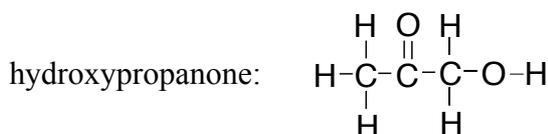
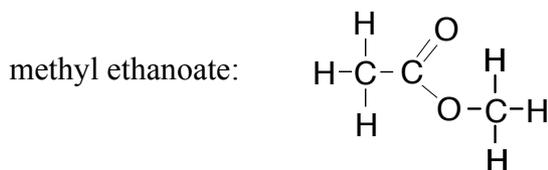
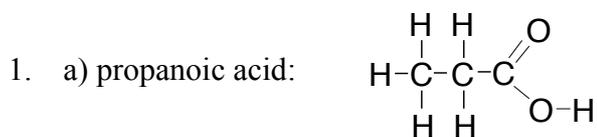


## Chemguide – answers

### INFRA-RED SPECTROSCOPY: INTERPRETING SPECTRA



b) Spectrum 1:

Notice that there isn't much of interest going on in the region around  $3000 \text{ cm}^{-1}$ , apart from the small troughs close to  $3000 \text{ cm}^{-1}$  which are due to C-H bonds. But there certainly isn't an O-H bond present either in an alcohol or an acid.

The only structure without an O-H bond is the ester, methyl ethanoate.

The spectrum shows the presence of the C=O bond by the trough at about  $1750 \text{ cm}^{-1}$ , and the two troughs in the region between  $1000$  and  $1250 \text{ cm}^{-1}$  will be due to C-O. The two C-O bonds in the molecule aren't quite the same because of the different bonding around the two carbon atoms (one is  $\text{sp}^3$  hybridised and one  $\text{sp}^2$ ), and so absorb at two different frequencies. But you don't really need this extra information to answer the question.

Spectrum 2:

This is showing an absorption due to an O-H bond at the left-hand side of the spectrum, but in an alcohol and not an acid. The trough for an acid O-H would be much wider, and slightly further to the right (see Spectrum 3).

The other important absorption is the one at just over  $1700 \text{ cm}^{-1}$ , showing a C=O bond.

So there is an O-H group and a separate C=O group. The molecule is hydroxypropanone.

You should also spot the trough due to C-H at about  $2900 \text{ cm}^{-1}$ , and one due to a C-O bond at about  $1100 \text{ cm}^{-1}$ , but again that isn't necessary for answering this particular question.

## Chemguide – answers

Spectrum 3:

The key absorption here is very wide trough either side of  $3000\text{ cm}^{-1}$  characteristic of the O-H group in a carboxylic acid.

So this has to be propanoic acid.

But you might also notice the absorption at about  $1700\text{ cm}^{-1}$  due to the C=O bond in the acid. There is only one C-O bond in the acid, and that will cause a trough in the  $1000 - 1300\text{ cm}^{-1}$  region, but we are in the fingerprint region here, and have to be cautious about which it is. But again, you don't need to worry about it for this question.