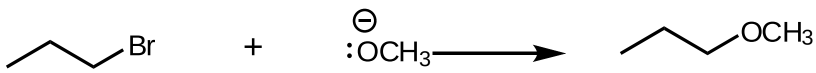
Problem 1

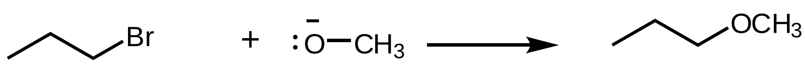
Consider the following transformation that is an example of Williamson ether synthesis.



The arrow formalism mechanism for this transformation can be drawn by keeping in mind the points mentioned in the previous section and by following the steps mentioned below.

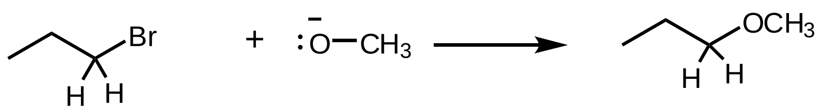
ANALYSIS

Draw all of the bonds at the reactive atoms in the starting materials



This step will keep analysis neat.

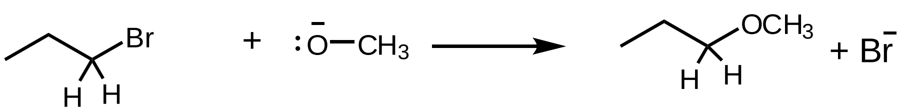
Draw all of the H-atoms at or near the reactive sites of the starting materials and the products



This will help avoid drawing too many bonds, keeping track of charges and numbering the atoms (see below).

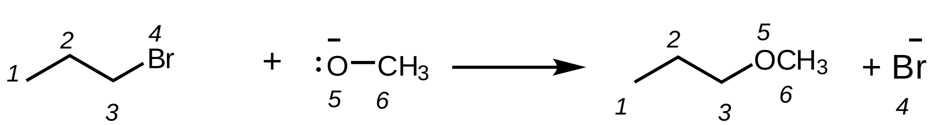
Balance the equation

Balance the atoms and the charges. When balancing the charges, the sum of charges on the left hand side of the equation must equal the sum of charges on the right.



Number the non-H atoms

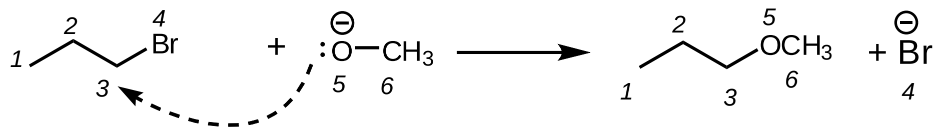
Number the non-H atoms in the starting materials. The order does not matter. Mark the corresponding atoms in the product(s) with the same numbers.



Identify the bonds made and broken

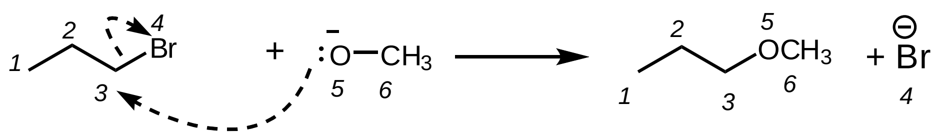
Write the bonds made, and draw a dotted line between the two atoms making sure that the arrow points to the electrophile. This dotted line will help you immensely in the drawing of the mechanism.

Bonds Made: 5-3



Identify the broken bonds. Draw another dotted line between the two atoms making sure that the arrow points to the electronegative atom.

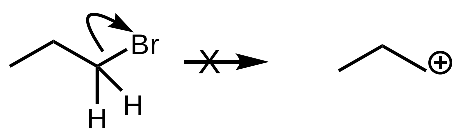
Bonds Broken: 3-4



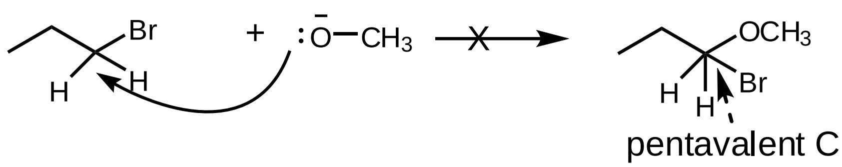
Identify the conditions:
Basic (do not generate strong acids)

Draw the Mechanism:
All arrows that will be used in this mechanism are already shown above with the dotted lines. This will be the case with all the problems that you will encounter in this book. Most arrows if not all will be visible in the analysis of all the problems.

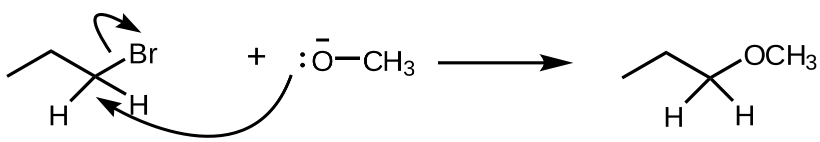
Initially it may be difficult to identify which arrow should be drawn first for any problem. Do the following: draw any one arrow and see what you will get. If the arrow produces an intermediate that cannot exist under the reaction conditions, then the arrow must be incorrect. Thus, for the above transformation, the top arrow will produce a carbocation. Carbocations should not be generated under basic conditions, thus this arrow must not be the first one.



Now try the second arrow and analyze the intermediate. In this particular case, it will generate a pentavalent carbon.



For this situation, draw the other arrow present on the reaction site as well. If there is no other arrow in the initial analysis, then this step must also be incorrect. However, in this particular case, the second arrow is present and can be drawn. Thus, the complete reaction mechanism is as follows:



How to tell when a step is complete?

1. Initially, it may be difficult to know when a step is complete. You will know when the step is complete when the minimum number of arrows will give an intermediate that can exist under the reaction conditions. So, for example, in the above case, when the first correct arrow was drawn it generated a pentavalent C. This indicated that the step was incomplete and needed the second arrow. The second arrow gave the product that can exist under the reaction conditions.

2. It is customary to write the organic products only. Thus, Br^- is not shown in the mechanism.

We will be using the above step-wise approach to solve all the problems in this book.