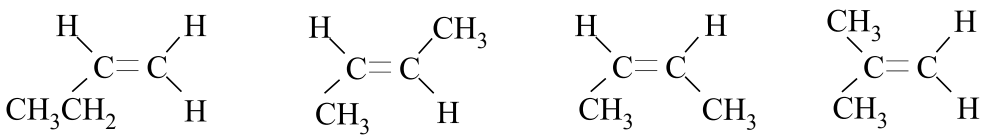
# Chemguide – answers

## ALKENES: INTRODUCTION

1. a) (i) $CH_2{=}CH_2$

   (ii) $CH_3CH{=}CH_2$

   b) 

Whenever you are asked to draw structural formulae for anything other than the most simple alkenes like ethene and propene, it is always a good idea to show the proper bond angles around the carbon-carbon double bond. If you draw the groups in a single straight line by writing $CH_3CH{=}CHCH_3$ you are likely to miss the fact that this could be one of two isomers.

c) The two middle isomers are geometric isomers. Their names are trans-but-2-ene and cis-but-2-ene as drawn above. If you use the E/Z system, they are (E)-but-2-ene and (Z)-but-2-ene.

Geometric isomerism occurs because there is no free rotation about the C=C bond, and so the attached $CH_3$ groups and hydrogens are locked in position either on the same side of the bond or on opposite sides.

2. a) Gas

b) No. For the but-1-ene to dissolve, you have to break the van der Waals forces attracting the but-1-ene molecules to each other, and the all the forces including hydrogen bonds attracting water molecules to each other. The only new forces set up between but-1-ene and water molecules would be van der Waals forces. More energy is used to break the original attractions than you get back forming the new ones, and so solution isn't energetically profitable.

c) Yes. The new forces of attraction between but-1-ene and hexane are similar in strength to those broken because both just have van der Waals forces.

3. a) All the lines show shared pairs of electrons in molecular orbitals between the two nuclei. The simple line shows a bond in the plane of the paper or screen. The dotted lines show bonds going back into the paper or screen. The wedges show bonds coming out of the paper or screen.

b) These represent a pi ($\pi$) bond. Both of the red areas are part of the same molecular orbital, and the two electrons can be found anywhere within the orbital.

c) The pi bond above and below the plane of the rest of the molecule is an exposed region of negative charge which is attractive to positively or slightly positively charged things. Such things are called electrophiles. Attack by an electrophile can break the pi bond and use its electrons to form new bonds in an addition reaction. No similar reactions can happen with alkanes.