# Chemguide – answers

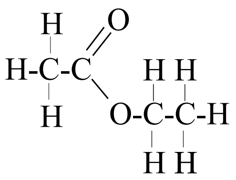
## ESTERS: INTRODUCTION

1. a) (i) methyl ethanoate

   (ii) ethyl propanoate

   (iii) propyl methanoate

   b)



   c) (i) $CH_3CH_2CH_2COOCH_3$

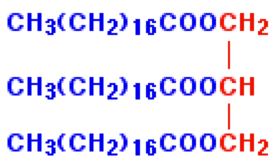
   (ii) $HCOOCH_2CH_2CH_2CH_3$

2. a) van der Waals dispersion forces and dipole-dipole attractions

   b) Ethyl ethanoate doesn't form hydrogen bonds when it is on its own because it has no hydrogen atom attached to an electronegative atom like oxygen. But there are lone pairs on the oxygens in the ester which can form hydrogen bonds with hydrogen atoms from water molecules. The energy needed to break the intermolecular forces in pure ethyl ethanoate and water is largely recovered when new bonds are made between the two in the mixture,

   c) The esters get bigger because the hydrocarbon groups get bigger. These would have to force their way between water molecules, breaking hydrogen bonds in the water. However, the hydrocarbon groups can't form hydrogen bonds with the water, and so solution gets energetically less profitable as the esters get bigger.

3. a) (Using the diagram from the Chemguide page to save time)

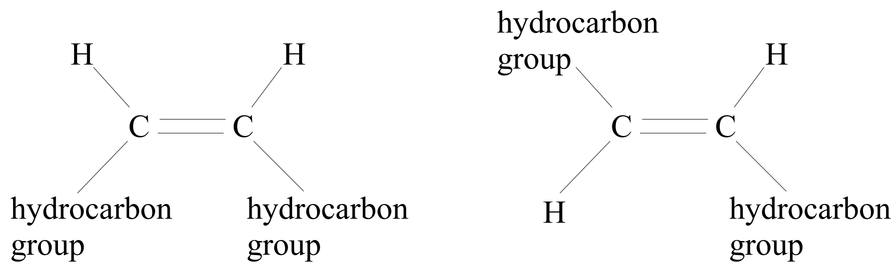


   You don't need to colour code it, and you could also write it with the chains on the right-hand side (although this makes life more difficult!). If you do this, you must show the correct bonding, so that attached to the $CH_2$ groups you have $OOC(CH_2)_{16}CH_3$.

   b) A saturated acid has no C=C bonds in the carbon chain. A monounsaturated acid has one C=C group, and a polyunsaturated acid has more than one.

c) Working along the carbon chain from the $CH_3$ end, the first C=C bond starts on the sixth carbon atom along.

d) Cis and trans refer to the arrangement of groups around the C=C bonds. In the cis form similar groups (hydrogen atoms or hydrocarbon groups) are on the same side of the C=C bond. In the trans form they are on opposite sides.




cis trans

e) The more unsaturated the chains, the lower the melting point of the fat or oil. In a saturated fat, with no C=C bonds, in the solid the chains in a particular molecule can lie tidily alongside each other. That lets the molecules lie close to each other and so maximises the amount of dispersion forces between the chains, giving a relatively high melting point. Unsaturation puts fixed kinks in the hydrocarbon chains, and this stops them lying so tidily together – both within a molecule and between molecules. The dispersion forces are therefore less effective, and the melting points lower.

f) The cis form forces major kinks into the carbon chains, stopping molecules from getting as close to each other. The trans form distortion is less, and so there is less effect on the way the molecules can lie together.

You might sketch diagrams a bit like the ones from the Chemguide page to make this clearer if you wanted to: