ALCOHOLS: OXIDATION

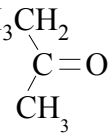
1. a) $CH_3CH_2OH + [O] \longrightarrow CH_3CHO + H_2O$

$CH_3CH_2OH + 2[O] \longrightarrow CH_3COOH + H_2O$

You could have shown the second reaction in two steps by using the first equation again and then adding: $CH_3CHO + [O] \longrightarrow CH_3COOH$

b) To get ethanoic acid formed you need an excess of the oxidising agent to make sure that there is enough to oxidise the ethanal formed at the half-way point to completion. That is why you heat under reflux with an excess of oxidising agent.

To get ethanal as the product, you need to prevent the second stage of the oxidation. Therefore you reduce the amount of oxidising agent, and boil off the ethanal as soon as it forms so that it can't be oxidised any further.

c) 

You could equally well have drawn this with all the carbons horizontally with a double-bonded oxygen hanging off the second carbon in the chain. (I already had this diagram, and it saved having to redraw it! But once you have done some work on ketones, you will find that the structure drawn here is a common way of drawing them.)

d) The product (butanone) isn't oxidised by acidified potassium dichromate(VI) solution. There needs to be a hydrogen attached directly to the carbon next door to the C=O bond in order for further oxidation to take place. So whatever conditions you use, you can't get any other product.

2. a) The presence of an -OH group

b) If you know you have an alcohol, then only primary and secondary alcohols are oxidised by acidified potassium(VI) dichromate solution. If you get a reaction, the alcohol is primary or secondary. If you don't, then it is tertiary.

c) It tests for aldehydes which are formed by the oxidation of primary alcohols, but not secondary ones.

d) We are ignoring D for the moment, because it obviously isn't an alcohol. The lack of reaction with PCl_5 shows that it doesn't have an -OH group.

A and E give the same reactions. The reaction with Schiff's reagent shows that an aldehyde is being formed on oxidation, and so A and E must both be primary alcohols.

Primary alcohols all have the OH group at the end of a chain, and both contain $-CH_2OH$. The

obvious possibility is $CH_3CH_2CH_2CH_2OH$.

The other possibility must have a branched chain, because it must still have the $-CH_2OH$ group at the end. It is $CH_3CH(CH_3)CH_2OH$

Which is A and which is E? There is no way of telling from the information you are given.

Now think about B. It is an alcohol which isn't oxidised by acidified potassium dichromate(VI) solution, and so must be tertiary. $(CH_3)_3C(OH)$

(There are other ways you might have drawn this. Your structure is right if you have three CH_3 groups and an OH all attached to the same carbon atom.)

C is a secondary alcohol, because it doesn't produce an aldehyde on oxidation. It can only be $CH_3CH_2CH(OH)CH_3$

e) Because D doesn't have an OH group, the oxygen atom must be in the middle of a chain of carbons, so that it is attached to two carbon atoms rather than one carbon and a hydrogen.

The three possibilities are:

$CH_3CH_2-O-CH_2CH_3$

$CH_3-O-CH_2CH_2CH_3$

$CH_3-O-CH(CH_3)_2$

Well done if you got all of these! As a matter of interest, these compounds with an oxygen in the middle of a chain are called ethers.