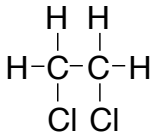
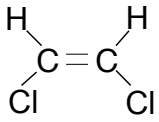
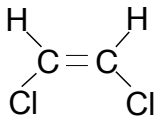
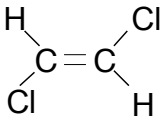
GEOMETRIC ISOMERISM

1.

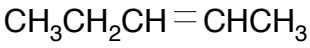



The molecule on the left has a carbon-carbon single bond, with free rotation around that bond. Geometric isomerism can only occur where bonds are locked into one position, as they are in the right-hand molecule. There is no free rotation around the double bond, and so the chlorines could be locked into one of two positions relative to each other:

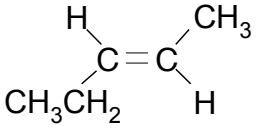
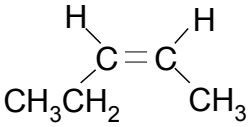
That isn't possible in the other molecule, because the two chlorines can simply rotate around the single bond from one position to another.

2. This is the only one which can have geometric isomers:

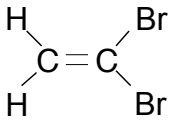
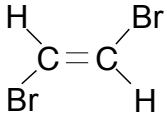
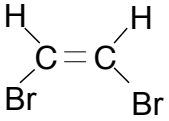


Geometric isomers have to have two different groups at both ends of the double bond. All the other structures have either two hydrogens or two methyl groups on one of the ends of the double bonds.

The geometric isomers are:

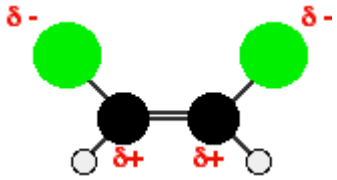



3.

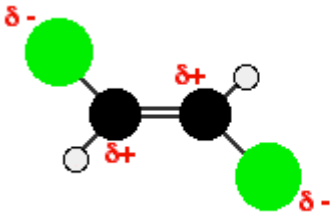




4. a) Boiling point is governed by the size of the intermolecular forces – the stronger the attractions, the higher the boiling point. In both cis and trans forms, the van der Waals dispersion forces are identical. However, the cis form has a permanent dipole, and therefore also has dipole-dipole attractions.

   The permanent dipole happens because both of the electronegative chlorines are on the same side of the molecule:



   In the trans form, they are on opposite sides, and so cancel each other out. There is no permanent dipole on the molecule as a whole.



   b) In a solid, you have to take account of the way molecules pack together as well as the possible forces between them. The straighter shape of the trans form packs better than the U-shape of the cis form.