

Chemguide – answers

HALOGENOALKANES: INTRODUCTION

1. A: 2-bromobutane, secondary.
B: 1-chloropropane, primary.
C: 2-chloro-2-methylbutane, tertiary.
D: 2-iodopropane, secondary.

If you got anything here wrong, however slight, and don't understand why, go back and look at it again. You must be able to convert reliably between names and formulae, and, for halogenoalkanes, you must be able to identify what kind they are.

2. a) van der Waals dispersion forces and (for all except the iodo- compounds) dipole-dipole interactions.
b) The boiling points rise as you go from chloro- to bromo- to iodo- compound. This is because of the large increase in the number of electrons, and so the increase in the potential for dispersion forces. The fact that the dipole-dipole interactions decrease is completely outweighed by the extra dispersion forces.
c) The boiling points increase, because there are more electrons and a greater length. Both of these increase the potential for effective temporary dipoles.
d) All of these have the same number of electrons. In the 1-bromobutane, you have the greatest chain length and so can establish the most effective temporary dipoles. The molecules can also lie closely together, and so maximise the attractions.

As the molecules get more branched, the dipoles aren't as great, and the molecules can't lie as closely together. The boiling points therefore fall.

e) To get 1-chloropropane to mix with water, you have to break the intermolecular forces in both compounds. In 1-chloropropane these are van der Waals dispersion forces and dipole-dipole attractions. In water, you also have to break hydrogen bonds. Breaking attractions costs energy.

When the molecules mix, the forces of attraction between the 1-chloropropane and water are only dispersion forces and dipole-dipole attractions. This releases energy, but not as much as you would have to put in to separate the molecules originally. It isn't energetically profitable for the mixing to happen.

3. The main factor influencing the reactivity isn't the degree of attraction, but the amount of energy it takes to break the carbon-halogen bonds. The carbon-fluorine bond is very strong – so strong that it doesn't easily get broken. As you go from chlorine to bromine to iodine, the carbon-halogen bond gets much weaker, and so the reaction becomes energetically easier, and so happens faster.