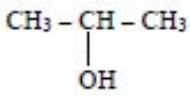
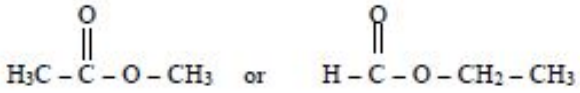
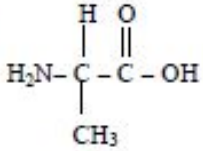
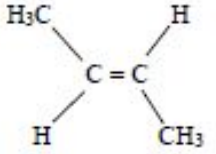
Mark Scheme - 4.1 Stereoisomerism

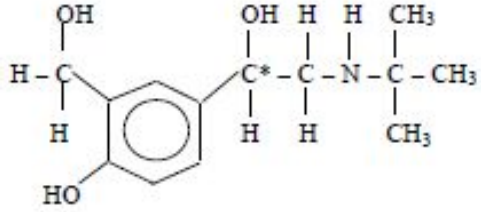
1.

(a)(i)  [1]

(ii)  [1]

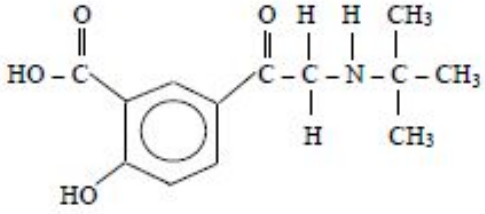
(iii)  [1]

(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) Hydrogen bonding occurs between (1) oxygen, nitrogen or fluorine (1) of one molecule and hydrogen, which is bonded to oxygen / nitrogen / fluorine of another molecule (1)
Alkanes do not contain an O-H, N-H or F-H bond and cannot therefore hydrogen bond to water molecules (1) [4]

QWC Candidates should have use 'a selection and form of writing appropriate to purpose and to complexity of subject matter' [1]

(b) (i) The (purified) petroleum is separated by heating (1) due to the different boiling temperatures of different fractions (1)

OR the mixture is vaporised (1) and then condensed according to boiling temperatures (1) (as at the oil refinery) [2]

(ii) $CuCl_2$ Cu +2 CuCl Cu +1 (1)

(reduction occurs when) the oxidation number becomes less positive (1) [2]

(c) (i) Same molecular formula but a different structural formula / structure [1]

(ii) Both of the carbon atoms of the double bond have different atoms / groups bonded to them (1)
There is no free rotation about the double bond (1) [2]

(iii) M_r of compound A is 146.3 / 146 (1)

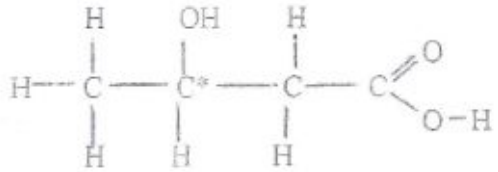
Cost per mole is $\frac{146.3 \times 48 \times 100}{100 \times 73}$ = £96.20 (1)

(Accept £96.00 per mole if M_r of 146 has been used) [2]

Total [14]

3.

(a)



[1]

(b) (i) Acidified potassium dichromate allow H^+, $Cr_2O_7^{2-}$ [1]

(ii) I An equimolar mixture of two enantiomers / optical isomers
do not accept 'equal mixture' [1]

II It has no (apparent) effect on the plane of polarised light [1]

(c) (i) But-2-enoic acid; this is because each of the carbon atoms of the double bond has two different groups / atoms
allow reason based on the other isomer [1]

(ii) Any TWO from the following for (1) each
reagent used / temperature / quantities / time of reaction / catalyst / solvent [2]

(d) Reagent(s) KOH / I_2 or NaOCl / KI (1) allow names
Observation Yellow precipitate (1) [2]

(e) The NMR spectrum will consist of two peaks, as there are two discrete 'areas' of protons; these will be seen at between 2.0 to 2.5 (CH_3) and between 2.5 to 3.0 (CH_2) (1)
The peak area ratio will be 3:2 for the CH_3 and CH_2 protons respectively (1)
There will be no splitting of either signal as the protons causing these signals are not bonded directly to other carbon atoms that also have protons (1)

1 max if only one peak described correctly [3]

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

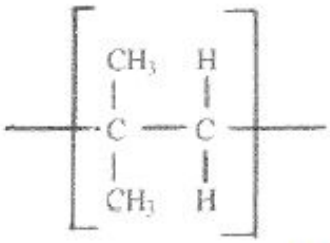
Total [13]

4. (a) (i) (2-)Methylpropan-2-ol **[1]**

(ii) 30.1 / 30 **[1]**

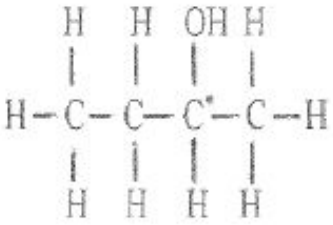
(iii) (Concentrated) sulfuric acid / phosphoric acid / aluminium oxide / pumice **[1]**

(iv)



(with or without n) **[1]**

(v)



(1) for structure, (1) for asterisk **[2]**

(vi) I acidified potassium dichromate / H^+, $Cr_2O_7^{2-}$(aq) **[1]**

II ethanal has a C = O bond at 1650-1750 cm^{-1}
(metaldehyde does not have this bond) (1)

metaldehyde has a C – O bond at 1000-1300 cm^{-1}
(ethanal does not have this bond) (1) **[2]**

(b) (i) **Reagent** 2,4-dinitrophenylhydrazine / 2,4-DNP OR iodine / NaOH or KI / NaOCl (1)

Observation yellow / orange / red precipitate OR yellow precipitate (1) **[2]**

(ii) **Reagent** ethanol / sulfuric acid OR $NaHCO_3$ OR Ag^+/NH_3 / Tollens' (1)

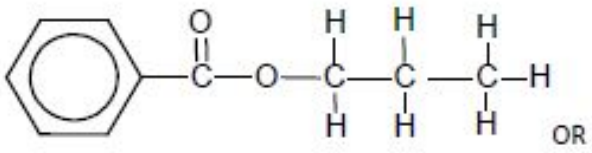
Observation sweet smelling liquid OR effervescence OR silver mirror (1) **[2]**

Total [13]

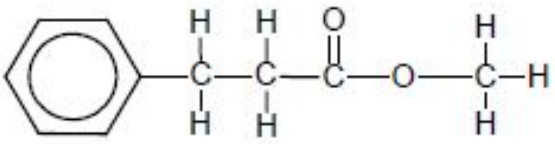
5.

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

Examples:

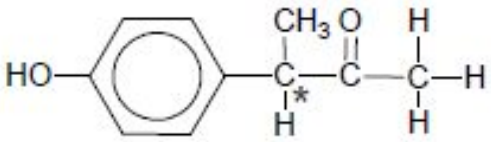


OR



(b) (i) Compound X [1]

(ii) [1]



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