GCE MARKING SCHEME

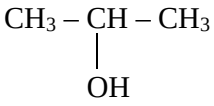
CHEMISTRY
AS/Advanced

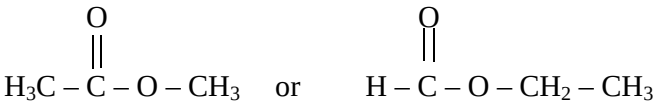
JANUARY 2013

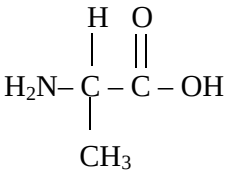
GCE CHEMISTRY - CH4

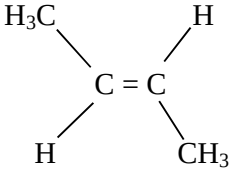
JANUARY 2013 MARK SCHEME

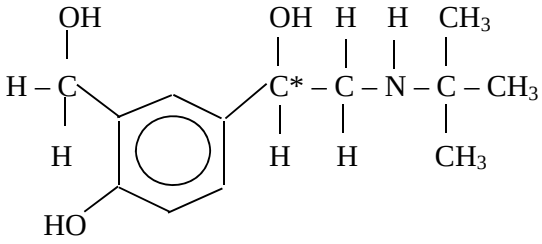
Section A

1. (a)(i)  [1]

(ii)  [1]

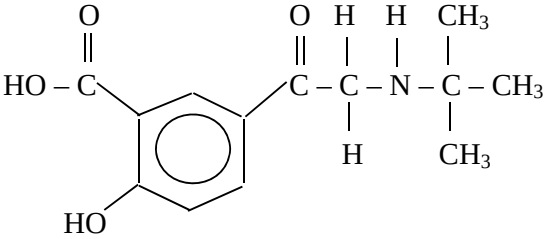
(iii)  [1]

(iv)  (or Z form) [1]

(b)(i)  [1]

(ii) The isomers rotate the plane of polarised light in opposite directions [1]

(iii) Side effects from other optical isomer / lower dose needed / improved pharmacological activity / only one isomer has correct orientation to bind with biological molecule [1]

(iv)  [2]

(1 mark for acid (accept aldehyde), 1 mark for ketone)

(c)(i) Ethylamine, ethanol, phenol, ethanoic acid [1]

(ii) Ethylamine is basic because it accepts a proton readily (1) due to the lone pair of electrons on the nitrogen. (1)
Phenol is acidic because it loses a proton / the anion formed is stabilised (1)
by delocalisation of the negative charge over the benzene ring. (1)
(Accept description e.g. in phenoxide ion lone pairs of electrons on oxygen become delocalised with electrons in benzene ring.) [4]

Total [14]

2. (a)

	Butan-2-ol	Ethanal	Ethanol	Propanone
2,4-DNP	No reaction	Yellow-orange precipitate	No reaction	Yellow-orange precipitate
Tollens' reagent	No reaction	Silver mirror	No reaction	No reaction
I_2/NaOH	Yellow precipitate	Yellow precipitate	Yellow precipitate	Yellow precipitate

(1 mark for each column) [4]

(b)(i) Electrophilic addition [1]

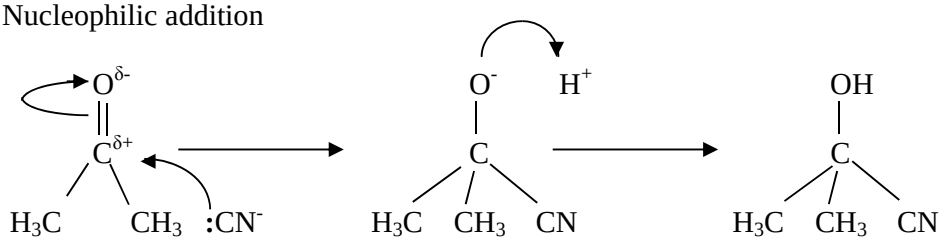
(ii) Carbonium ion / carbocation / electrophile [1]

(iii) Bromination / HBr addition / hydrogenation[1]

(iv) Secondary carbocation more stable than primary carbocation [1]

(c)(i) Nucleophilic addition [1]

(ii)



[3]

1 mark electron movement
1 mark charges

1 mark intermediate
and electron movement

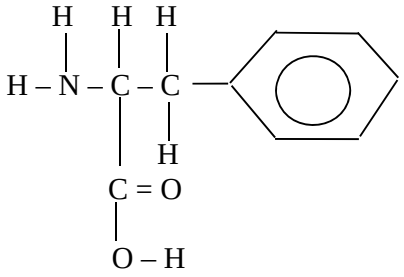
(Accept $CN^{\delta-} - H^{\delta+}$ for CN^-)

Total [12]

3. (a) Intermolecular bond formed (1) when hydrogen attached to a highly electronegative atom (1) is bonded to an electronegative atom attached to hydrogen (in another molecule) (1) forming a very strong dipole – dipole attraction (1) [3]
(maximum 3 marks)

QWC Legibility of text; accuracy of spelling, punctuation and grammar, clarity of meaning [1]

(b)

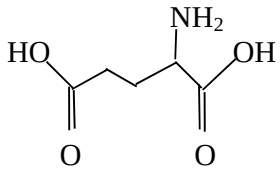


[1]

(c) Behaves as / can react with an acid or a base (1)

-COOH is an acidic group / donates proton, $-NH_2$ is a basic group / accepts proton (1) [2]

(d)



[1]

(e) Moles MSG = 1/169.08 = 5.91×10^{-3} (1)

Concentration = $5.91 \times 10^{-3} / 0.1 = 5.91 \times 10^{-2}$ (1) [2]

(f) (Neutral) $FeCl_3$ / Br_2 (1)
Purple colour / white precipitate (1) [2]

(g) 2,4-Dinitrophenylhydrazine / acidified sodium dichromate (1)

Yellow-orange precipitate / orange to green colour change (1) [2]

Total [14]

Total Section A [40]

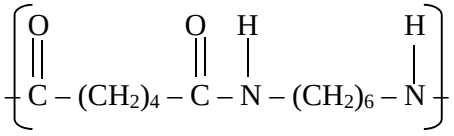
Section B

4. (a) For synthetic polymer:

Monomers: 1,6-Diaminohexane / ethane-1, 2-diol (1)

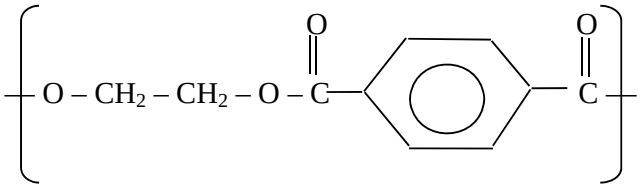
Hexanedioic acid / benzene-1,4-dioic acid (1)

Structure:



(1)

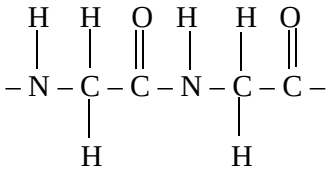
or



For natural polymer:

Monomers: aminoethanoic acid / 2-aminopropanoic acid (1)

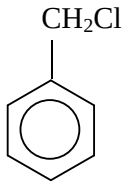
Structure: e.g.



(1)

[5]

QWC Selection of a form and style of writing appropriate to purpose and to complexity of subject matter [1]

(b) (i) 

[1]

(ii) 1,4-dichlorobenzene [1]

(iii) Chlorine (in the absence of ultraviolet light) (1)

$AlCl_3$ / $FeCl_3$ (as a halogen carrier) (1) [2]

(iv) Heat with NaOH (aq) (1)

add HNO_3(aq) followed by $AgNO_3$(aq) (1)

F gives white precipitate, **G** does not (1)

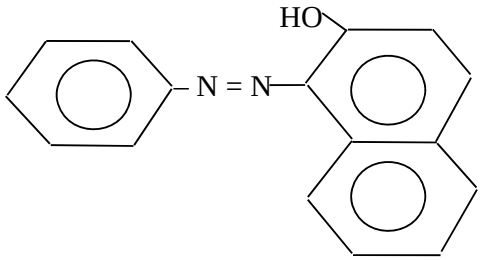
In **F**, the C–Cl bond is polarised / contains $C^{\delta+}$ or undergoes nucleophilic substitution (1)

In **G** due to delocalisation of the π electron cloud of the ring with the p-orbital electrons of the chlorine (1)

the C–Cl bond is too strong to break/ does not undergo nucleophilic substitution (1) [6]

QWC The information is organised clearly and coherently, using specialist vocabulary where appropriate [1]

(c)(i) To prevent decomposition of benzenediazonium chloride / HNO_2 [1]

(ii) 

[1]

(iii) A chromophore is the group of atoms responsible for the colour of the compound (by causing absorption in the visible region of the spectrum) [1]

Total [20]

5. (a)(i) Moles HCl = 5.4×10^{-3} (1)

M_r **B** = $\frac{0.395}{0.0054}$ = 73.1 (1) [2]

(ii) **B** is basic therefore must be amine (1)

C reacts with Na_2CO_3 therefore must be an acid (1)

D is oxidised to **C** therefore must be an alcohol (1)

A hydrolyses to acid but does not contain oxygen therefore must be nitrile (1)

B is $CH_3CH_2CH_2CH_2NH_2$ (1)

C is $CH_3CH_2CH_2COOH$ (1)

D is $CH_3CH_2CH_2CH_2OH$ (1)

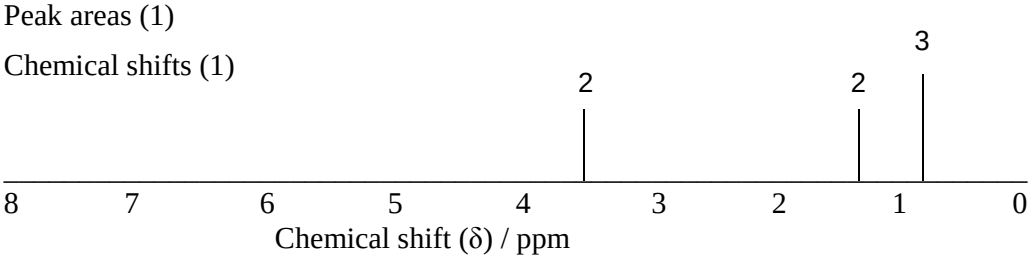
A is $CH_3CH_2CH_2CN$ (1) [8]

(4 marks structures – if 3 carbons in chains penalise only once
4 marks reasons – accept alternative reasons)

(b) $CH_3CH_2CH_2Cl$

Peak areas (1)

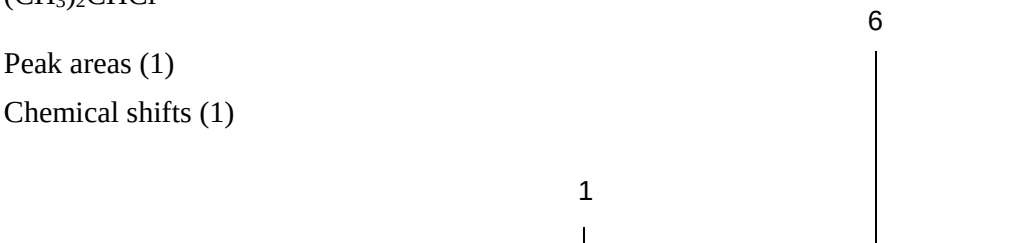
Chemical shifts (1)



$(CH_3)_2CHCl$

Peak areas (1)

Chemical shifts (1)



[4]

(c)(i) 2 steps instead of 3 / CH_3COCH_3 can be sold / reagents are cheaper / gives a higher yield / easier to extract phenol / phenol formed more quickly / fewer reactants [2]
(Accept any 2)

(ii) Lower temperature required / catalyst costs less / catalyst less likely to break up / catalyst less toxic or safer [1]

(d) Moles phenol = 58.75/94.06 = 0.625 (1)

Maximum mass aspirin = 0.625 × 180.08 = 112.55 g (1)

65% yield, therefore mass aspirin = 73.16 g (1) [3]

Total [20]

Total Section B [40]