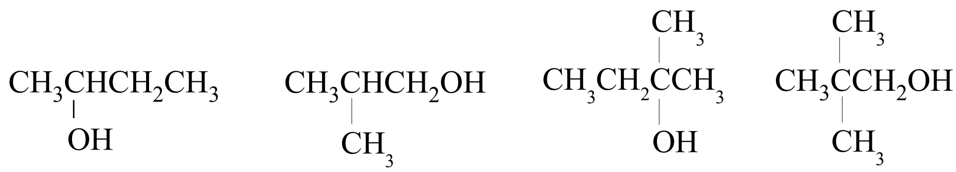
Chemguide – answers

ALCOHOLS: AN INTRODUCTION

1. a)



A B C D

A: secondary

B: primary

C: tertiary

D: primary

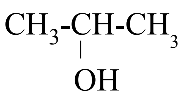
b) A: butan-2-ol (Not butan-3-ol – you number from the end giving the smallest number in the name.)

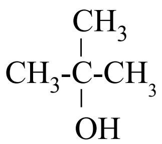
B: 2-methylpropan-1-ol (If the OH is on a carbon at the end of the longest chain, that carbon is automatically given the number 1.)

C: 2-methylbutan-2-ol

D: 2,2-dimethylpropan-1-ol

c) A secondary alcohol has two hydrocarbon groups attached to the carbon with the OH group on; a tertiary alcohol has three. The smallest possible secondary or tertiary alcohols will have only methyl groups attached.

(i) 

(ii) 

(There are various ways you might have drawn these in space. In the first case, make sure that you have a carbon with a hydrogen, two methyl groups and an OH group attached. In the second case, you should have a carbon with three methyl groups and an OH group attached, but ***no*** hydrogen!)

2. a) Only dispersion forces

b) All of them – dispersion, dipole-dipole and hydrogen bonds.

c) The boiling point of the ethanol is greater because it has two additional forces between the molecules, particularly the hydrogen bonds which are quite strong. Both of these molecules have identical numbers of electrons and a similar length so that the dispersion forces are going to be similar in each. The higher boiling point in the ethanol shows the extra effect of the hydrogen bonds and dipole-dipole attractions.

d) The increase in number of electrons and the greater length of the molecules increases the potential for the size of temporary dipoles, and therefore the dispersion forces between the molecules. Increased attractions means an increased boiling point.

3. To get two liquids to mix, you have to break the attractions in both liquids. These are then replaced by new attractions between the two different molecules in the mixture. Breaking the original attractions takes energy; making new ones releases energy.

   In both cases, the attractions being broken are dispersion forces, dipole-dipole attractions and hydrogen bonds, and in both cases, these are made again in the mixture. In ethanol and water, the energy released by the new attractions more or less compensates for the energy needed to break the old ones.

   The difference lies in the long hydrocarbon tails in the pentan-1-ol. You have to break several hydrogen bonds between water molecules to fit the long hydrocarbon group between them, but these are only replaced by much weaker dispersion forces between the small water molecules and the alcohol. It therefore costs more energy to break the intermolecular forces than you get out when new ones are made, and this makes mixing less feasible.