OCR
RECOGNISING ACHIEVEMENT

GCE

Chemistry B (Salters)

Advanced GCE

Unit **F334:** Chemistry of Materials

Mark Scheme for June 2011

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

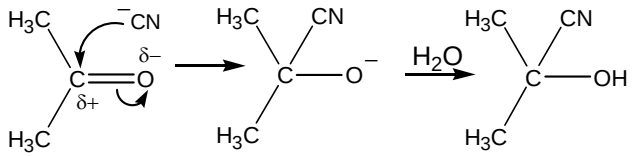
Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

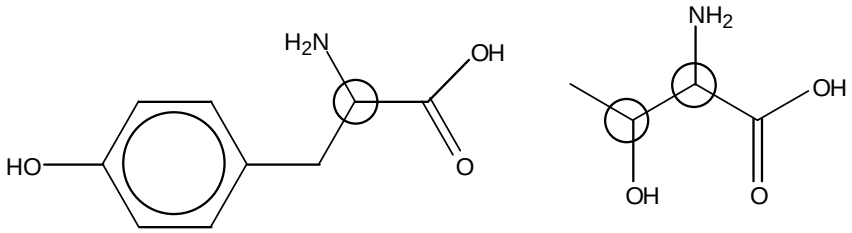
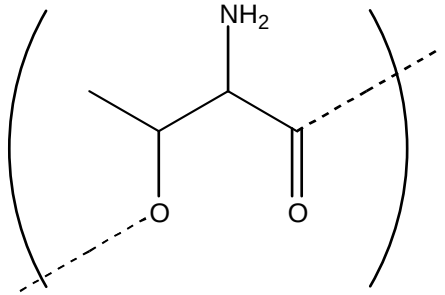
Question			Answer	Mark	Guidance
1	a	i	ethanal ✓	1	**DO NOT ALLOW** acetaldehyde
		ii	acidified / H^+ ✓ dichromate / $Cr_2O_7^{2-}$ ✓ distil ✓	3	**IGNORE** any sodium/potassium ions in formula/name **ALLOW** only sulfuric acid / H_2SO_4 **IGNORE** fractional **ALLOW** distillation **DO NOT ALLOW** if reflux is also stated
		iii	(strong) peak/trough at around 1720 (cm^{-1}) / *anywhere* in region **1700-1725 indicates C=O** (in carboxylic acid) (NOT PRESENT IN ETHANOL) ✓ (broad) peak/trough at around 3100 (cm^{-1}) / *anywhere* in region **2500-3200 indicates O-H** (in carboxylic acid) (NOT PRESENT IN COMPOUND A) ✓ ethanoic acid **OR** Compound B ✓	3	**OR** no peak above 3200 (cm^{-1}) OR in region of 3600-3640 (cm^{-1}) for –OH in alcohol **DO NOT ALLOW** No peak/trough at 1050-1300 for C-O in alcohol (cm^{-1}) *since peaks are present in this region* **ALLOW** no (strong) peak/trough at around 1720-1740 (cm^{-1}) for aldehyde group in compound A **DO NOT ALLOW** a carboxylic acid **ALLOW** labels on peaks in spectrum
		iv	Any suggestion that indicates that reflux/excessive heating took place / distillation of ethanal as it was formed did not take place **OR** **excess** acidified dichromate was used / acidified dichromate was not added slowly to ethanol ✓ (ethanol/ethanal was) <u>oxidised</u> further ✓	2	
1	b	i	ester ✓	1	

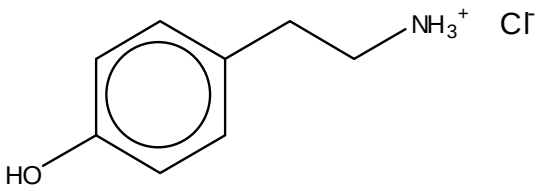
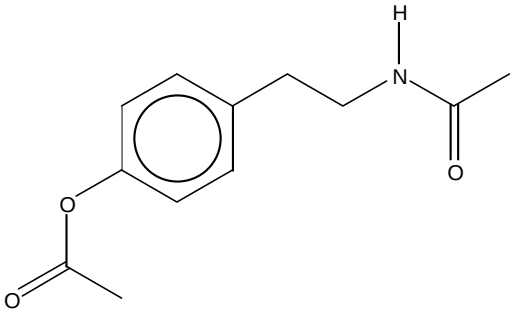
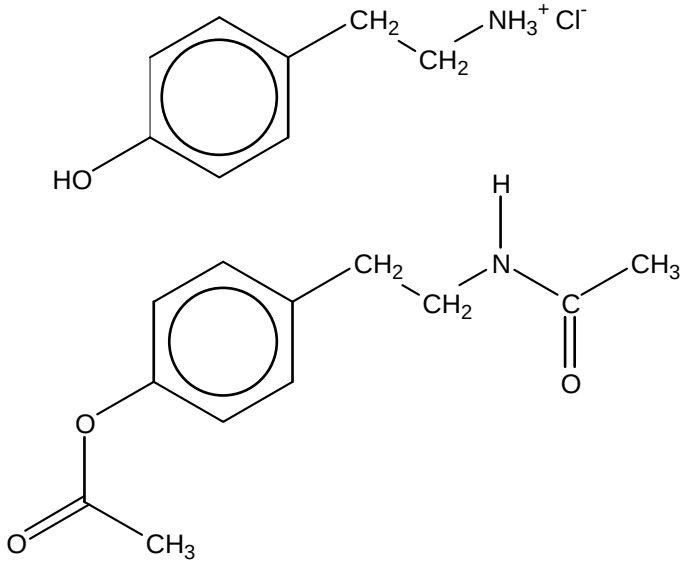
Question			Answer	Mark	Guidance
		ii	$C_2H_5OH + CH_3COOH \rightarrow CH_3COOC_2H_5 + H_2O$ ethanoic acid correct ✓ products correct ✓	2	**ALLOW** any correct type of structural formulae
		iii	concentrated sulfuric acid **OR** H_2SO_4 ✓ act as catalyst **OR** speed up reaction rate **OR** absorb water ✓	2	**IGNORE** references to activation enthalpy
		iv	reduces number of steps / increases atom economy **OR** could be cheaper **OR** could be faster **OR** reduces energy requirements **OR** can be carried out at low temperature **OR** can be reused ✓	1	

Question			Answer	Mark	Guidance
1	c		**ANY 5 POINTS FROM THE FOLLOWING 6:** 1. enzymes (are proteins / polypeptides) with a **specific** / *AW* **order** / sequence **of amino acids** ✓ 2. if the DNA is damaged the **primary structure** of the protein / **order of the amino acids** in the enzyme **will be altered** / changed ✓ 3. so the **tertiary structure**/folding of chains of the enzyme will also **alter** / change ✓ 4. the **active site** (is part of the tertiary structure and) is where the **reaction with the substrate** takes place *AW* ✓ 5. an altered active site will **not have the correct shape** ✓ 6. and (interact with the substrate) by **forming the correct** / *AW* **intermolecular bonds** / forces ✓ **AWARD QWC MARK FOR** altered/different active site linked to less/no reaction / enzyme does not work *AW* ✓	6	PLEASE ANNOTATE MARKS GIVEN WITH ✓ PUT ✓ for QWC next to 'pencil' icon **1. enzymes have a sequence of amino acids** **2. damage to DNA leads to different amino acids / primary structure** **3. resulting in different tertiary structure** **4. reaction takes place / substrate fits in at active site** **5. active site shape alters** **6. substrate can not bind/interact with active site OR can not form substrate-complex** **ALLOW** ….. by binding/bonding differently
				21	

Question			Answer	Mark	Guidance
2	a	i	T_g of PMMA is **above RT** so will be brittle / not enough energy to break intermolecular bonds / chains can not move over each other ✓ T_g of PMA is **below RT** so will be flexible/ rubbery / enough energy to break intermolecular bonds / chains can move over each other ✓	2	**IGNORE** any reference to crystallinity
		ii	chains in PMMA cannot move/slide over each other (easily) *ORA* ✓	1	*ORA* Chains in PMA can move over each other (easily) ✓
		iii	add a plasticiser / copolymerisation / add a copolymer ✓	1	**DO NOT ALLOW** cold-drawing
	b	i	intermolecular bonds in propene are instantaneous (dipole) – induced dipole ✓ intermolecular bonds in propanone are permanent (dipole) – permanent dipole ✓ more energy/higher temperature for propanone required ✓ because intermolecular bonds in propanone are stronger *ORA* ✓	4	**DO NOT ALLOW** id-id bonds **ALLOW** pd-pd bonds if an abbreviation is used for a second time **ALLOW** 1 mark if answer in terms of increased instantaneous – dipole induced dipole bonds (max mark is then 2)
		ii	hydrogen cyanide / cyanide ion ✓	1	**ALLOW** HCN / CN^- **ALLOW** potassium cyanide / sodium cyanide **OR** KCN / NaCN **IGNORE** acid or alkali

Question			Answer	Mark	Guidance
2	b	iii	 curly arrows correct on propanone ✓ partial charges correct on C=O ✓ correct anion formed ✓ correct reaction with H_2O or H^+ or HCN ✓	4	**ALLOW** mechanism if HCN is shown attacking but arrow must come from H-CN bond Curly arrow from nucleophile **MUST** come from carbon in either CN ion or HCN **ALLOW** CN^- for ion if arrow correct
		iv	(cyanide ion is a nucleophile and) the lone pair/electrons (which attack the electron deficient carbon) are on C (not N) ✓ **OR** nucleophile is **:**CN^- ✓	1	**ALLOW** the negative charge is on C **IGNORE** any reference to triple bond in CN
		v	few atoms wasted/high atom economy ✓	1	**ALLOW** 100% / no waste
	c	i	(moderately) concentrated acid ✓ (heat under) reflux ✓	2	**ALLOW** aqueous / dilute acid / H^+ and water **DO NOT ALLOW** conc. sulphuric acid or any form of alkali
		ii	amide ✓	1	**IGNORE** any qualification of amide i.e primary etc. **IGNORE** any given formulae **DO NOT ALLOW** peptide
		iii	only **F** ✓ there are (2) different groups on each C (of the double bond) ✓	2	marks are independent **DO NOT ALLOW** …on each side of C=C
				20	

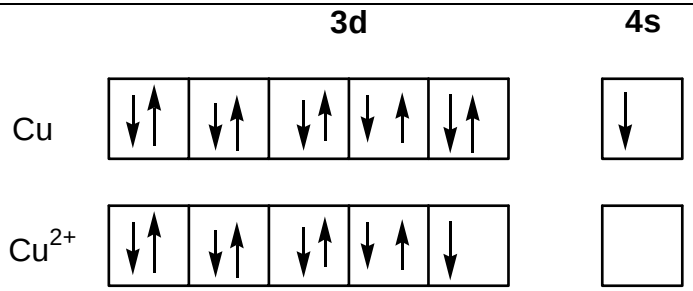
Question			Answer	Mark	Guidance
3	a		Tyrosine: <u>phenol</u> ✓ Threonine: <u>alcohol</u> ✓ add (neutral) $FeCl_3$ / iron(III) chloride ✓ Tyrosine: turns purple/violet **AND** Threonine remains yellow /does not change colour ✓	4	**ALLOW** orange **BUT NOT** brown alone for colour of $FeCl_3$ **ALLOW** acidified dichromate ✓ – Threonine goes green **AND** Tyrosine remains orange / does not change colour ✓
	b		 Tyrosine: correct: 1 chiral centre ✓ Threonine correct: 2 chiral centres ✓	2	
	c		 1 mark for correct repeating unit ✓ ester ✓	2	**IGNORE** brackets and *n* full structural / skeletal formula not required **ALLOW** multiple repeating units showing correct ester linkage

Question			Answer	Mark	Guidance
3	d	i	**with HCl**  1 mark for -NH_3^+ group correct ✓ 1 mark for rest of ion correct ✓ **with CH_3COCl**  and HCl 1 mark for each acyl group ✓✓ 1 mark for HCl (**IGNORE** number of HCls) ✓	5	**ALLOW** correct (full) structures but H's must be shown **ALLOW** –NH_3+ve ion without Cl^- 
		ii	phenols / phenol group / -OH group on tyramine will form ion / react with alkalis ✓ ionic substances / salts are (more) soluble in water **OR** ions interact / bond / with water (molecules) **OR** ions are attracted to water (molecules) ✓	2	**ALLOW** …… forms salts
				15	

Question			Answer	Mark	Guidance
4	a		water / H_2O ✓	1	
	b	i	**1**. (fill) **burette** with $KMnO_4$ / MnO_4^- solution ✓ **2**. use bulb / volumetric / graduated / 25 cm^3 / 10 cm^3 **pipette** for sodium ethanedioate ✓ **3**. to place solution in flask / beaker and then **acidify** (and warm flask) ✓ **4**. then add $KMnO_4$ / MnO_4^- solution **slowly** (*AW*) near end point ✓ **5**. until **permanent <u>pink</u>** colour *AW* ✓	5	PLEASE ANNOTATE MARKS GIVEN WITH ✓ **QWC:** Either **burette** or **pipette** must be spelled correctly to get both marks for **1** and **2**; **2.** pipette must be qualified by type as shown **OR** by saying 'pipette a known / *stated (e.g. 25 cm^3)* volume' for **1-4 ALLOW** different ways of describing each solution, either by an appropriate name or formula **3.** If acid is named **ONLY ALLOW** sulfuric acid **4. ALLOW** alternatives – *e.g. swirling and use of white tile* **5. ALLOW** pink colour persists / remains /is constant **ALLOW** 'pale pink/purple' **BUT NOT** 'purple' alone **DO NOT ALLOW** if indicator is used **IF SOLUTIONS REVERSED** 1 AND 2 score 1 mark only 5. becomes… permanent *AW* <u>colourless</u> solution So max mark = 4 **IGNORE** any reference to rough titrations
4	b	ii	moles of sodium ethanedioate = **0.0500 x 250/1000** (= 0.0125) ✓ mass = **((moles of ethanedioate) x 134)** correctly evaluated (1.675(0) g) ✓	2	**the marks are awarded for the working out given in bold** **ALLOW** 2 - 5 sig. figs. **ecf** for moles in mass calculation

Question			Answer	Mark	Guidance
		iii	**1**. moles of $C_2O_4^{2-}$ = **0.0500 x 10/1000** (= 0.000500) ✓ **2**. moles of MnO_4^- = **2/5** x 0.0500 x 10.0/1000 (= 0.000200) ✓ **3**. concentration = 2/5 x 0.0500 x 10/1000 x **1000/26.0** ✓ **4**. = **0.00769** / 7.69 x 10^{-3} 3 significant figures ✓	**4**	**the marks are awarded for the working out given in bold** IF FINAL ANSWER IS INCORRECT PLEASE ANNOTATE MARKS GIVEN WITH ✓ **1**. moles of $C_2O_4^{2-}$ = correct concentration x correct volume in dm^3 **2**. moles of MnO_4^- = 2/5 x moles of $C_2O_4^{2-}$ **3**. concentration = moles of MnO_4^- x 1000/26.0 **4**. must be to 3 significant figures **ecf** from **2** and **3**
4	**c**	**i**	**1**. transition metal ion / Cu^{2+} reacts with one of reactants (to form a product) **OR** reacts to form an intermediate (compound) ✓ **2**. oxidation state of the transition metal ion / Cu^{2+} changes **OR** metal ion can be oxidised or reduced **OR** metal ion can lose or gain electrons ✓ **3**. new ion / intermediate then reacts to reform the original transition metal ion / Cu^{2+} *AW* **OR** form original oxidation state at end of reaction *AW* ✓ **4**. activation enthalpy / energy for this reaction is lower than without the transition metal ion / Cu^{2+} ✓	**4**	PLEASE ANNOTATE MARKS GIVEN WITH ✓ **IGNORE** any name / formulae given to the intermediate **ALLOW** transition metal ions have variable oxidation states
		ii	Homogeneous ✓	**1**	

Question			Answer	Mark	Guidance
	d	i	during the reaction only the $[MnO_4^-]$ would be effectively changing *AW* **OR** the $[C_2O_4^{2-}]$ and $[H^+]$ would be (effectively) constant *AW* ✓	1	
		ii	calculate at least 2 half-lives (construction lines for two half lives shown on graph) ✓ value of at least 2 half-lives quoted as 14.5±1 (s) ✓ half-life is constant ✓	3	
		iii	$6.7 \times 10^{-4} = k \times 1.20 \times 10^{-3}$ ✓ k = 0.56 (0.558) ✓ units = s^{-1} ✓	3	**ALLOW** 2+ sig figs **IGNORE** $time^{-1}$
				24	

Question			Answer	Mark	Guidance
5	a	i	 1 mark each ✓✓	2	**ALLOW single** arrow in either direction
		ii	Cu forms an <u>ion</u> with an incompletely/partly filled set of <u>d</u> orbitals / (sub) shells / energy levels ✓	1	
	b	i	the $E^{\ominus}$ of oxygen/OH^- is more positive/less negative than that for Cu^{2+}/Cu ORA ✓ <u>O_2/oxygen</u> will oxidise Cu / gain electrons from Cu (forming Cu^{2+})✓	2	ORA The $E^{\ominus}$ of Cu^{2+}/Cu is less positive/more negative than oxygen/OH^- **DO NOT ALLOW** more/less electronegative/electropositive **DO NOT ALLOW** higher/lower ORA
		ii	the $E^{\ominus}$ of Fe^{2+}/Fe is more negative/less positive than that for Cu^{2+}/Cu so Fe reacts/corrodes instead of Cu *AW* ✓	1	
	c		$Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$ equation correct ✓ state symbols correct ✓	2	EQUATION MUST BE BALANCED

Question			Answer	Mark	Guidance
5	d		**EITHER** barrier protection: Paint / grease / plastic coating / galvanising ✓ prevents copper reacting/corroding with oxygen/air **AND** water ✓ **OR** sacrificial protection: coat with/strap on blocks of Mg or Zn / galvanise ✓ the more reactive Mg or Zn corrodes/reacts instead of Cu ✓		
				10	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553