GCE MARKING SCHEME

SUMMER 2016

CHEMISTRY - CH4
1094-01

INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE CHEMISTRY - CH4

SUMMER 2016 MARK SCHEME

SECTION A

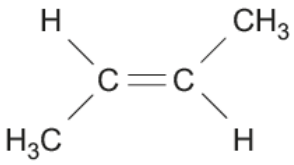
1. *(a)* (i) Redox / oxidation of **P** [1]

(ii) **Q** is not an aldehyde / **P** is not a primary alcohol / **P** is a secondary alcohol [1]

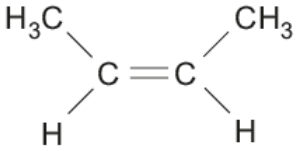
(iii) I Dehydration / elimination [1]

II

(1)

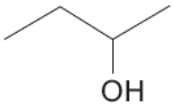


(1)

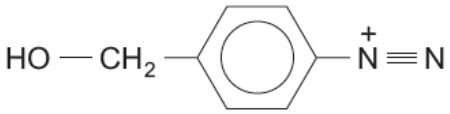


(1)

[3]

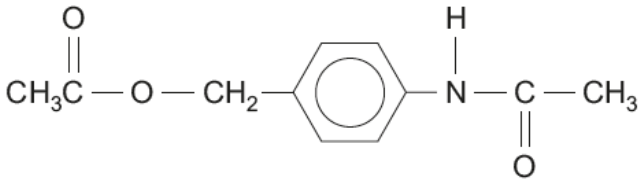
(iv)  [1]

(b) (i)



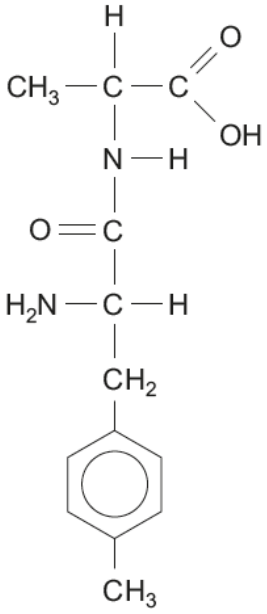
[1]

(ii)

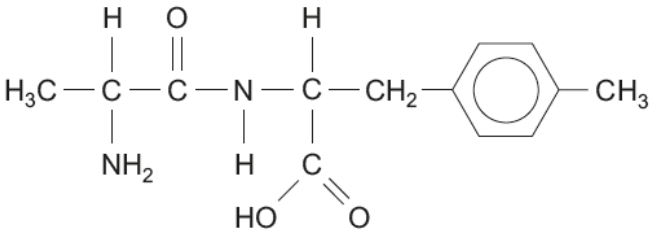


(1) for ester (1) for amide [2]

(iii)



(1)



(1)

accept any unambiguous correct structures

[2]

Total [12]

2. *(a)* **Both** ethanol and propanone will give a yellow solid (1)

Solid is CHI_3/ triiodomethane (1)

Caused by $CH_3C{=}O$ in propanone (1)

Caused by CH_3CHOH in ethanol / ethanol forms $CH_3C{=}O$ (1)

Award (1) for identification of both groups without links to propanone and ethanol [4]

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

(b) Carboxylic acids react but phenols do not (1)

Bubbles are carbon dioxide (1)

Carboxylic acids stronger acids than phenols (1)

Carboxylate more stable than phenoxide / O—H bond weaker in carboxylic acid (1) [4]

(c) Hydrogen bonds are not responsible for the higher than expected melting temperature (1)

Results from ionic bonds between zwitterions (1)

High melting temperatures imply the presence of strong <u>intermolecular</u> forces - accept any link between melting and intermolecular forces (1)

Formula of any zwitterion shown unambiguously /
presence of NH_3^+ and CO_2^- /
description of proton transfer from COOH to NH_2 (1)

[4]

Total [13]

3. *(a)* (The existence of more than one compound) with the same structural formula but a different arrangement in space [1]

(b) Fehling's solution (1)

Observe red solid formed (1)

OR

Tollens' reagent (1)

Observe silver mirror (1) [2]

(c) (i) (Optical activity occurs when different isomers) rotate the plane of plane polarised light (1)

(Values have) opposite signs since rotation is in opposite directions (1)

[2]

(ii) When hydrolysis is complete there will be equal amounts of glucose and fructose (1)

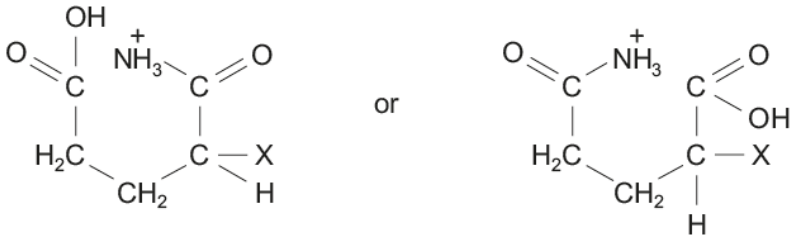
Clear use of + 52.8 and –92.0 to give –39.2 (1) [2]

(d) Asterisk on C attached to CH_2, CO, N and H [1]

(e) Equimolar amounts of two isomers formed/ half the original changes to the other isomer (1)

3D diagrams to show mirror images of **any** chiral centre (1) [2]

(f)



NH_3^+ in correct formula (1)

COOH in correct formula (1)

[Allow two —COOH groups (1) and NH_3/ NH_4^+ (1)] [2]

(g) (i) $C_6H_{12}O_6$ shown twice [1]

(ii) All contain lots of OH groups (1)

That can hydrogen bond to water (1) [2]

Total [15]

SECTION B

4. *(a)* Any 3 from:

Energy absorptions / transitions / jumps in either NMR or IR (1)

NMR – involves proton spin aligned with or against (1)

Magnetic field (1)

IR – bonds / molecules vibrate / stretch / bend (more) (1)

Max 2 if only NMR or IR considered [3]

(b) (i) R_f = 0.62 – 0.63 [1]

(ii) I Retention time [1]

II Use of area under peaks/ heights of peaks (1)

20% (answer showing correct use of area under peaks) (1)
[2]

(iii) TLC shows number of components in the mixture (1)

Gas chromatography shows (number of components and) amounts / relative abundance of each component (1)

[2]

(c) (i) Molecular ion is at 72 / M_r is 72 (1)

Mass of C in 1 mol = $\frac{66.7 \times 72}{100}$ = 48 (1)

24 difference so only one oxygen atom possible / recognition of fragment containing one oxygen atom – CO at 28 or CH_3CO at 43 (1)

C_4H_8O (1) [4]

(ii) 3 hydrogen environments (1)

Number of Hs in each environment 1:1:6 (1)

Doublet produced by H next to C with 1 attached H/

multiplet produced by H next to C with many Hs (1)

Any **two** δ values:

δ = approximately 1 for CH_3

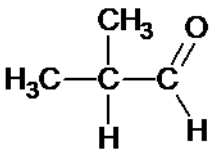
δ = 2.0 to 2.5 for CH_3CO (accept CH_2CO)

δ = approximately 9.5 for HC=O (1) [4]

QWC *Selection of a form or style of writing appropriate to purpose and complexity of subject matter* (1)

Organisation of information clearly and coherently; use of specialist vocabulary (1) [2]

(iii)



[1]

Total [20]

5. *(a)* Reagent: chloromethane (1)

Type of reaction: electrophilic substitution (1)

Conditions: aluminium chloride/ iron(III) chloride (catalyst) (1)

Mechanism: equation to show formation of CH_3^+ (1)

arrow from π bond towards CH_3^+ (1)

structure of intermediate (1)

arrow from bond on H to reform π (1) [7]

(b) (i) (Process involving continuous) evaporation and condensing (1)

(Achieved using) vertical condenser/ avoids losing liquids (during continuous heating) (1) [2]

(ii) $C_6H_5CH_3 + 3[O] \rightarrow C_6H_5COOH + H_2O$ [1]

(iii) To add H^+ to COO^- / to replace Na^+ in COO^-Na^+ /
to form acid from salt / strong acid displaces weak acid [1]

(iv) Dissolve solid in <u>minimum</u> of hot water / solvent (1)

Allow to cool (to crystallise solid) (1)

Filter and dry (1) [3]

(v) Melting temperature same as literature value /
melting temperature sharp/ melts not over range

OR

Chromatography – produces only one peak / reading [1]

(vi) M_r C_6H_6 = 78 and C_6H_5COOH = 122 (1)

10.0g C_6H_6 = 10.0/78 = 0.128 mol **and**

should produce 0.128 × 122 = 15.6 g C_6H_5COOH (1)

Percentage yield = 3.8 × 100/ 15.6 = 24(.4)% (1) [3]

(vii) Any 2 from:

Incomplete oxidation/ formation of aldehyde (1)

Solid left in solvent during recrystallisation (1)

Two-stage process so losses at both stages (1)

Multiple alkylation possible (1) [2]

Total [20]