OCR
RECOGNISING ACHIEVEMENT

GCE

Chemistry B (Salters)

Advanced GCE

Unit **F334:** Chemistry of Materials

Mark Scheme for January 2011

Oxford Cambridge and RSA Examinations

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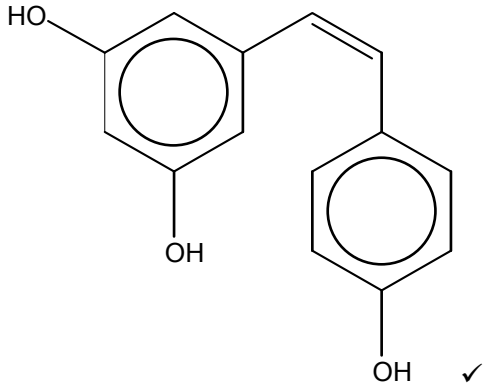
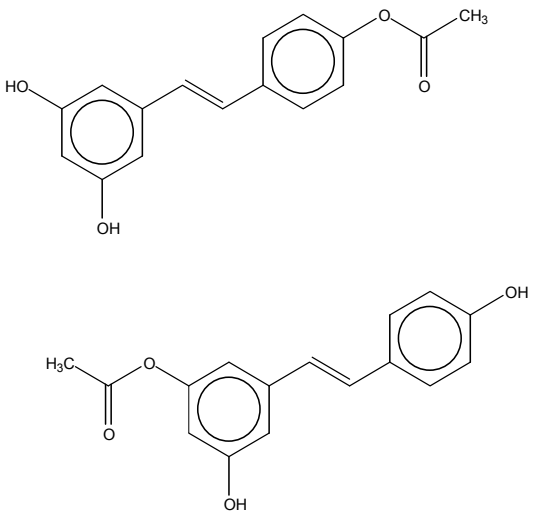
MARK SCHEME

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

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)	$C_{14}H_{12}O_3$ + **3OH$^-$** → **$C_{14}H_9O_3^{3-}$** + **3H_2O** acceptable anion (see Guidance) ✓ all correct as above equation ✓	2	**For first marking point:** **IGNORE** any positive metal cation anion must be $C_{14}H_9O_3^{3-}$ **ALLOW** $C_{14}H_9(O^-)_3$ or $C_{14}H_{10}O_3^{2-}$ or $C_{14}H_{11}O_3^-$
	(e)	(i)	C_6H_5O / C_6H_4OH ✓ positive charge on molecule ✓	2	**ALLOW** use of phenyl ring in formula for C_6H_4OH 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'

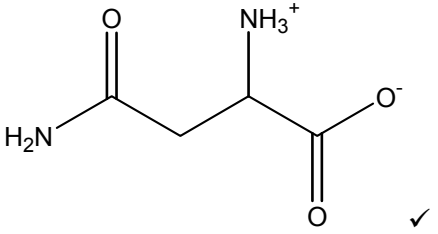
Question			Answer	Mark	Guidance
1	(f)	(ii)	 ethanoyl ($CH_3C{=}O$) group correct ✓ phenyl ring attachment correct (via O− to a correct OH position)✓ the two unreacted OH groups in correct position ✓	3	If 2 or 3 correct –OH groups are ethanoylated then award 2 marks **ALLOW** skeletal formula for ethanoyl group **ethanoyl** group can be on either ring system if on the **left hand side** of the double bond it can be in either of the **two** possible positions
			Total	**22**	

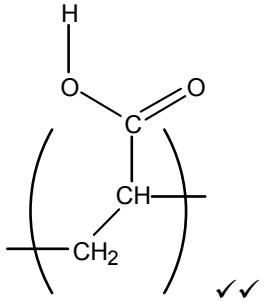
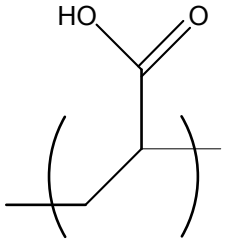
Question			Answer	Mark	Guidance
2	(a)	(i)	Br^- + O_3 → BrO_3^- -1 0 +5 -2 Br^- -1 **AND** O_3 0 ✓ Br +5 ✓ O -2 ✓	3	SIGNS MUST BE BEFORE THE NUMBER
		(ii)	 bromide (ion) / Br^- ✓ **EITHER:** (ozone / O_3 has been reduced) because the oxidation state of O has decreased *or* O has gained electrons ✓ **OR** (bromide (ion) / Br^- has been oxidised) because the oxidation state of Br has increased *or* Br^- has lost electrons✓	2	**Mark independently** **ALLOW** bromine (1)− ion **NOT** bromine ion **ACCEPT** ozone/O_3 has gone from 0 to -2/-6 *or* has gained electrons **ACCEPT** bromine/Br^- has gone from -1 to +5 *or* has lost electrons

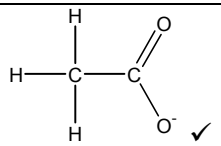
Question			Answer	Mark	Guidance
2	(b)	(i)	*Any one of the following methods:* **Method 1** concentration ✓ iodine ✓ (by) titration (with thiosulfate/suitable reducing agent) ✓ **Method 2** colour / absorbance ✓ iodine ✓ (by) colorimetry ✓ **Method 3** acidity/pH ✓ H^+ ✓ (by) pH meter / titration ✓	3	**DO NOT ALLOW** the 1st marking point if answer contains 'change' The 'property' stated determines the method used *i.e. no mix and match allowed* **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^- **Method 2: ALLOW** concentration / transmission for **first mark** in adaption of **method 3: ALLOW** concentration (of H^+) **OR** conductivity for **first mark**
		(ii)	BrO_3^- = 0 ✓ I^- = 2 ✓ H^+ = 1 ✓	3	
		(iii)	k = 2.40 x 10^{-3} / (0.20 x 0.10 x $(0.10)^2$) ✓ = 12 (to 2 sf) ✓ $mol^{-3}\ dm^{+9}\ s^{-1}$ ✓	3	**REMEMBER:** if answer = 12 then **2 marks** awarded irrespective of working 12.0 scores only **1 mark** Ecf for 2nd mark if sf correct **NO ECF for UNITS** **ALLOW** numbers only for positive indices **ALLOW** terms in any order *e.g.* $dm^9\ mol^{-3}\ s^{-1}$

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 *or* **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)	$C_2H_3CONH_2 + H_2O + H^+ \rightarrow C_2H_3COOH + NH_4^+$ ✓✓ $C_2H_3CONH_2 + OH^- \rightarrow C_2H_3COO^- + NH_3$ ✓✓	4	1 mark for each correct product **DO NOT ALLOW** NH_4OH **H_2O** as a product in 2nd equation means max of 3 marks
	(b)	(i)	Propylamine / 1-aminopropane ✓	1	**ALLOW** 1-propylamine **DO NOT ALLOW** aminopropane
		(ii)	*Any* **two** *of the following* **three** *answers:* NO peak at about 1620-1680 cm^{-1} indicates NO C=C / alkene present ✓ NO peak at about 1630-1700 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 3300-3500 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	**2 marks** for correct skeletal formula/structural formula **ALLOW** if –OH attached to C=O rather than –O–H  **1 mark** for correct structural formula with acid group as –COOH **OR** a correct dimer etc. **IGNORE** brackets
	(b)	**(i)**	addition ✓ C=C bonds on **side chains** (in different polymer chains) break/open up and form a (covalent) bond/link ✓	2	**IGNORE** polymerisation, electrophilic, radical nucleophilic is a **CON**
		(ii)	an alcohol group present ✓ any correctly drawn formula with **two** hydroxyl / -OH groups ✓ condensation ✓	3	*e.g.* $HOCH_2CH_2OH$ **ACCEPT** the two OH groups attached to the same carbon **IGNORE** polymerisation **ALLOW** esterification **ALLOW** addition AND elimination
		(iii)	(addition) so no atoms/products are wasted **OR** only ONE product ORA ✓	1	**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

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)	crosslinks will prevent **chains moving apart** (sufficiently to dissolve) / held in position (so it does not dissolve) AW ✓ without crosslinks water will force polymer chains apart (and so polymer will dissolve) AW ✓	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)	**Any 6** marking points from the following **7:** **1.** Select orange/red/complementary colour for **filter** ✓ **2.** Make up/use dye solutions of different **known/standard concentrations** ✓ **3**. **Measure the absorbance**/transmission/transmittance of the dye solutions of different known concentrations **OR** absorbance/transmission/transmittance of the blue dye solution AW ✓ **4. Plot calibration graph** of absorbance(or alternative see 3 above) readings v concentration ✓ **5. Add the polymer** (known mass) to the dye solution and **measure** the new **absorbance** ✓ **6. Repeat/take** measurements until no further change in absorbance/transmission / over a period of time AW ✓ **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 ✓	**6**	PLEASE ANNOTATE MARKS GIVEN WITH ✓ **DO NOT ALLOW** 'suitable' filter **ALLOW** any shade of orange or red **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** **Annotate the QWC mark by ✓ on the correctly spelt word** If no correct spelling indicate with **X** on a mis-spelt word

Question			Answer	Mark	Guidance
4	(e)		*One marking point from:* Used packaging consists of many different polymers which need to be **sorted / separated** first AW ✓ Lots of **other compounds/additives in plastics** used for packaging need to be **removed** AW ✓ Can wash/**separate polymer** from nappies and then **heat to remove absorbed water** AW ✓	**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 battery is greater than/not 1.0 mol dm^{-3} **OR** the Ni/Cd battery is not at standard conditions ✓ **OR** the measured 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)	$Ni(OH)_2 + Cd(OH)_2 \rightarrow NiO_2 + Cd + 2H_2O$ ✓	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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>5</td><td>(c)</td><td></td><td>1. moles of NO_2^- in 1000 dm^3 = $6.0 \times 10^{-6} \times 10^3$ = 6.0×10^{-3} ✓

2. moles of K_2FeO_4 required = 6.0×10^{-3} x 2 / 3 = 4.0×10^{-3} ✓

3. M_r of K_2FeO_4 = 198(.0) ✓

4. mass of K_2FeO_4 required = 4.0×10^{-3} x 198.0 = 0.79(2) g ✓</td><td>4</td><td>The marks are awarded for the working out given in bold.
IF FINAL ANSWER IS INCORRECT PLEASE ANNOTATE MARKS GIVEN WITH ✓

1. moles of nitrate = correct concentration x correct volume in dm^3

2. moles of ferrate (K_2FeO_4) = 2/3 x moles of nitrate

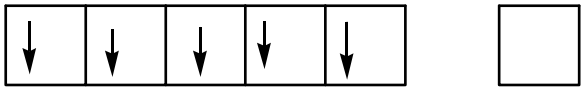
3. M_r of ferrate (K_2FeO_4) correct to at least 3 sig figs

4. mass of ferrate (K_2FeO_4) = ferrate (K_2FeO_4) in 250 cm^{-3} x 198
Do not allow 0.8 g

ecf from 2 and 3</td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td><table><tr><td>shape of ion</td><td>Octahedral ✓</td></tr><tr><td>coordination number of Fe</td><td>6 ✓</td></tr><tr><td>colour of ion in water</td><td>Yellow or yellow-brown ✓</td></tr></table></td><td>3</td><td>ALLOW orange or orange-brown
DO NOT ALLOW red / brown / red-brown / rusty-brown / rust coloured</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>$Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$✓

species correct and balanced ✓

state symbols correct ✓</td><td>2</td><td></td></tr>
</table>

Question			Answer	Mark	Guidance
5	(d)	(iii	3d 4s Fe^{3+} 	1	**IGNORE** direction of arrows **ALLOW** single headed arrows
			Total	**15**	

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