GCE MARKING SCHEME

CHEMISTRY
AS/Advanced

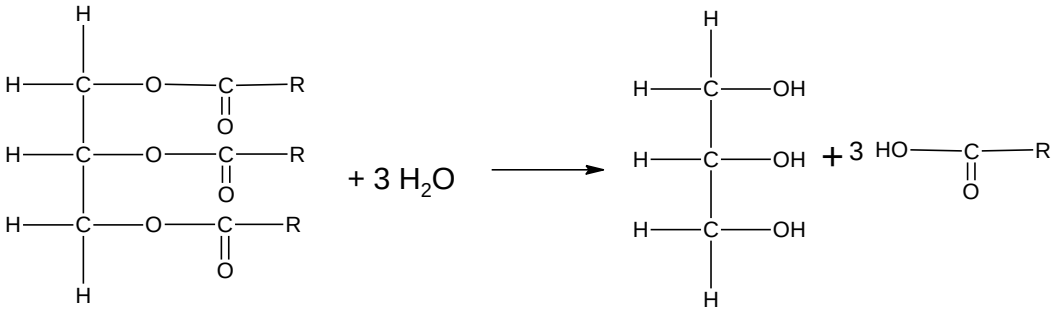
JANUARY 2014

CH4

Section A

Q.1 (a) Reagent(s): (aqueous) sodium hydroxide followed by acid (1)

Condition(s): Heat (to reflux) (1)



[IF NO ACID LISTED IN REAGENT, THEN EQUATION SHOULD CONTAIN SODIUM SALTS] (1) [3]

(b) (i) Reagent(s): (aqueous) bromine (1)
Observation(s): Changes from orange to colourless (1) [2]

(ii) Nickel / Platinum / Palladium [1]

(iii) Moles of hydrogen gas = $1.15 \div 24.0 = 4.79 \times 10^{-2}$ mol (1)
Moles of stearic acid produced = $4.79 \times 10^{-2} \div 2 = 2.40 \times 10^{-2}$ mol (1)
Mass of stearic acid = $2.40 \times 10^{-2} \times 284 = 6.80$ g (1) [3]

(c) (i) **C** $69.7 \div 12 = 5.808$ **H** $11.7 \div 1.01 = 11.584$ **O** $18.6 \div 16 = 1.163$ (1)
Empirical formula = $C_5H_{10}O$ (1) [2]

(ii) $C_{10}H_{20}O_2$ [1]

(d) e.g. biodiesel is renewable/won't run out / carbon neutral
do not accept 'produces less carbon dioxide' [1]

Total [13]

Q.2 (a) Chromophore [1]

(b) (i) Melting temperature **lower** than literature value / melting occurs over a temperature range [1]

(ii) Identify percentage or amount of impurities (1)
Identify the number of compounds present or number of impurities (1) [2]

(c) (i) Acidified potassium dichromate (1)
Heat and distil (1) do not accept 'reflux' [2]

(ii) M_r of phenylmethanol = 108.08 M_r of benzenecarbaldehyde = 106.06 (1)
100% conversion would be 10.0 ÷ 108.08 × 106.06 = 9.815g (1)
86% yield = 9.815 × 86 ÷ 100 = 8.44g (1) [3]

(iii) Two resonances in the range 5.8-7.0 ppm (1)
These are doublets (1)
One **singlet** at around 11.0 ppm (1)
All resonances have the same area (1) [4]

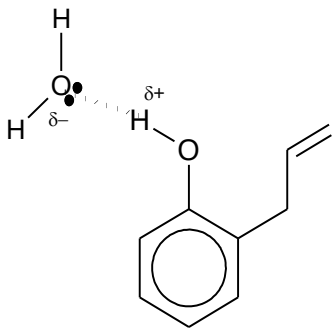
Total [13]

Q.3 (a) Isomers [1]

(b) (i) Peak at 2500-3550 cm^{-1} present in product but not reactant [1]

(ii) Add $FeCl_3$ (1)
Forms a purple solution (1) do not accept 'precipitate' [2]

(iii) 1 mark for correct location of hydrogen bond; 1 mark for dipole OR lone pair
e.g.



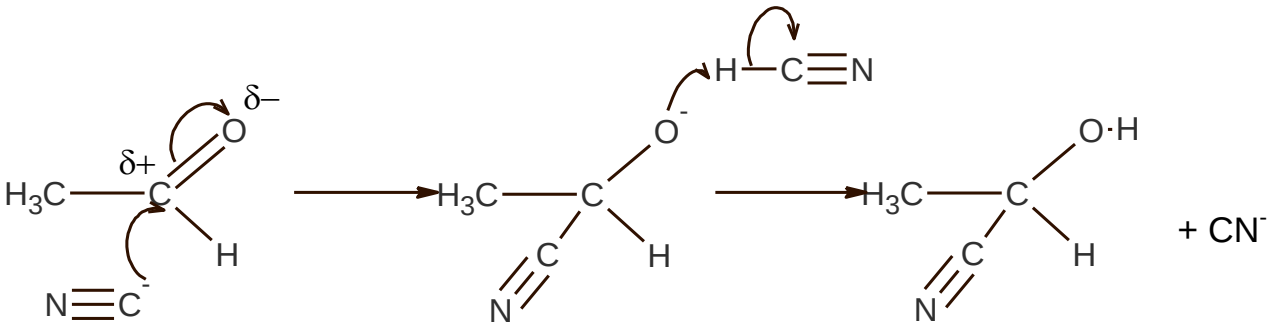
[2]

(c) Aromatic Claisen product is more acidic / better proton donor than product of 1,2-Wittig rearrangement (1)

The 1,2-Wittig rearrangement product is an alcohol, so the charge on the **anion** formed is localised / the **anion** is unstable (1)
The product of the aromatic Claisen rearrangement is a phenol, so the charge on the anion can be delocalised which stabilises it (1)
(Must be reference to 'anions'; (1) mark awarded for 'stability of anions' if no reference to delocalisation) [3]

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

(d) 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^+); 1 mark for bond polarity – max 3 marks; lose 1 if incorrect final structure



Mechanism: Nucleophilic addition (1) [4]

Total [14]

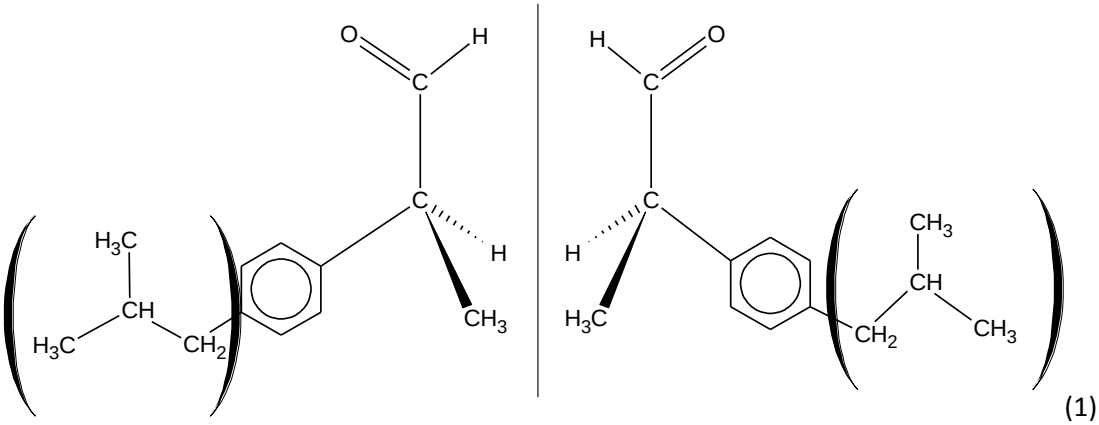
Total Section A [40]

Q.4 (a) $CH_3CH(CH_3)CH_2Cl$ (1) $AlCl_3$ / $FeCl_3$ (1) Room temperature / in the dark (1) [3]

(b) (i) 2,4-DNP (1) Orange precipitate (1) [2]

(ii) Tollen's reagent (1) Silver mirror with **C**, no reaction with **B** (1) [2]

(c) Optical isomerism is where a molecule and its mirror image are different / non-superimposable (1)
Compound **C** has a chiral centre / 4 different groups attached to one carbon atom (1)



(1)

The two isomers rotate the plane of polarised light in opposite directions (1) [4]

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

(d) Dilute acid (1) heat (1) hydrolysis (1) [3]

(e) Acidified potassium dichromate (VI) (1) / heat (1)

One step reactions are generally better as they have a better yield / there is waste in each stage (1)

Two step process may be cheaper / use more sustainable reagents/ may give a better yield in this case / produce less harmful waste materials / potassium dichromate may react with other parts of the molecule as well / may be easier to separate product (1)

Do not credit same idea twice e.g. if 'better yield' gains first mark, a different point is required to gain second mark [4]

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

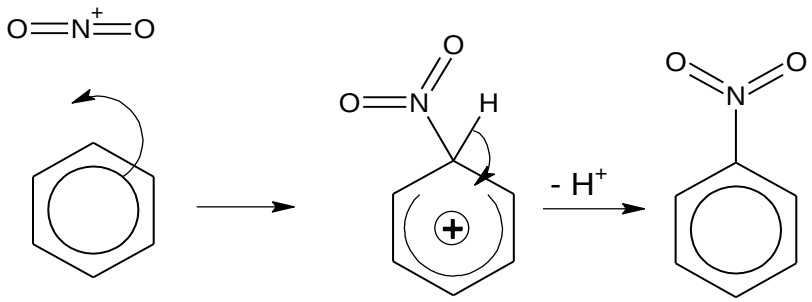
Total [20]

Q.5 (a) (i) Both molecules have lone pairs on nitrogen (1)

The lone pairs can form (coordinate) bonds with H^+ ions (1) [2]

(ii) Lone pair on N in phenylamine is delocalised over benzene ring (1) therefore less able to accept H^+ (1) [2]

(iii) I Arrow in first step (1)
Cation structure in second step (1)
Arrow in second step (1)

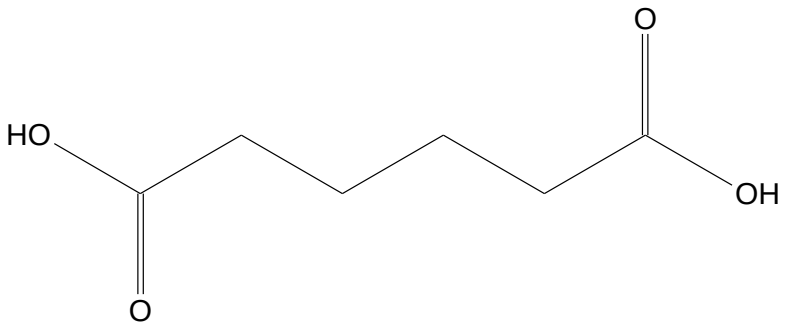


[3]

II (fractional) distillation / steam distillation [1]

III Sn and conc. HCl (1) followed by NaOH (1) [2]

(b) (i)



[1]

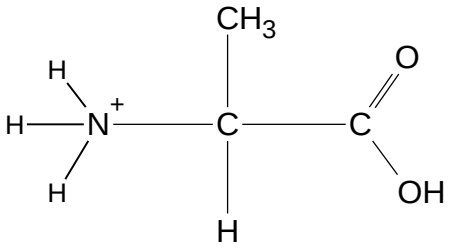
(ii) Addition polymerisation makes one product only /
Condensation produces one product plus a small molecule like water (1)

Addition polymerisation uses one starting material /
Condensation polymerisation has two different starting materials (1)

Addition polymerisation involves monomer with one functional group /
Condensation polymerisation involves monomer with two functional groups (1)

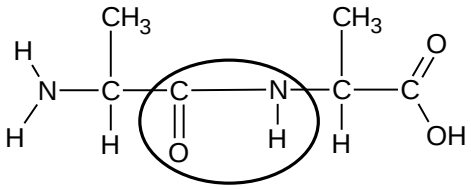
(max 2) [2]

(c) (i)



[1]

(ii)



[2]

(iii) Alanine has strong (electrostatic) forces between the zwitterions (1)

Butanoic acid has hydrogen bonding between molecules / electrostatic forces in alanine are stronger than forces in butanoic acid (1)

[2]

(iv) Soda lime (1) $CH_3CH_2NH_2$ (1) [2]

Total [20]

Total Section B [40]