ALKENES: DIRECT HYDRATION

1. a) $CH_2=CH_2 + H_2O \rightleftharpoons CH_3CH_2OH$

(Don't forget the equilibrium sign - it is important to realise that this reaction is reversible. Apart from in boring reactions like combustion, never write simple molecular formulae like C_2H_4. Always use the sort of simplified structural formulae shown here.)

b) The mixture going through the reaction vessel contains an excess of ethene. Remember from Avogadro's Law that equal volumes of gases contain equal numbers of molecules under the same conditions of temperature and pressure. In this case, for every 10 molecules of ethene there are only 6 molecules of water rather than the 1:1 needed by the equation.

(If you don't know why this strange proportion is used, you can find out by following one of the links on the Chemguide page to the reasons for the reaction conditions.)

c) The reaction is reversible, and only about 5% of the ethene is converted on each pass through the reactor.

2. This is an effect of Markovnikov's Rule.

If you add water to propene, the hydrogen will go to the carbon with the most hydrogens on already (the CH_2 group), which forces the OH group into the middle of the chain rather than the end to give $CH_3CH(OH)CH_3$.

If you add water to but-1-ene, the hydrogen will again go to the carbon with the most hydrogens on already (again the CH_2 group at the end), which forces the OH group into the middle of the chain to give $CH_3CH_2CH(OH)CH_3$.

If you add water to but-2-ene, there is no way that an OH group can attach to an end carbon, because the end carbons are already full of hydrogen atoms.

So wherever the double bond is in the alkene, you won't get an OH attaching to the end of the chain.

(Actually, if you want to be really fussy, it is more accurate to say that any OH attaching to the end of the chain will only be the minor product. Some water *will* add on the "wrong" way around, but the Markovnikov addition is very much faster, and so you get much more of the "right" product. At this level, we often tend to ignore the minor reaction.)