

Chemguide – answers

ELECTROPHILIC ADDITION – UNSYMMETRICAL ALKENES

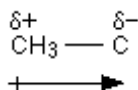
1. a) A carbocation is an ion with a positive charge on a carbon atom.

b) $\text{CH}_3\text{CH}_2\overset{+}{\text{C}}\text{H}_2$ There is no other possibility.

c) $\text{CH}_3\text{CH}_2\overset{+}{\text{C}}\text{HCH}_3$ You could also have drawn this with the methyl group on the left and the ethyl on the right.

d) $\begin{array}{c} \overset{+}{\text{C}} \\ | \\ \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$ As long as you have drawn three methyl groups attached to the carbon with the positive charge, that's fine.

e) Alkyl groups, including methyl groups, tend to “push” electrons away from themselves. (You can use the term “have a positive inductive effect” if you prefer, but it is less easy to remember.) This gives a slight negative charge to the carbon atom they are attached to:



In a carbocation, that carbon is the one which carries a positive charge, and the effect is to cut down the size of the positive charge by spreading it around the rest of the ion.

In a primary ion, there is only one alkyl group doing this, but in a secondary ion there are two. That means that the charge is more effectively spread around in a secondary ion than in a primary one.

The more you can spread a charge around, the more stable the ion becomes.

2. a) When a compound HX is added to an unsymmetrical alkene, the hydrogen becomes attached to the carbon with the most hydrogens attached to it already.

b) The right-hand carbon atom in the double bond of the structure $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ has more hydrogen atoms already (2) than the left-hand one (1), so the new hydrogen will attach to the right-hand end of the bond, and the X to the other end – to give $\begin{array}{c} \text{CH}_3\text{CH}_2\text{CHCH}_3 \\ | \\ \text{X} \end{array}$

c) The faster route is the second one because it forms a secondary carbocation as an intermediate. The first route forms a primary ion.

Secondary ions are more energetically stable than primary ones, and so less energy is needed to form them. That means that the activation energy for the second route is less than that of the first, and so more molecules have enough energy to go via that route.