Review: Alcohols & Ethers

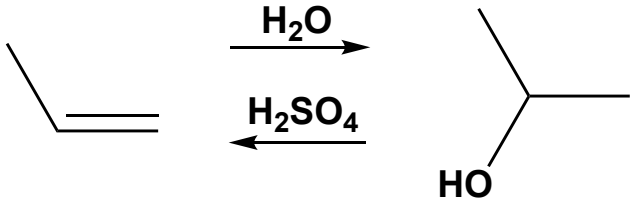
Properties of Ethers

- usually unreactive, due to lack of strong net polarity (the C-O bond on one side is balanced out by the O-C bond on the other side)
    - except in very strong acids, where they can react
- good solvents for organic compounds, they have a dipole
- lower boiling and melting points than alcohols
- H-bond acceptors (not donors), but insoluble in water

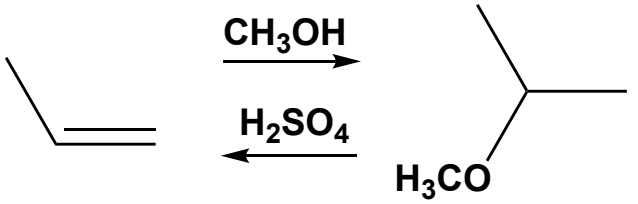
Synthesis of Alcohols & Ethers

Addition Reactions to Alkenes - REVIEW

Alcohols:

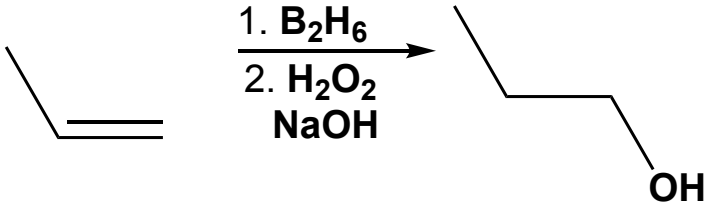


Ethers:

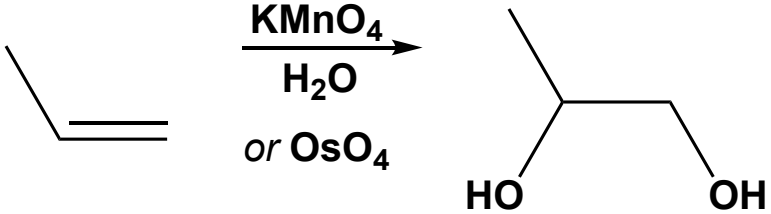


methyl isopropyl ether

Alcohols:

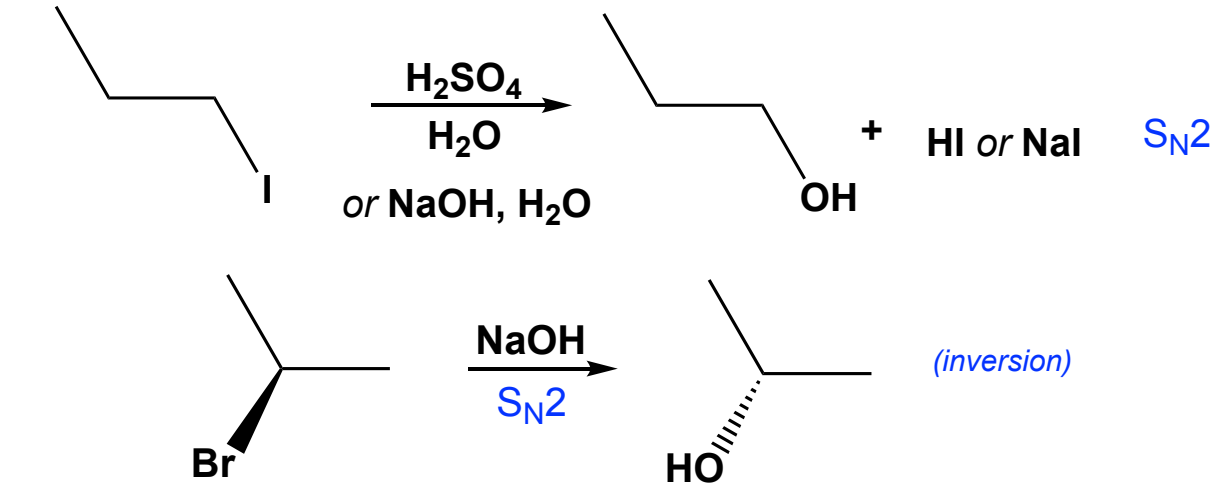


Diols:

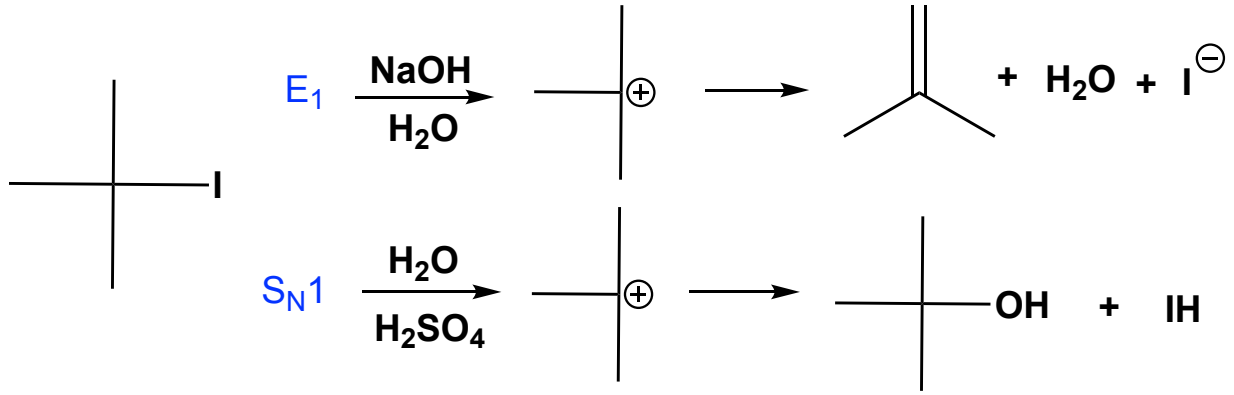


propan-1,2-diol

Substitution Reactions

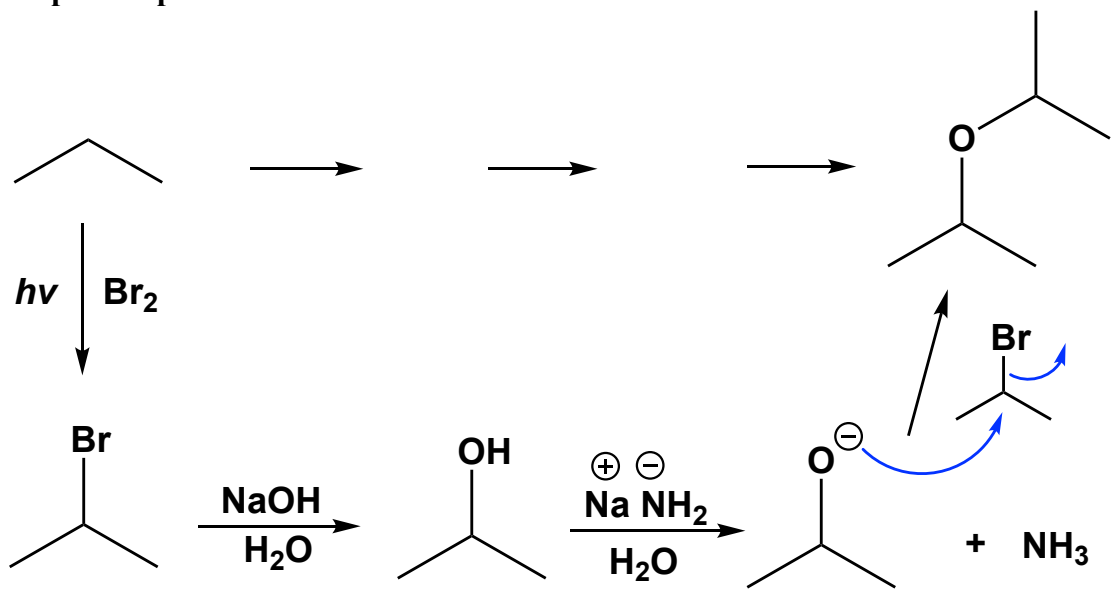


Recall: stereochemistry is inverted for S_N2 reactions as everything occurs in 1 step (concerted) and there is no planar carbocation intermediate.

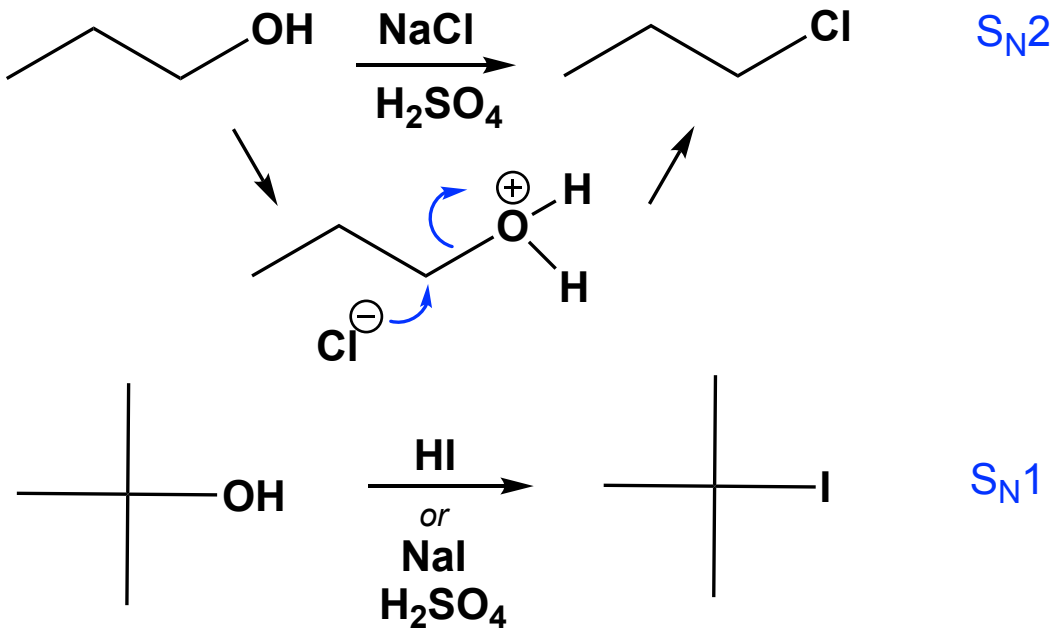


Note: The same starting material can undergo various reactions. In the above case, the carbocation undergoes either E1 or S_N1 depending on the reagents present.

Multi-step Example



Reactions with Alcohols



Carbohydrates

- sugars, saccharides

A familiar equation:

$$6\,CO_2 + 6\,H_2O \xrightarrow[\text{photosynthesis}]{h\nu} C_6H_{12}O_6 + 6\,O_2$$

- about 4 x 10^{11} metric tons of carbon dioxide is converted into glucose by plants
- the process of photosynthesis only uses 0.02% of the suns total energy on Earth
- the sugar produced is known as D-glucose (shown below) which is an aldohexose

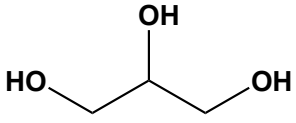
Nomenclature

General formula of sugars: $C_NH_{2N}O_N$ *(approx.)*

The number of carbons is indicated as follows:

3 carbon sugar – triose
4 carbon sugar – tetrose
5 carbon sugar – pentose
6 carbon sugar – hexose

Remember glycerol? It is a triose.



The location of the carbonyl group is indicated by the prefix:

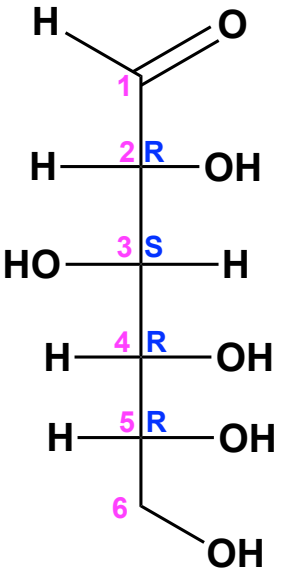
aldo – aldehyde (at the end of the carbon chain)
keto – ketone (in the middle of the chain)

Additionally, an allocation of D or L is given to indicate the stereochemistry of the highest numbered (last) stereocentre.

D sugar – highest numbered stereocentre in *R* configuration.
L sugar – highest numbered stereocentre in *S* configuration.

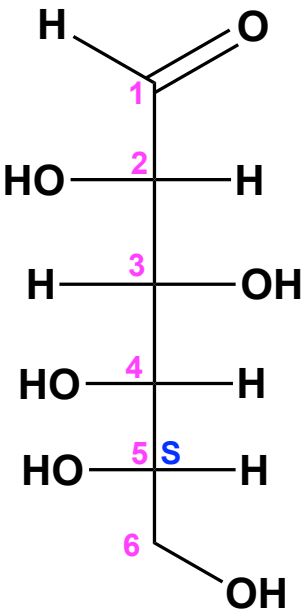
Example: **D-Glucose**

**know this structure*



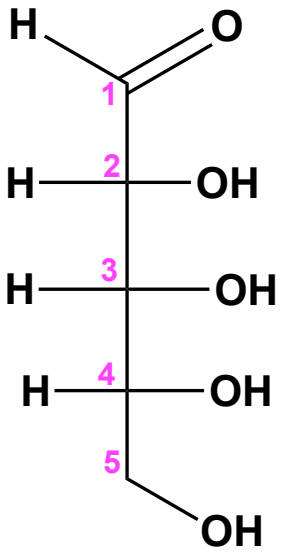
Based on the above nomenclature, D-glucose is an aldohexose (aldehyde, 6 carbons)
The above structure is labelled as "D" because the R configuration occurs at carbon 5 *(note that carbon 6 is not a stereocentre).*

Example: **L-Glucose**



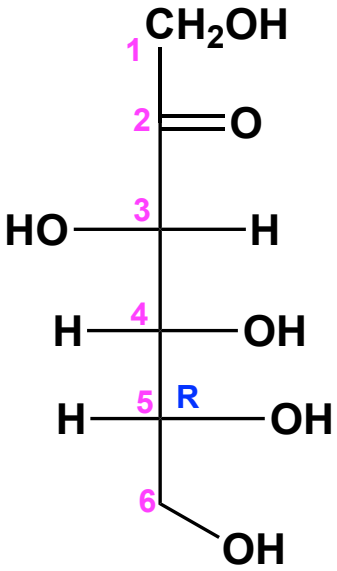
S configuration occurs at the highest numbered stereocentre (again at carbon 5), this is an L sugar. The sugar contains an aldehyde therefore this is an aldohexose. Turns out this is called L-glucose.

Example: **D-Ribose**



An aldopentose (aldehyde, 5 carbons long). At the highest numbered stereocentre (carbon 4) the stereochemistry is R.
The name of this is D-ribose (found in RNA! – deoxyribose is in DNA)

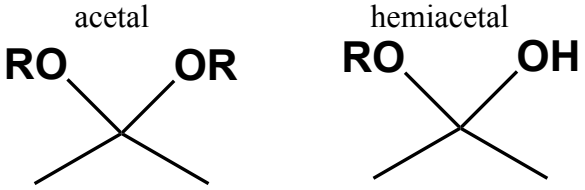
Example: **D-fructose**



Carbonyl is internal, therefore this is a ketone, and there are 6 carbons. This is a ketohexose. The R stereochemistry at carbon 5 designates this as a D sugar.

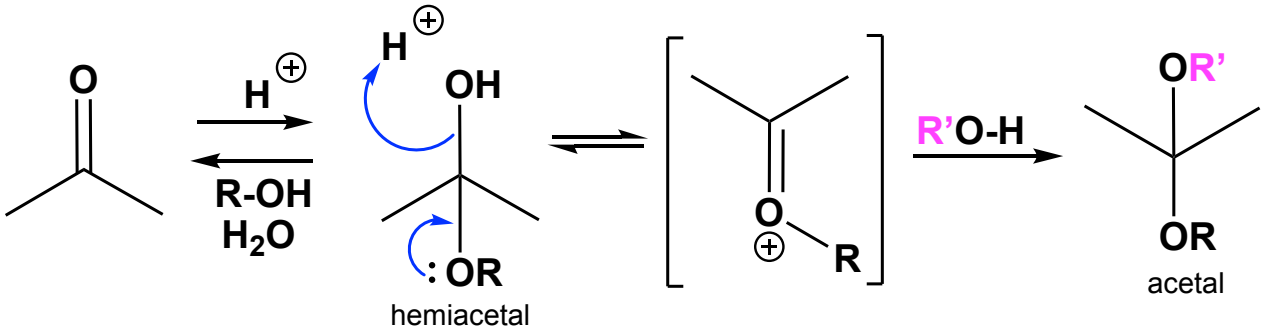
<u>Reactions of Carbohydrates</u>

Names to know:

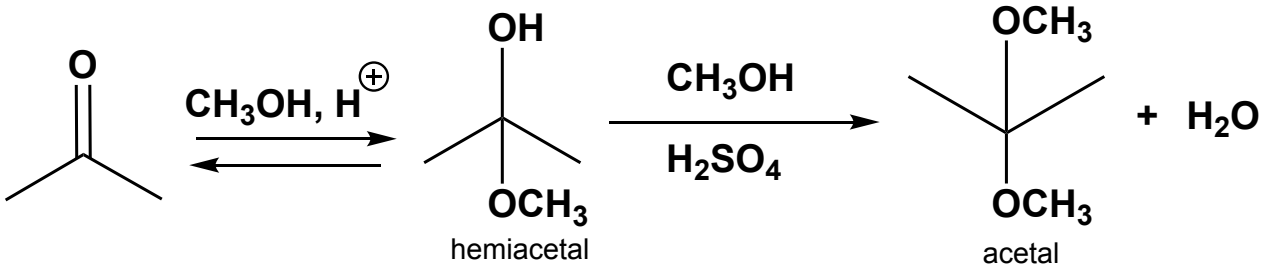


Addition Reactions

Scheme



Example



Intramolecular Example