fe}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) \checkmark$</p> <p>species correct and balanced \checkmark</p> <p>state symbols correct \checkmark</p>	2							

Question			Answer	Mark	Guidance
5	(d)	(iii)	<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>3d</p> <div style="display: flex; align-items: center;"> Fe^{3+} <div style="border: 1px solid black; display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; width: 20px; height: 20px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> </div> <div style="text-align: center;"> <p>4s</p> <div style="border: 1px solid black; width: 30px; height: 30px; margin: 0 auto;"></div> </div> </div> </div>	1	<p>IGNORE direction of arrows</p> <p>ALLOW single headed arrows</p>
			Total	15	