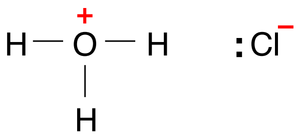
Chemguide – answers

CURLY ARROWS

1. One of the lone pairs on the oxygen atom moves towards the carbon to make a new bond with it. At the same time, the carbon-bromine bond is broken, with both of the electrons in the bond moving over entirely to the bromine. That leaves the bromine with a negative charge – a bromide ion.

   (Be sure that you understand why the bromine ends up negatively charged. There has to be a negative charge somewhere on the products side of the equation, because you started with a negative charge on the left-hand side. Charges have to balance in equations as well as atoms. The bromine now not only has the electron that it gave to the C-Br bond in the first place, but also the carbon's electron as well.)

2. 

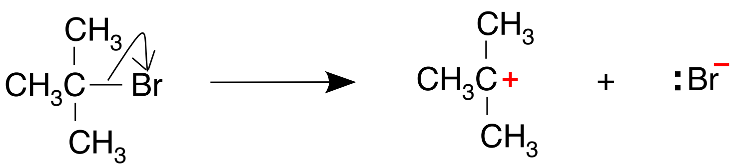
   A new bond is being formed using a lone pair on the oxygen attaching to a hydrogen from an HCl molecule. At the same time the bond between the hydrogen and the chlorine is being broken, with both electrons ending up on the chlorine.

   It is easy to see that the chlorine must have a negative charge. It has taken the electron that the hydrogen originally contributed to the covalent bond as well as its own.

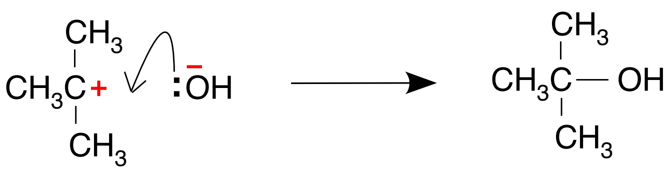
   That means that the hydrogen must have transferred to the water molecule without its electron, so the H_3O^+ has picked up a hydrogen nucleus (positive) without its electron.

   It isn't quite so easy to see immediately why the positive charge must lie on the oxygen. You *can* (sort of!) work it out, but there is an easy way of doing this without having to worry about it. If you have an atom which isn't bonding as you expect it to (in this case, the oxygen ends up with three bonds rather than its normal two), that's where the charge is likely to be.

3. First step:

   Second step:

   (As with all these examples, you only show the lone pairs on the O and Br that you are interested in. If you got this right, well done! This (and the similar sort of equation in Q1) is described as a *reaction mechanism,* showing step-by-step how reactions happen, and is a bit of organic chemistry that many students get hopelessly lost with. You are over that hurdle now. If you didn't get it right, don't give up on it until you do. A bit of extra time spent now, will save you major headaches later on.)

4. A normal curly arrow is used to show the movement of a pair of electrons. A fish-hook curly arrow is used to show the movement of a single electron.

   (I am not asking any more about fish-hook arrows, because I haven't used them anywhere on Chemguide apart from this page, or in 40-odd years of teaching. I think they just make otherwise simple diagrams and equations look seriously complicated and confusing, and I have no intention of encouraging their use!)