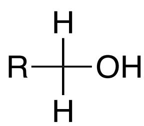
Back to: Alcohol Nomenclature

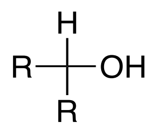
-OH group can be named:
- alcohol
- hydroxyl
- hydroxy

Steps:
1. Find the longest chain, with the OH attached (as it takes priority over other groups)
2. Number in such a way to give the OH the lowest number
3. Drop the “e” of the alkane name, add “ol”

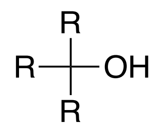
Alcohols are classified as primary (1°), secondary (2°), or tertiary (3°), depending on the number of organic groups bonded to the hydroxyl bearing carbon.



primary alcohol (1°)



secondary alcohol (2°)

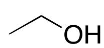


tertiary alcohol (3°)

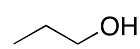
Examples

H_3C-OH

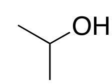
methanol
or methyl alcohol
or wood alcohol



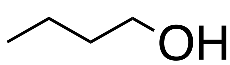
ethanol
or ethyl alcohol
or grain alcohol



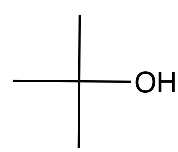
n-propanol
or 1-propanol



2-propanol
or isopropanol

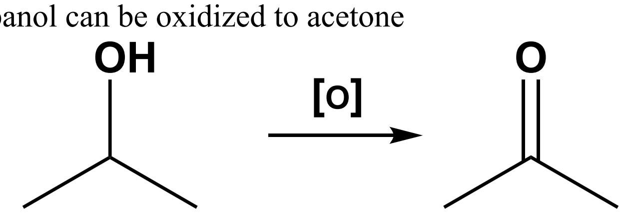


butanol
1-butanol
n-butanol (n = normal = straight chain)

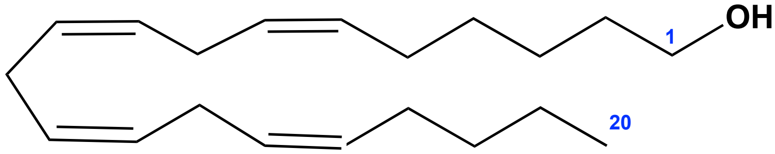


2-methyl-2-propanol
tert-butyl alcohol
t-butyl alcohol

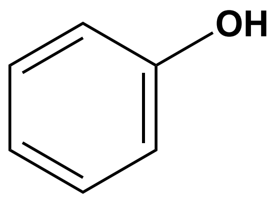
In the body, isopropanol can be oxidized to acetone



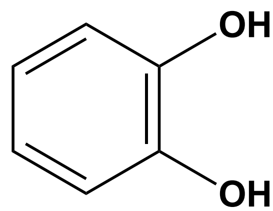
More Complex Examples



eicosa-6Z,9Z,12Z,15Z-tetraen-1-ol



phenol



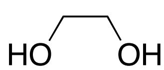
catechol

<u>**Polyols**</u>

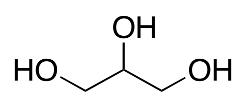
If more than one hydroxyl group is present, a prefix is added to the "ol"

2 OH's	diol (glycol)
3 OH's	triol
4 OH's	tetraol
5 OH's	pentaol

Some simple and widely occurring alcohols have common names that are accepted by IUPAC. For example:



ethylene glycol
or 1,2-ethanediol
(antifreeze component)



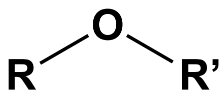
glycerol or glycerine
or 1,2,3-propanetriol
or propane-1,2,3-triol

the freezing point is lower if mixed with water

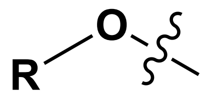
Glycerol is a precursor to fats (fatty acid esters in cell membranes) and is used in personal lubricants such as KY jelly

Ethers

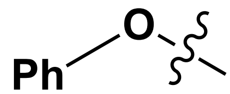
Recall the difference between ethers and esters



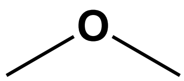
ether



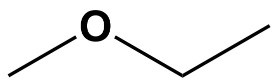
alkoxy



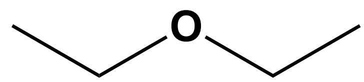
phenoxy



dimethyl ether
methoxymethane

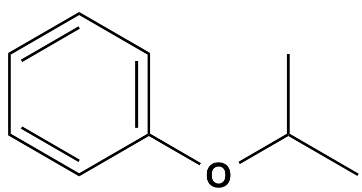


methoxyethane
ethyl methyl ether

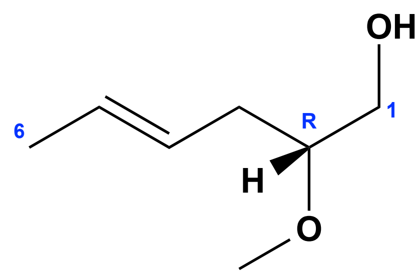


diethyl ether
ethyl ether

Examples



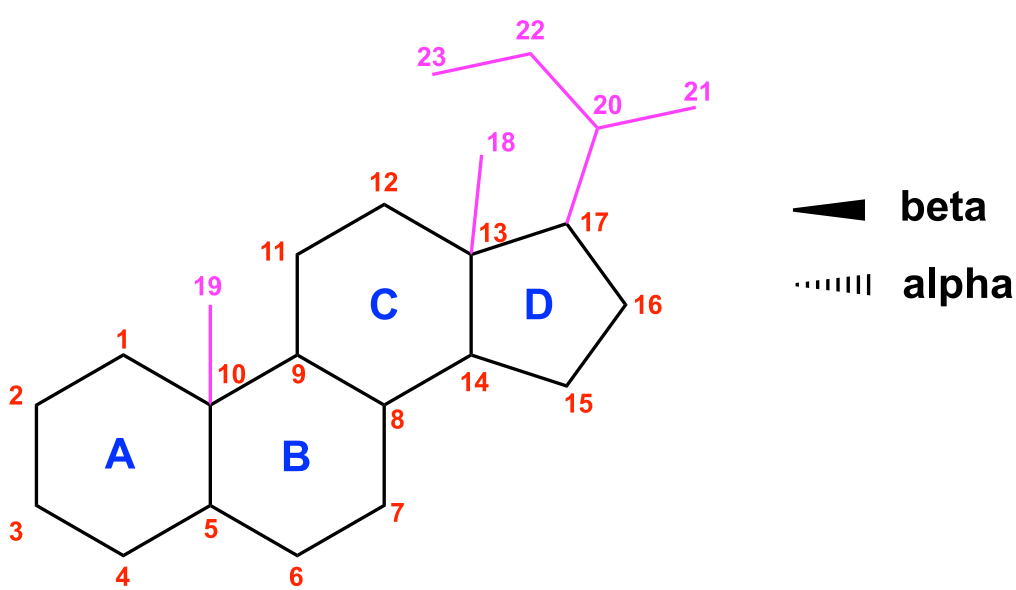
isopropyl phenyl ether



(R)-2-methoxyhex-4-en-1-ol

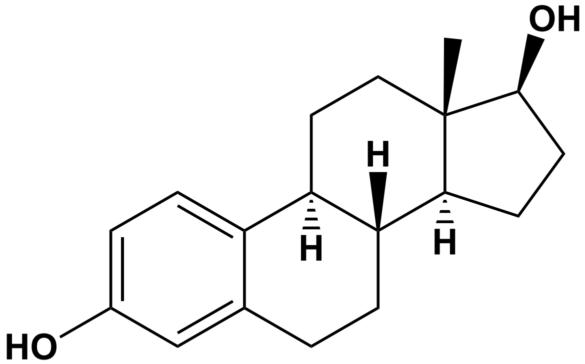
Steroids

Nomenclature - skeleton numbering – also alpha (α) and beta (β)

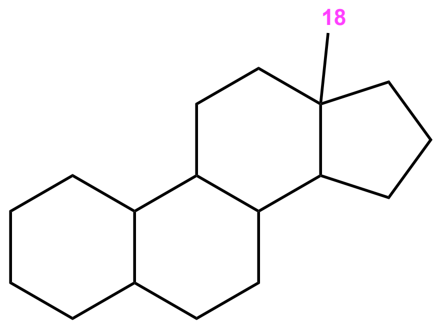


Some examples of common steroids:

Estradiol – female sex hormone (estrane is the parent skeleton)



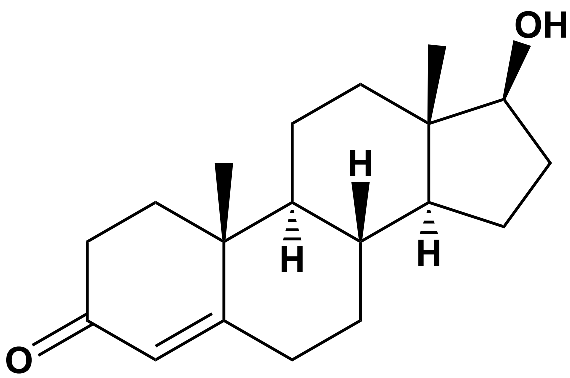
estradiol



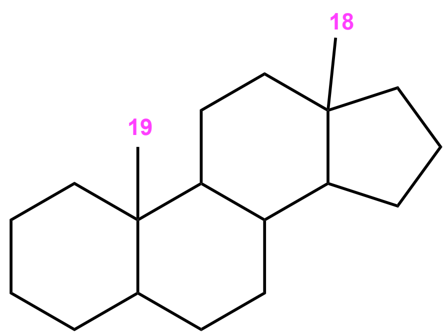
estrane

First isolated in 1929, by Doisy and Butenandt

Testosterone – male sex hormone (androstane is the parent skeleton)

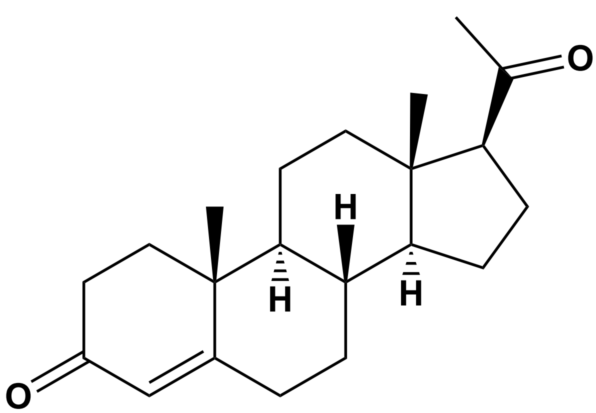


testosterone

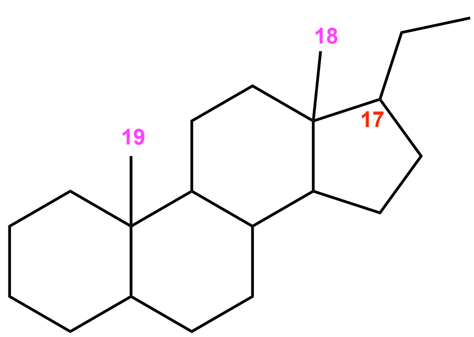


androstane

Progesterone – pregnancy hormone (pregnane is the parent skeleton)

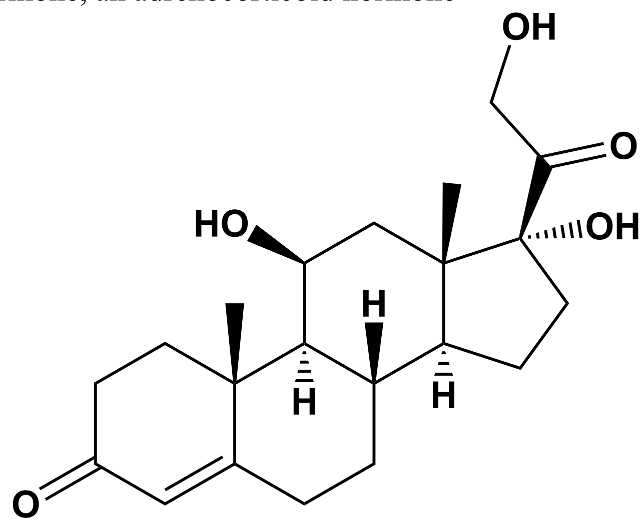


progesterone



pregnane

Cortisol - stress hormone, an adrenocorticoid hormone



cortisol

Alcohol Physical Properties

- The hydroxyl group is a very polar group. This allows them to be miscible with water as they are good hydrogen bond donors *and* acceptors.
- Alcohol densities are usually ρ < 1.0.
- They are good solvents.
- They have high boiling and melting points, again due to their hydrogen bonding capabilities.

Look at the following comparisons:

Name	Methanol	Ethane
Formula	CH_3OH	CH_3CH_3
Molecular Weight (g/mol)	32	30
Boiling Point (° C)	65	-89
State (at room temp)	liquid	gas

Ethane has almost the same molecular weight as methanol. However, the boiling point is much lower than methanol.

Acidity

Recall the acidity constant equations:

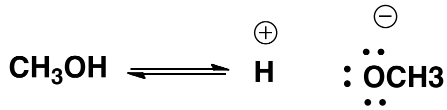
$$\mathbf{HA} \rightleftharpoons \mathbf{H}^{\oplus} \quad \mathbf{:A}^{\ominus}$$

HA is the conjugate acid of A^-, and A^- is the conjugate base of HA.

The equilibrium constant, or acidity constant, $\boldsymbol{K_a}$, for this reaction can be expressed as:

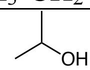
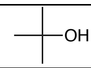
$$K_a = [H^+]\,[A^-] / [HA]$$

For example: the dissociation of methanol

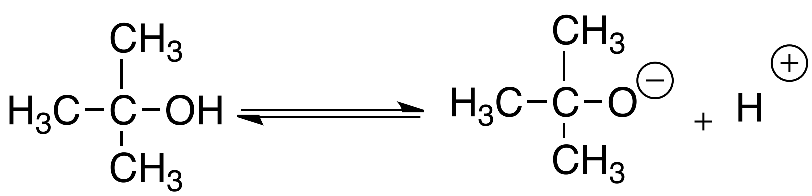


$$K_a = [H^+][CH_3O^-] / [CH_3OH] = 10^{-16}$$

Other alcohol examples:

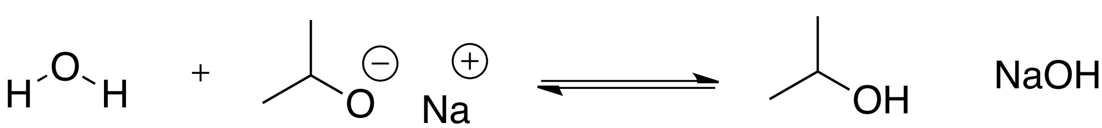
Name	Structure	pKa	
methanol	$H_3C\text{-}OH$	16	More acidic
ethanol	$CH_3\text{-}CH_2\text{-}OH$	17	
isopropyl alcohol		18	
tert-butanol		19	Less acidic

Recall that **the stability of the conjugate anion determines the acidity of a compound**. The more stabilized the anion is, more acidic the molecule is.



For *tert*-butanol (tert-butyl alcohol), there are three alkyl groups (methyls) that donate electron density to the carbon next to a negative charged group (inductive donation of electrons destabilizes the anion). Therefore, it is less likely to dissociate (pK_a 19) and the molecule is even less likely to ionize (less acidic).

Consider the example below:



Where does the equilibrium lie in the above reaction?

Answer: It lies far to the right.

The reaction of a stronger base (isopropoxide) **and a stronger acid** (water) **to a weaker base** (sodium hydroxide) **and weaker acid** (isopropanol) **is very fast**.