SL & HL Answers to Alcohols questions

1. i. $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ **ii.** $2CH_3CH(OH)CH_3 + 9O_2(g) \rightarrow 6CO_2(g) + 8H_2O(l)$

2. i. In both cases the colour of the solution will turn from orange to green. A distinct smell due to the volatile organic products may be smelt.

ii. Propanone $CH_3CH(OH)CH_3(l) + [O] \rightarrow CH_3COCH_3(l) + H_2O(l)$

iii. The two half-equations are: $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$

and $CH_3CH(OH)CH_3(l) \rightarrow CH_3COCH_3(l) + 2H^+(aq) + 2e^-$

So the overall equation is:

$3CH_3CH(OH)CH_3(l) + Cr_2O_7^{2-}(aq) + 8H^+(aq) \rightarrow 2Cr^{3+}(aq) + 3CH_3COCH_3(l) + 7H_2O(l)$

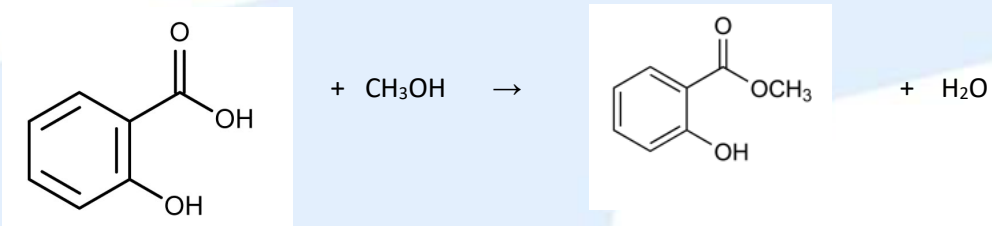
iv. Propanal and propanoic acid

v. Propan-1-ol is a primary alcohol whereas propan-2-ol is a secondary alcohol but this does not really explain it. The correct explanation is that, once the two hydrogen atoms have been removed from propan-2-ol to form the ketone, the carbon atom bonded to the oxygen atom contains no more hydrogen atoms to be removed so cannot be oxidized further. However in the case of propan-1-ol, the aldehyde formed, CH_3CH_2CHO, still contains a hydrogen atom bonded to the carbon atom attached to the oxygen. This means that further oxidation can occur as this hydrogen atom is removed to form a carboxylic acid.

vi. Because carboxylic acids have hydrogen bonding and aldehydes do not the boiling point of the carboxylic acid is much higher than the boiling point of the aldehyde so they can be separated by simple (or fractional) distillation. They could also be separated by GLC or HPLC.

3. In fact tertiary alcohols can be readily oxidized – just set fire to them! However the carbon chain is then completely broken down as carbon dioxide is formed. What chemists normally mean by 'not readily oxidized' is that they cannot be oxidized whilst still retaining the carbon chain length.

4. i.



ii. Warm salicylic acid with ethanoic acid in the presence of concentrated sulfuric acid as a catalyst. (In fact it works better if ethanoyl chloride or ethanoic anhydride is used but this is not on the syllabus).

iii. 2-hydroxybenzoic acid

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