GCE MARKING SCHEME

CHEMISTRY
AS/Advanced

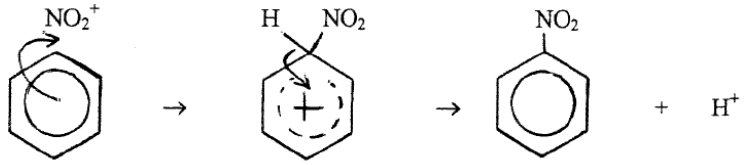
SUMMER 2011

CHEMISTRY - CH4

Q.1 (a) (i) Chromophore [1]

(ii) Yellow transmitted (or reflected) / other colours (e.g. blue and red) absorbed [1]

(b) (i)



(arrow must come from the bond) [1]

(ii) $C_3H_2NO_2$ [1]

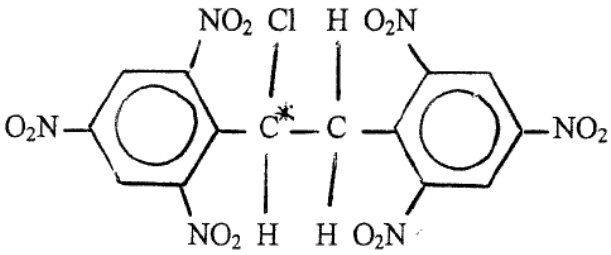
(iii) H_2SO_4 is losing a proton (to another species and becoming an HSO_4^- ion, acids are proton donors). [1]

(c) The benzene ring is more stable than an alkene because of its delocalised electron structure / π electron system / OWTTE (1)
If benzene underwent addition this would mean disrupting this stable electron system and this would require relative more energy / activation energy would be (much) higher. (1) [2]

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

(d) (i) There is no rotation about a double bond / each 'end' of the double bond has two different 'groups' attached to it [1]

(ii) I



[1]

II They are mirror image forms (1) that rotate plane polarised light in opposite directions (1) [2]

III Elimination [1]

Total [13]

Q.2 (a) (i) Sodium borohydride / sodium tetrahydridoborate(III) / lithium aluminium hydride / sodium and ethanol / zinc and ethanoic acid
(accept correct formulae) [1]

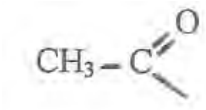
(ii) The absorption at ~ 1700 cm^{-1} is due to the C = O bond (1)
As the reaction proceeds the intensity of this absorption becomes smaller because the butanal is being used up / butan-1-ol does not contain a C = O bond (1) [2]

(b) (i) butan-1-ol > propanone > ethanol [1]

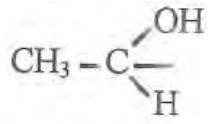
(ii) Propanone [1]

(iii) *Compounds* propanone / ethanol / propan-2-ol
Any two for one mark [1]

Explanation the compounds that give a positive iodoform test have to contain a



or the



grouping

[1]

(iv) So that a valid comparison can be made between results from other teams / OWTTE [1]
(do not accept 'fair test')

(c) There is a balance between the 'carbon' produced by burning and the 'carbon' absorbed by the plant (1)
When butan-1-ol is burnt carbon dioxide is produced, but this is used by plants / in photosynthesis to produce cellulose (1) [2]

(d) (i) $CH_3CH_2CH_2CH_2OH + CH_3COOH \rightarrow CH_3COOCH_2CH_2CH_2CH_3 + H_2O$ [1]

accept C_4H_2OH but not $C_4H_{10}O$ - functional groups must be present

(ii) (concentrated) sulphuric acid / H_2SO_4 / hydrogen chloride (gas) / HCl(g) [1]

do not accept H_2SO_4(aq) / HCl

Total [12]

Q.3 (a) (Free) radical [1]

(b) $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$ [1]

(c) (i) It is providing a pair of electrons to bond to a proton / acting as a lone pair donor / proton acceptor [1]

(ii) I A process of boiling / evaporation and condensation without loss (of reactants) [1]

II By using an electrical heater / or a suitable heating bath / heating mantle - do not accept 'water bath' [1]

(d) Halothane would cause the most damage as it contains a weaker C-Cl / C-Br bond (1), which is broken in the upper atmosphere (1) (producing radicals that attack ozone).
Desflurane does not contain C-Cl / C-Br bonds, only the more stable C-F bonds. [2]

(e) (i) Purple colour / solution / complex - do not accept 'precipitate' [1]

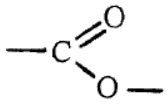
(ii) I

Compound	***Colour given with Universal Indicator paper***	***Reaction with sodium hydrogencarbonate solution***
propofol	yellow / orange	no reaction
compound **L**	~~~~~~~~~~~	~~~~~~~~~~~
compound **M**	orange / red	fizzing

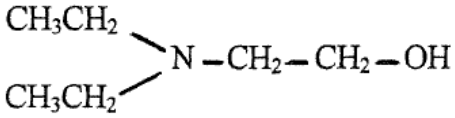
One mark for each correct column [2]

II Gas evolved turns ‘lime water’ milky [1]

(f) (i) [1]



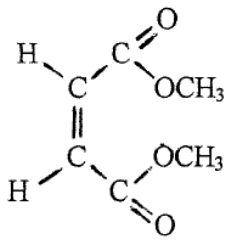
(ii) [1]



(g) It would melt at a lower temperature (than 89 ^{o}C) / below 89 ^{o}C (1)
and over a range of temperature / not a sharp melting temperature (1) [2]

Total [15]

Q.4 (a) (i) Stereoisomerism is where the compound has the same structural formula but whose atoms / groups take up different positions in space / in three dimensions (1)



[2]

(ii) The signal at 3.8 δ due to the methoxy protons (1) would disappear and be replaced by a signal at 11.0 δ (1) due to the OH protons (1). These protons would have peak area 2
(rather than peak area 6 for the methoxy protons) (1)
The signal at 6.9 δ would be (largely) unchanged (1) as the C –H bond is not affected by the hydrolysis of the ester. [5]

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

(iii) $C_6H_8O_4 \rightarrow 144$
113 is 31 less, could be CH_3O (1)
ion could be $C_5H_5O_3^+$ (1) [2]

(b) (i) Raw material prices become cheaper / reduce the reaction temperature / use a method where the % yield is increased [1]

(ii) Use a different (more economic) starting material / find a way of reducing the time taken for fermentation / effect an easier separation method.
Do not accept reference to increased amounts of enzyme /bigger batch. [1]

(iii) Number of moles of fumaric acid expected = 140 (1)

Actual number of moles of fumaric acid obtained = $\frac{13.0 \times 1000}{116}$ = 112 (1)

$$\% \text{ Yield} = \frac{112 \times 100}{140} = 80 \quad (1)$$

Alternatively

180 g / kg of glucose give 2 x 116 g / kg of fumaric acid (1)

∴ 1 g / kg of glucose gives $\frac{2 \times 116}{180}$ g / kg of fumaric acid

∴ 12.6 kg of glucose gives $\frac{2 \times 116 \times 12.6}{180}$ kg of fumaric acid = 16.2(4) kg (1)

$$\% \text{ Yield} = \frac{13.0 \times 100}{16.2} = 80 \quad (1)$$

[3]

(iv) I starting material (1) e.g. ethanol / ethanal OR ethyl ethanoate OR ethanoyl chloride

reagent (1)	$Cr_2O_7^{2-}$ / $\mathbf{H^+}$	acid(aq) / base (aq) followed by acidification	water
type of reaction (1)	oxidation / redox	hydrolysis	hydrolysis

[3]

II platinum / nickel [1]

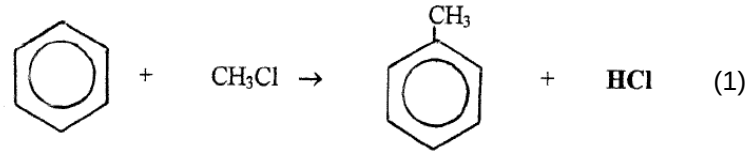
(c) e.g. Tollens reagent - silver mirror

OR 2,4 - dinitrophenylhydrazine - yellow/ orange / red precipitate

OR Fehling's / Benedict's reagent - brown / red precipitate [1]

Total [20]

Q.5 (a) (i)



(1)

catalyst - aluminium chloride (1) [2]

(ii) Mass of methylbenzene = 27.6 g (1)

Moles of methylbenzene = $\frac{27.6}{92.1}$ = 0.30(0) (1)

∴ 0.30 mole of $C_6H_5CH_2Cl$ should be made
this will have a mass of 0.30 x 126.6 = 38.0 g (1)

∴ Mass of flask + product needs to be 120.4 + 38.0 = 158.4 g (1) [4]

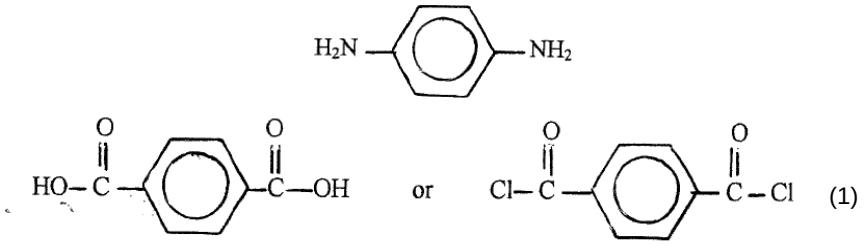
(iii) I potassium cyanide [1]

II lithium tetrahydridoaluminate(III) / lithium aluminium hydride (accept correct formulae) [1]

(b) The nitrogen atom is electron rich / has a lone pair (1) and will act as a proton acceptor / electron pair donor (1) [2]

(c) 2-Phenylethylamine reacts with nitrous acid giving an alcohol (1) and evolving nitrogen gas as bubbles (1)
4-Ethylphenylamine gives a diazonium compound (1) [3]

(d)



(1)

[2]

(e) (i) 2-amino-3-hydroxypropanoic acid [1]

(ii) Hydrogen bonding occurs because of the difference in electronegativity between hydrogen and oxygen / nitrogen(in O-H and N-H bonds), (1).
leading to polar covalent bonds / $\delta+$, $\delta-$ (1)
There are attractive forces between the oxygen or nitrogen of one molecule and the hydrogen atom bonded to an oxygen or nitrogen atom of another molecule (1) [3]

(Marks can be obtained from a suitable diagram)

QWC Information organised clearly and coherently, using specialist vocabulary when appropriate [1]

Total [20]