GCE MARKING SCHEME

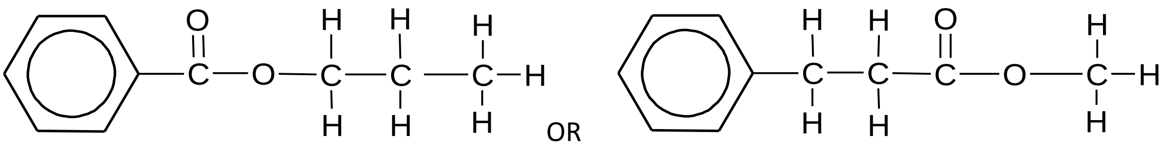
CHEMISTRY
AS/Advanced

SUMMER 2012

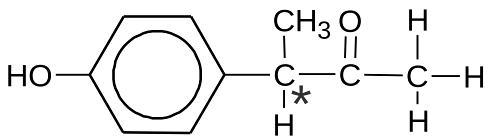
<u>Question 1</u>

(a) Any valid ester structure with formula $C_{10}H_{12}O_2$ [1]

Examples:



(b) (i) Compound X [1]

(ii)  [1]

(iii) Rotate the plane of polarised light in opposite directions [1]

(c)

Reagent(s)	*Observation if the test is positive*	*Compound(s) that would give a positive result*
I_2 / NaOH (aq)	Yellow solid	X
Na_2CO_3 (aq)	Bubbles of colourless gas / effervescence	W
$FeCl_3$ (aq)	Dark purple/blue/green - do not accept 'precipitate'	X, Z

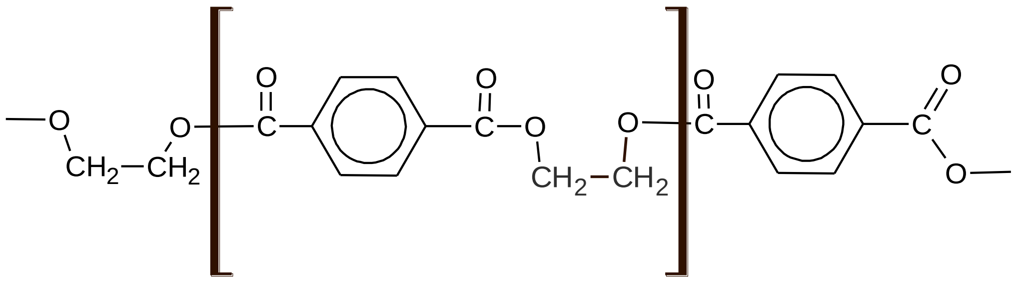
(*1 mark for each box*) [6]

(d) (i) Heat / Alkaline / Potassium manganate(VII) / then acidify
(1 mark for Potassium manganate + 1 other point; 2 marks for all) [2]

(ii) I. Addition polymer – One large molecule formed only / Condensation polymer – one large molecule with small molecules (e.g. water) lost. (1)

Addition polymer – one starting material / Condensation – two starting materials
OR Addition polymer – one functional group in each molecule/ Condensation polymer – two functional groups in each molecule (1) [2]

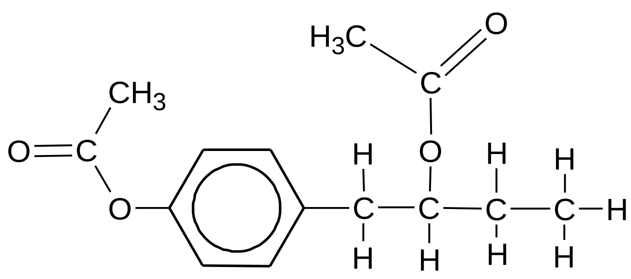
II.



[1]

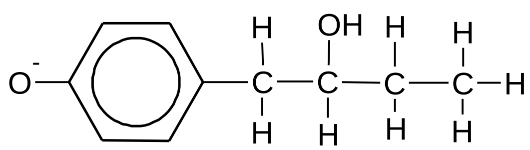
(e) (i) $NaBH_4$ / $LiAlH_4$ or name(1) Reduction (1) [2]
- ignore conditions unless $LiACH_4$ in water
- do not accept 'redox'

(ii)



Accept structures with only one –OH group reacted. [1]

(iii) [1]

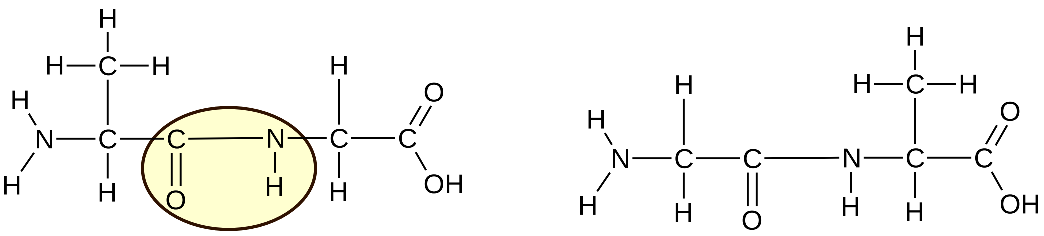


[19 marks]

Question 2

(a) (i) Alanine forms a zwitterion (1)
Forces between alanine molecules are ionic bonding (1)
Ionic bonding much stronger than hydrogen bonding / van der Waals (1)
Max 2 marks [2]

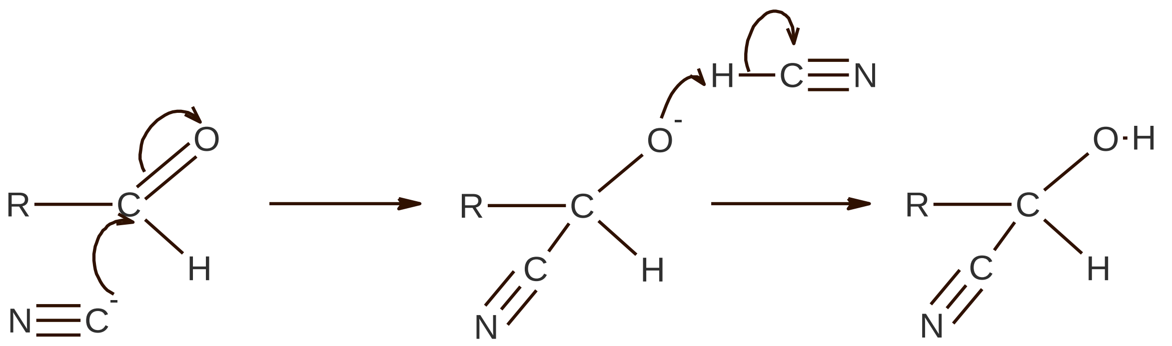
(ii) 1 mark for each correct structure [2]



(iii) 1 mark for correct identification of peptide link [1]

(b) Enzymes / Structural proteins / Hormones or specific example [1]

(c) 1 mark for arrows in first stage; 1 mark for correct intermediate; 1 mark for arrow giving gain of proton in second stage (from HCN or from H^+).



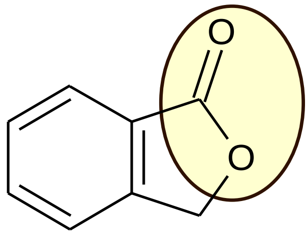
[3]

(d) Soda lime [1]

[10 marks]

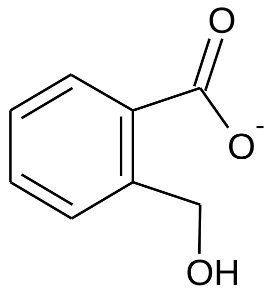
Question 3

(a) (i) [1]



Phthalide

(ii) [1]



(b) Distillation / Chromatography [1]

(c) Hydrogenation of 3-butyl phthalide removes a benzene ring (1)
Benzene ring is more stable than alkene/ Reference to delocalisation energy (1) [2]

(d) 62.1% [1]

(e) (i) Greater variety of different phthalides that can be produced [1]
(ii) Higher atom economy / less waste / carbon monoxide is toxic [1]
- do not accept references to yield

(f) Silver nitrate and ammonia / Tollen's reagent (1); Q = Silver mirror (1); R = No reaction (1)
OR 2,4,-DNP (1); Orange precipitate with Q (1); No reaction with R (1)
OR Fehling's solution (1); Orange solid with Q (1); No reaction with R (1) [3]

[11 marks]

Question 4

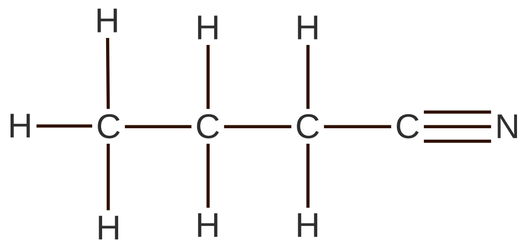
(a) (i) Nucleophilic substitution / Hydrolysis [1]

(ii) Dissolved in alcohol (1) Propene or unambiguous structure (1) [2]

(iii) Potassium manganate(VII) / Potassium dichromate(VI) - must be **name** (1)
Oxidation (1) [2]

(iv) (Add Potassium dichromate(VI)) and distil off the propanal from the reaction mixture [1]

(b) (i) Step 1: Potassium cyanide in ethanol / Heat (1)
Step 2: Heat with aqueous hydrochloric acid (or other acid) (1)



(1) [3]

(ii) Two points from different bullet points – 1 mark each.

- Atom economy / Amount of waste / Whether waste material was recyclable / Whether waste was toxic.
- Amount of energy required / temperature required / pressure required / conditions used
- Rate of production / time
- Availability of catalyst
- Cost of reactants / Availability of reactants / toxicity of reactants.
- Two step processes usually have lower yields than one step processes / percentage yield [2]
- Purification method / separation

(c) (i) Butanoic acid is $C_4H_8O_2$ so M_r = 88 (1)
Percentage carbon = 48/88 x 100 = 54.5%; percentage hydrogen = 8/88 = 9.1%;
Percentage oxygen = 32/88 = 36.4% (At least two of these for 1)
OR empirical formula for butanoic acid = C_2H_4O (1) and
calculate empirical formula from percentage masses = C_2H_4O (1) [2]

(ii) Structure 1 mark + 4 marks for explanations.

- Product is ethyl ethanoate. (1)
- Two points from the following required for each mark– MAX 4 marks
    - Sweet-smelling = ester
    - Peak at 1.0ppm implies – CH_3
    - Peak area 3 = CH_3
    - Peak area 2 = CH_2
    - Triplet shows CH_3 is next to a CH_2 group.
    - Singlet shows CH_3 no hydrogen atoms bonded to adjacent carbon.
    - Peak at 2.1 ppm suggests this is next to C=O.
    - Quartet shows CH_2 is adjacent to a CH_3 group.
    - Peak at 4.0 ppm shows it is –O-CH_2-
    - IR Peak at 1752 cm^{-1} = C=O
    - IR Peak at 2981 cm^{-1} = C-H or O-H
    - Cannot be –OH as we know there is no –OH in NMR spectrum

[5]

QWC: selection of a form and style of writing appropriate to purpose and to complexity of subject matter. (1)

QWC: organisation of information clearly and coherently; use of specialist vocabulary where appropriate. (1) [2]

[20 marks]

Question 5

(a) (i) (Concentrated) nitric acid / (concentrated) sulfuric acid / Temperature of 40-80°C
(*Any 2 = 1 mark; All 3 = 2 marks*)
Electrophilic substitution (1) [3]

(ii) I. Peak area is proportional to amount of substance (1)
Percentage = (30 / 38) x 100 = 79% (1)
(Can obtain both marks from correct percentage) [2]

II. 45 = $COOH^+$, 46= NO_2^+, 122 = $C_6H_4NO_2^+$ and 167 = $C_7H_5NO_4^+$.
(*Any 2 = 1 mark; All 4 = 2 marks*) [2]

(iii) I. Lower melting point / melts over a range [1]
II. 1 mark for each point.

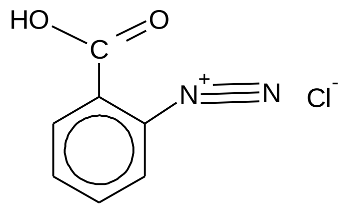
- Dissolve in the minimum volume
- Of hot water
- Filter hot
- Allow to cool
- Filter
- Dry residue under suction / in oven below 142°C

Max 4 marks [4]

QWC: legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning.[1]

(b) (i) Tin and concentrated hydrochloric acid [1]

(ii) Below 10°C (1)



(1) [2]

(iii) N=N double bond is chromophore (1)
Compound absorbs blue /green / complementary colours to red / all colours but red (1)
Remaining frequencies are transmitted, giving the red colour seen. (1)
Any 2 out of 3 [2]

(c) Nitrogen has a lone pair (1) which can accept a proton (1) [2]

[20 marks]