**Alcohols & Ethers Worksheet** **Name:**
**Part A**

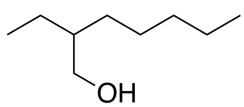
The focus of this chapter can be thought of as the organic version of water. When $H_2O$ has one or both of its hydrogens replaced by an R group we get alcohols and ethers.

Alcohols are named by taking the longest chain connected to the –OH group and numbering from the side nearest the –OH then dropping the final e in the name of the parent chain and replacing it with ol. The locant number for the OH can either be placed before the name of the parent chain of the name separated by a dash or right before the ol separated by dashes on either side. Try it.

For example, 2-ethyloctan-3-ol which can also be called. 2-ethyl-3-octanol.

Draw it.

Name this molecule (using both of the acceptable ways, like in the example above)

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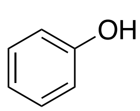
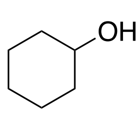
Did you correctly notice that the longest chain connected to the OH is a seven, not eight, carbon chain?

When the –OH is connected to an arene ring it is called a “phenol”. This is phenol:




What is this other next molecule’s IUPAC name?

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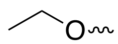
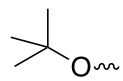
Read the section 11.1B about naming ethers – I have a little to add. For a complicated ether we can look at the two R groups and choose the parent by selected the one this has the longest carbon chain or if one is a ring, then the ring is the parent. The other will be a substituent along with the O it is attached to.

For example, $CH_3O$- would not be called a methyl substituent it would be called methoxy (drop the yl and add oxy. Name each of these as substituents:

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Now adopting the method that the longest chain is a parent, name these ethers:
(reminder, if there is a ring it is always a parent)

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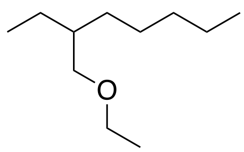


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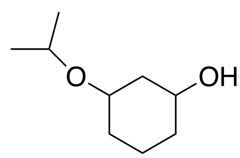


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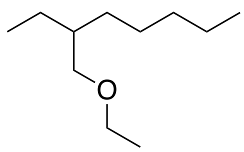
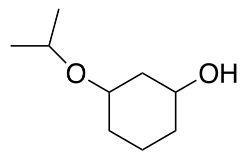
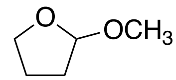
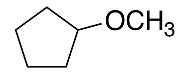
Alcohols and ethers have very similar water solubility properties because the main factor that determines the water solubility is the ratio of #carbon/(#oxygen+#nitrogen) in the molecule. The smaller the ratio, the more water soluble the molecule will be. As a rule of thumb, if the ratio is less than five, the molecule will have “reasonable” water solubility. If it is five or higher then the molecule has very little water solubility.

Circle the molecules you will expect to be reasonably water soluble below and put a box around the one that is the *most* water soluble.










On the other hand, alcohols and ethers can be very similar in shape and size but have very different boiling points. This is because alcohols can form strong hydrogen bonds (dipole-dipole interaction) with one another and that makes them more difficult to boil. For each pair below, circle the molecule you would expect to have the *highest* boiling point.

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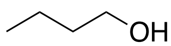

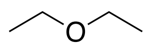


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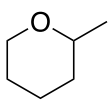

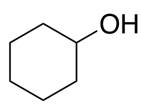


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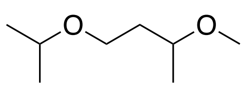

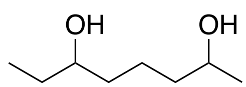


Section 11.4 reviews some reactions from last semester, with several ways of making alcohols by addition of water to an alkene. The methods are used for different purposes. What is the purpose of …

1. …simple hydration

2. …Oxymercuration – Demercuration

3. …Hydroboration – Oxidation

Write summary reactions to show the preparation of 2-hexanol using simple hydration.

If one tries to prepare 3-methyl 2-hexanol by simple hydration, something goes wrong. What?

Which of the three methods above could be used to prevent that problem and successfully prepare 3-methyl 2-hexanol.

Show the preparation of 1-hexanol using hydroboration-oxidation. Why would the other two methods not work in this case?

The chapter forgot to remind us about nucleophilic substitution. Show how this method could be used to make 1-hexanol from a suitable starting material.

When alcohols react they do so by either breaking a bond between the O and the H or between the O and the C. The –O-H bond is broken by the treatment of the alcohol with a suitably strong base, like $NaNH_s$. or NaH. Try problem 11.5 on page 500 of the textbook.

We have also seen reactions that break the C-O bond such as the dehydration of an alcohol to form an alkene. Another reaction of the C-O comes when we prepare an alkyl halide from an alcohol, RX => ROH

The mechanism of this reaction involves the formation of a carbocation. What type of carbocation is *least difficult* to form?

In order to prevent carbocation rearrangement, special reagents are sometimes used. $PBr_3$ is used in place of conc. HBr and $SOCl_2$ in place of conc. HCl. Note that 2° alcohols are the most likely to rearrange. 1° alcohols follow a different mechanism and usually do not rearrange. Fill in the reaction arrows by writing the reagent that could be used to perform the transformation. It more than one reagent could be used, then simply pick one of them.

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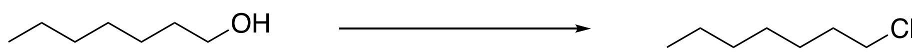


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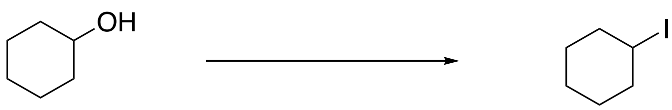


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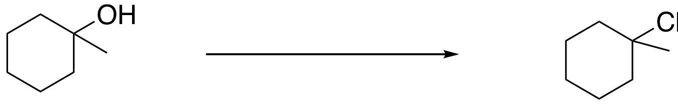

Acid /base reaction are not the only ones that the O-H in the alcohol can undergo. Read section 11.10 and then answer these questions.

On page 506 the bond line drawing of ethyl mesylate and ethyl tosylate are shown. Redraw these two substances with a structure that shows every atom. Do not use any abbreviations.

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Try problems 11.8 and 11.9 on page 507. What would have happened in 11.9a if the first step (using TsCl and pyridine) was omitted?

Williamson Ether synthesis is a multistep method to prepare ethers from two alcohols following this method:

Ether => Alkoxide & Alkyl halide (the $S_N2$ reaction); to work well the RX should not be 2° or 3°
Alkoxide ion => alcohol (acid/base reaction)
Alkyl halide => alcohol (the reaction we just studied on the previous page of this handout)

Rewrite this retrosynthetic strategy as a set of three reaction steps that shows the general way the Williamson method is done.

Now let's get real. Show how it is possible to convert 2-methyl-2-propanol and 1-propanol into 1-*t*-butoxypropane.

Above, I said, “to work well the RX should not be 2° or 3°”. Why is this. What will go wrong if the RX is 2° or 3°? You may want to refer to the mechanism handout provided on the second day of class.