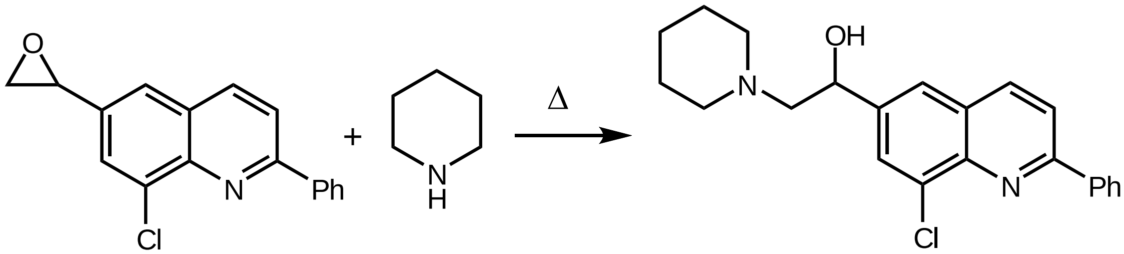
Problem 2



R. Paul and H. Normant, Bull. Soc. Chim. France, 1945, 12, 388.

1. Draw all of the bonds near the reactive center in the starting materials

2. Draw all of the H-atoms near the reactive sites of starting materials and products

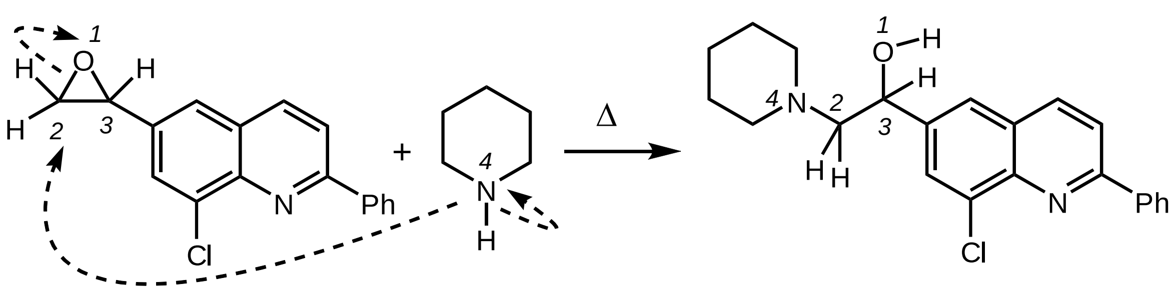
3. Balance the equation:

4. Number the non-H atoms:

5. Identify the bonds made and broken:

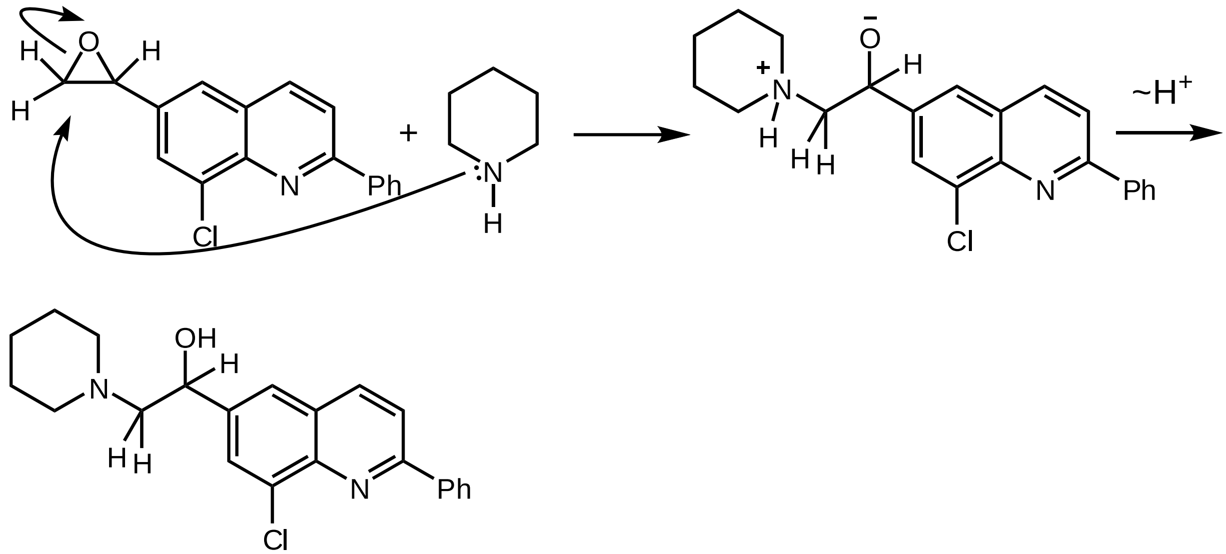
Bonds made: 4-2, 1-H

Bonds broken: 1-2, 4-H.



Identify the conditions:
Basic (do not generate strong acids)

Mechanism:

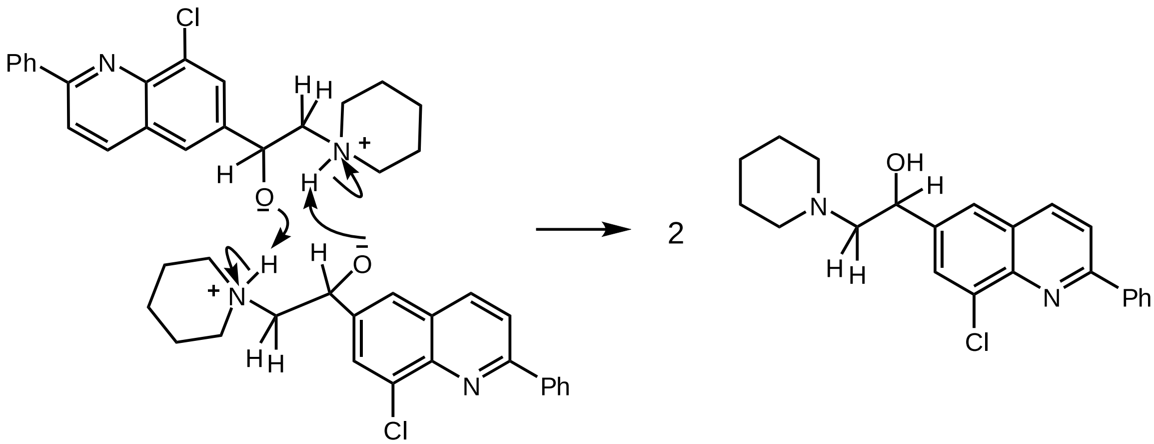


Discussion:

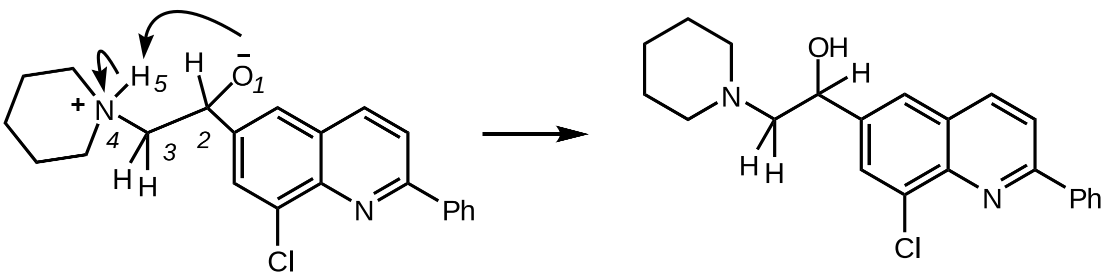
1. When the structures are big, as in this problem, numbering only the important atoms is enough. Important atoms can be identified easily as they are present at or near the site of change. However, if you are uncertain, do number all of the atoms that you are not sure of.

2. A positive charge can be generated under basic conditions provided it does not generate a strong acid. This can be seen in the middle structure of the mechanism. The pka of ammonium is about 10 and hence it is not a strong acid.

3. When protonation on one site and deprotonation on another is required, the two processes can be represented by the symbol $\sim H^+$. The same process can also be shown, in detail, by the reaction of one molecule with another.



Intramolecular proton exchange is also possible when the transition state is not strained. For the above example it can be represented as follows.



The transition state in this case is five membered (it can be judged by the numbers on the atoms involved). The five membered transition state is strained, but not too much. So, the above mechanism should be acceptable. However, do not write such a mechanism if it goes through three or four membered transition states.

Proton transfer can also occur easily with the help of solvents. In short, proton exchange can be shown by a number of ways. Most people find writing ~H^+ to be the easiest way.