RECOGNISING ACHIEVEMENT

GCE

Chemistry

Advanced GCE **2814/01**

Chains, Rings and Spectroscopy

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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.

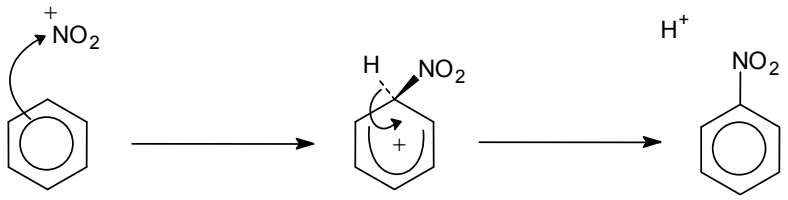
Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

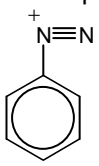
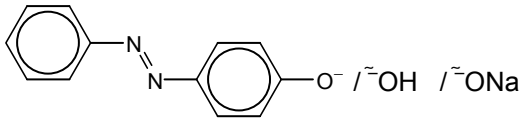
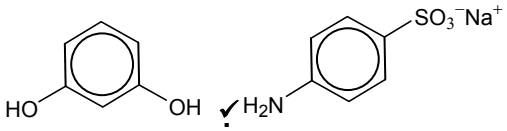
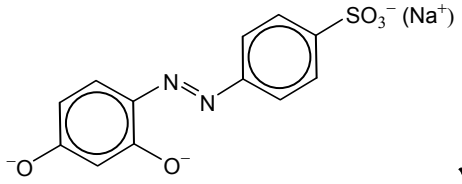
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

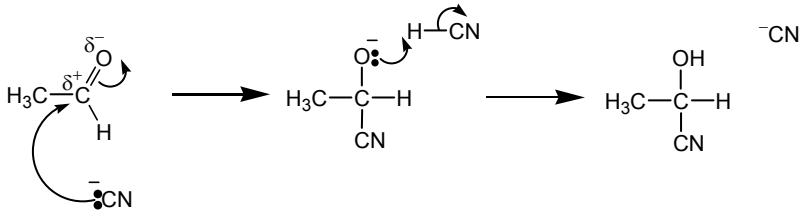
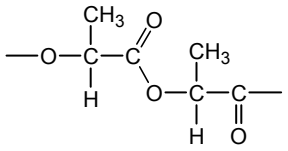
Any enquiries about publications should be addressed to:

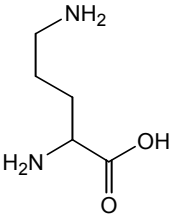
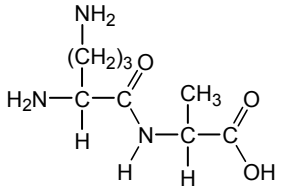
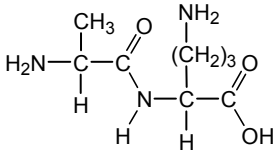
OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

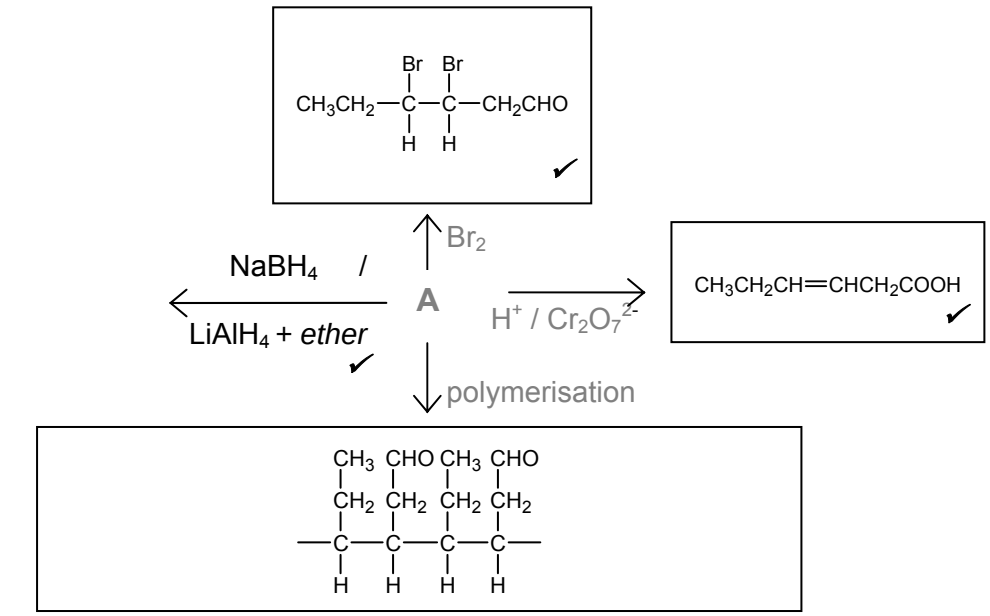
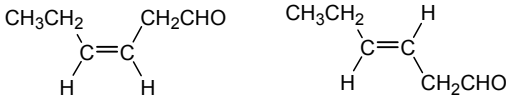
Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

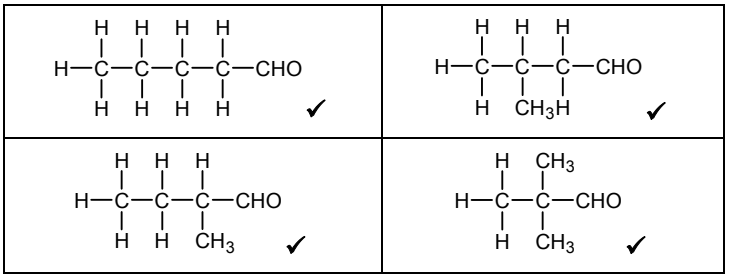
Qu.	Expected Answers		Marks
1 (a) (i)	HNO_3 + H_2SO_4 ✓ (both acids) conc ✓ 50–60°C ✓		**3**
(ii)	NO_2 ✓		**1**
(iii)	H_2SO_4 + HNO_3 ⟶ NO_2^+ + H_2O + HSO_4^- / **2**H_2SO_4 + HNO_3 ⟶ NO_2^+ + H_3O^+ + **2**HSO_4^- ✓		**1**
(iv)	 curly arrow from π bond to electrophile ✓ intermediate ✓ curly arrow from C–H bond to π bond ✓ correct products ✓		**4**
(v)	moles benzene = $^{3.9}/_{78}$ = 0.050 ✓ actual moles of nitrobenzene formed = $^{4.9}/_{123}$ = 0.040 / 0.0398 **or** theoretical mass nitrobenzene = 0.050 x 123 = 6.15 (g) ✓ % yield = $^{actual}/_{theoretical}$ mass/moles = = 79.67% = **80%** ✓	80% without working only scores 1 mark	**3**
(b) (i)	$AlBr_3$ / Fe / $FeBr_3$ ✓	**ALLOW** $AlCl_3$	**1**
(ii)	bromine decolourised ✓ white/cream solid/ppt. ✓ 2,4,6-tribromophenol identified by name/structure ✓ lone pair from O (of O–H) is delocalised into the ring (or orbital diagram to show) ✓ increases the (π) electron density(around the ring) ✓ Br–Br more polarised / more attracted ✓	**ora** for benzene	**6**
QWC	for correct use of **one** of the terms **electrophile** / **electrophilic** / **activation**		**1**
			[Total: 20]

Qu.	Expected Answers		Marks
2 (a)	**step 1** HNO_2 + HCl / $NaNO_2$ + HCl ✓ below 10°C ✓ **step 2** add to phenol in alkaline conditions / NaOH (below 10°C) ✓  ✓  ✓	**ALLOW** C_6H_5 not displayed **ALLOW** any substitution position in the dye	5
(b) (i)	N=N̰ circled ✓		1
(ii)	12 carbons ✓ 9 hydrogens ✓		2
(iii)	 ✓ ✓	**DO NOT ALLOW** connection errors here **ALLOW** $-SO_3H$	2
(c)	 ✓	**ALLOW** just one O̰	1
		[Total: 11]	

Qu.	Expected Answers		Marks
3 (a) (i)	**mechanism** arrow from **C** of CN^- to C ✓ dipole and curly arrow breaking π-bond on C=O ✓ structure of the intermediate ✓ curly arrow to H of HCN / H_2O / H^+ ✓ e.g.  **reagents:** HCN + KCN / H_2SO_4 + KCN ✓	**ALLOW** NaOH / HCN	**5**
(ii)	**type of reaction:** hydrolysis ✓ **equation:** – e.g. $CH_3CH(OH)CN + \mathbf{2}H_2O \longrightarrow CH_3CH(OH)COOH + NH_3$ / $CH_3CH(OH)CN + \mathbf{2}H_2O + H \longrightarrow CH_3CH(OH)COOH + NH_4$ H_2O / NH_3 ✓ rest of the equation and balancing ✓		**3**
(b)	lactic acid has a chiral centre / optical isomers ✓ laboratory sample has both optical isomers / stereoisomers fermentation would contain only one optical isomer **AW** ✓	**DO NOT ALLOW** just 'isomers'	**2**
(c) (i)	 ester link ✓ rest of structure also correct ✓		**2**
(ii)	**renewable** = made from plants that can be grown **AW** **biodegradable** = broken down by bacteria etc **AW** **reason linked to biodegradability** e.g. less landfill / less harm to animals / broken down by hydrolysis / no need to burn so no harmful gases etc **AW ora** **reason linked to renewability** e.g. does not increase atmospheric CO_2 **AW ora**	**ANY two for ✓✓**	**2**
(d)	$\mathbf{2}CH_3CH(OH)COOH \longrightarrow C_6H_8O_4 + \mathbf{2}H_2O$ H_2O as product / 2x lactic acid as reactants ✓ rest of the equation correct and balanced ✓	**ALLOW** any combination of molecular or structural formulae	**2**
			[Total: 16]

Qu.	Expected Answers		Marks
4 (a) (i)	$CH_2CH_2CH_2NH_2$ / ringed on structure ✓	**IGNORE** 'propylamine' but 'con' if named as an amide	**1**
(ii)	 two $-NH_2$ and skeletal $-COOH$ ✓ rest of the molecule correct ✓	**ALLOW** ecf from non-skeletal COOH	**2**
(b) (i)	$^{+}H_3NCH(CH_2CH_2CH_2NH_3^{+})COOH$ one NH_2 protonated ✓ both NH_2 protonated ✓	**IGNORE** $\bar{Cl}$ **ALLOW** $-NH_3Cl$	**2**
(ii)	$H_2NCH(CH_2CH_2CH_2NH_2)\dot{C}O\bar{O}$✓	**IGNORE** Na^+ **ALLOW** COONa **ALLOW** ecf from **(i)** on minor structural errors	**1**
(c)	$PCl_5 \longrightarrow POCl_3 + HCl$ / $SOCl_2 \longrightarrow SO_2 + HCl$ ✓ ✓ ✓ ✓ ✓ ✓ (allow $PCl_3 \longrightarrow H_3PO_3$ for the first two marks)		**3**
(d)	one peptide linkage correct ✓   one correct dipeptide ✓ second dipeptide with R groups swapped ✓	**ALLOW** CONH not displayed max one mark if COONH linkage **ALLOW** ornithine linked by either NH_2 group **ALLOW** $C_3H_6NH_2$ for the side chain **ALLOW** ecf for last mark for idea of swapping side chains as long as a peptide is attempted	**3**
			[Total: 12]

Qu.	Expected Answers	Marks
5 (a)	hex-3-en ..... al ✓ ✓	**ALLOW** 'ene' **ALLOW** '-1-al' **2**
(b)	 addition polymer attempted with two repeats ✓ correct side chains ✓	**5**
(c)	 *cis* ✓ *trans* ✓	**ALLOW** one mark for two correct structures with incorrect labels **ALLOW** ecf on minor side chain errors **2**
		[Total: 9]

Qu.	Expected Answers		Marks
6 (a)	**To confirm aldehyde or ketone** 2,4-dinitrophenylhydrazine / Brady's reagent ✓ red / orange / yellow ... solid / ppt / crystals ✓ **To distinguish between aldehyde or ketone** warm with ✓ ammoniacal silver nitrate / Tollens' reagent ✓ → silver (mirror) ✓ / acidified $Cr_2O_7^{2-}$ ∴ → green	**DO NOT ALLOW** recrystallise etc for the 2nd mark **ALLOW** any other suitable tests e.g. Fehlings, MnO_4^-	**5**
(b) (i)	**M** written next to the peak at *m/e* = 106 ✓		**1**
(ii)	C_7H_6O / C_6H_5CHO C = 7 ✓H = 6 and O ✓	**ALLOW** ecf on H5 if the peak at 105 labelled	**2**
(c)	 ✓ ✓ ✓ ✓		**4**
(d)	**D**: No of peaks and areas: 3 peaks ratio 3:1:6 ✓; chemical shifts (ppm): 2.0–2.9 (×2) 0.7–1.6 ✓; splitting AW to describe: singlet doublet / 1:1 ✓ (multiplet) **E**: No of peaks and areas: 4 peaks ratio: 3:2:2:3✓; chemical shifts (ppm): 2.0–2.9 (×2) 0.7–1.6 1.2–1.4 ✓; splitting AW to describe: singlet 2 x triplet / 1:2:1 ✓ (multiplet) **F**: No of peaks and areas: 2 peaks ratio: 2:3 /4:6✓; chemical shifts (ppm): 2.0–2.9 0.7–1.6 ✓; splitting AW to describe: triplet / 1:2:1 quartet 1:3:3:1 ✓ on **D** and **E**, **IGNORE** any splitting given for the multiplet		**9**
QWC	For at least **two** relevant sentences in which the meaning is clear with correct spelling, punctuation and grammar (**ALLOW** bullet points and note form where appropriate).		**1**
			[Total: 22]

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