

## Chemguide – answers

### ARYL HALIDES: INTRODUCTION

1. a) The first diagram shows the benzene ring with its delocalised electrons attached to a chlorine atom with three lone pairs. One of the lone pairs is lined up in such a way as to be able to delocalise to some extent with the ring electrons.

The second diagram show the result of that delocalisation, so that one of the lone pairs is now involved with the ring delocalisation.

- b) The delocalisation of the lone pair introduces some extra shared electrons between the chlorine and the carbon, and so increases the bond strength.
- c) Chlorine is more electronegative than carbon and so usually the chlorine-carbon bond is polarised with the chlorine slightly negative and the carbon slightly positive. In this case, though, there is also some movement of electrons towards the carbon because of the delocalised lone pair. That offsets the electronegativity effect to some extent and so the bond isn't as polarised as it would otherwise be. That means that the polarity of the molecule will be less than expected.
2. a) van der Waals dispersion forces.
- b) As the molecule gets bigger (because of the increasing size of the halogen atom) there are more electrons which can be involved in temporary dipoles. Therefore the dispersion forces increase, and more energy is needed to overcome them.
- c) To produce a mixture of water and, say, chlorobenzene, you would have to break hydrogen bonds in the water and the quite strong dispersion forces in the chlorobenzene. But these would only be replaced by weaker dispersion forces between the small water molecules and the chlorobenzene. It isn't therefore energetically profitable for the two molecules to mix to form a solution. Exactly the same thing is true for the other aryl halides.