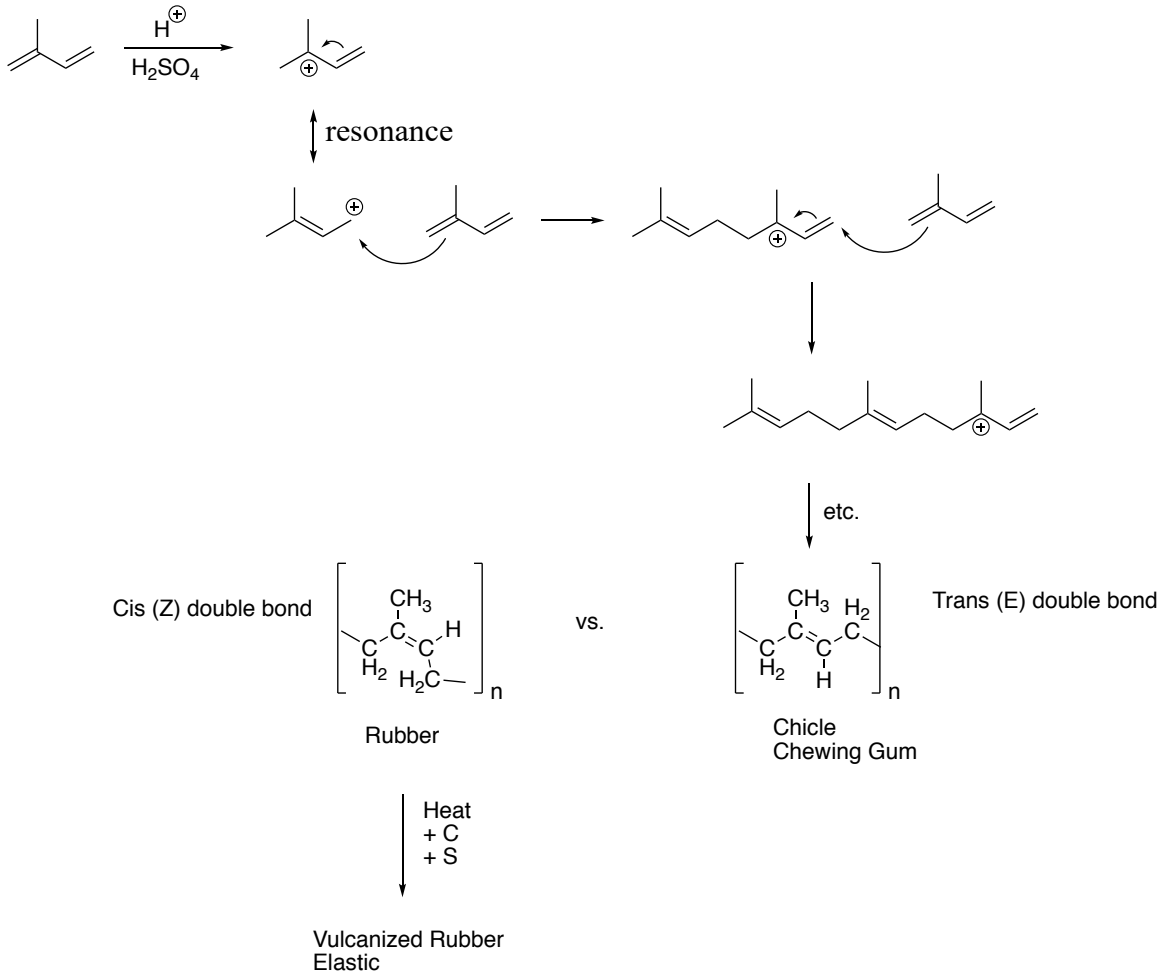
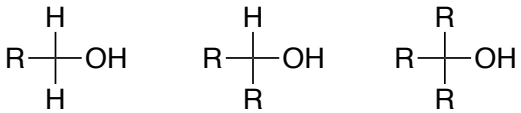
Polymerization: If no nucleophile is present in previous addition reaction - e.g. isoprene



Alcohol and Ether Nomenclature

Alcohol	Ether
R-OH	R-O-R

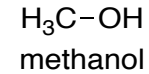


1° 2° 3°

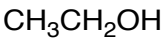
Alcohols are classified as primary (1°), secondary (2°), or tertiary (3°), depending on the number of organic groups bonded to the hydroxyl bearing carbon.

Naming:
1. Find the longest chain, with the maximum number of OH groups.
2. Number in such a way to give the OH the lowest number
3. Drop the "e" of the alkane name, add "ol"

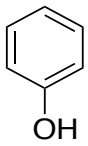
Examples:



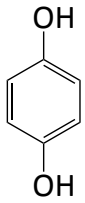
methanol
-toxic



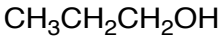
ethanol



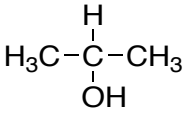
Hydroxybenzene
Phenol
C_6H_6O



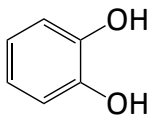
Hydroquinone



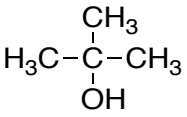
1-propanol
n-propanol
propan-1-ol



2-propanol
propan-2-ol
Isopropyl alcohol

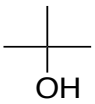


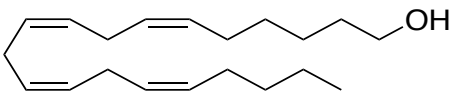
catechol



2-methyl-2-propanol
tertiary butyl alcohol
t-BuOH

≡



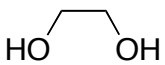


Eicosan-6,9,12,15-tetraen-1-ol

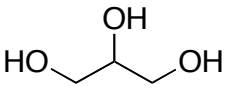
Polyols: If more than one hydroxyl group is present, a prefix is added to the "ol" :

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:



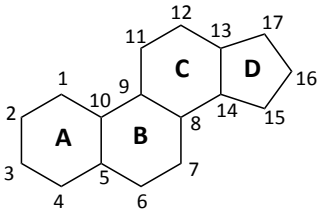
ethylene glycol
or ethan-1,2-diol



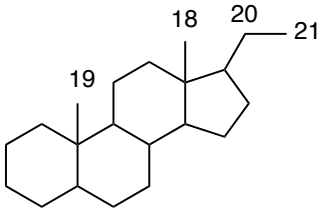
glycerol or glycerine
or propan-1,2,3-triol

Ethylene glycol is an antifreeze component.
Glycerol is a precursor to fats (fatty acid esters in cell membranes) and is used in personal lubricants such as KY jelly.

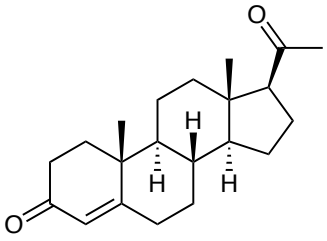
Examples: Hormones



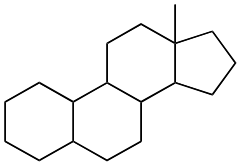
Steroid
group above (β)
group below (α)



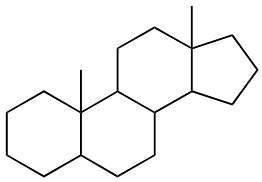
Pregnane skeleton



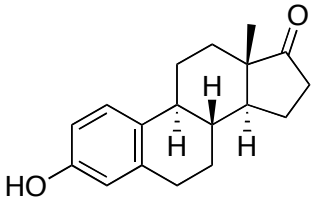
Progesterone



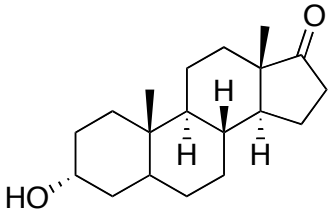
estrane skeleton



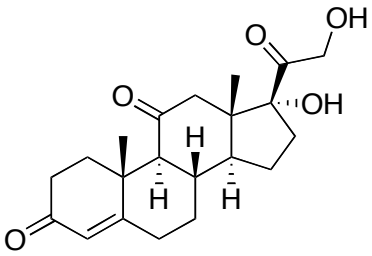
androstane skeleton



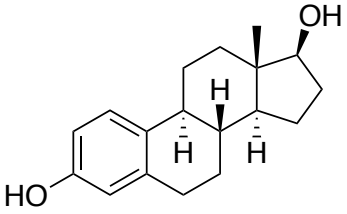
estrone



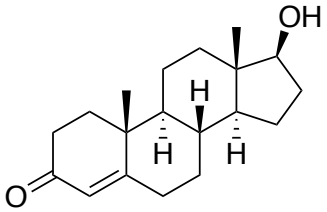
androsterone



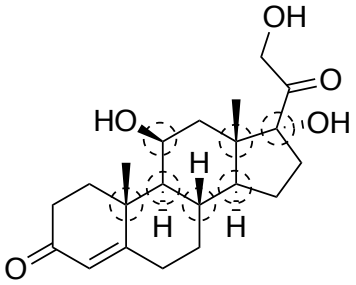
cortisone



Estradiol
-Female sex hormone



Testosterone
-Male sex hormone



Cortisol
-Stress hormone

Stereogenic centers

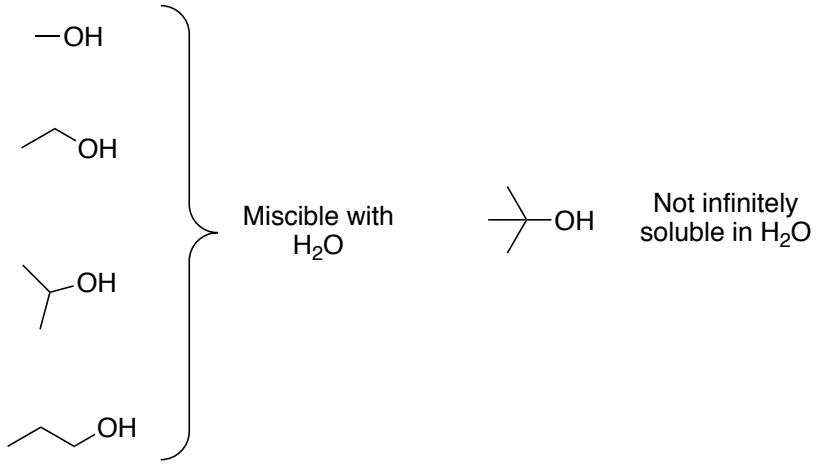
Physical properties

- The hydroxyl group is a very polar group. This allows small alcohols (methanol, ethanol, propanols) to be miscible with water as they are good hydrogen bond donors *and* acceptors.
- Alcohol densities are usually $\boldsymbol{\rho} < 1.0$.
- They have high boiling and melting points, again due to their hydrogen bonding capabilities.

Look at the following comparisons:

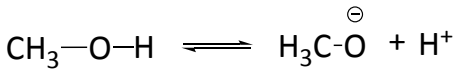
Name	Methanol	Ethane
Formula	CH_3OH	CH_3CH_3
Molecular Weight (g/mol)	32	30
Boiling Point (° C)	65	-89
State (at room temp)	liquid	gas

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



Acidity of Alcohols

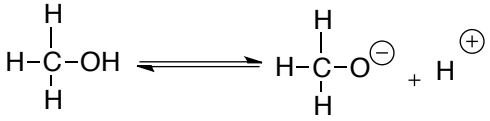
Name	Structure	pKa	
methanol	H_3C-OH	16	More acidic
ethanol	CH_3-CH_2-OH	17	
isopropyl alcohol		18	
tert-butanol		19	Less acidic



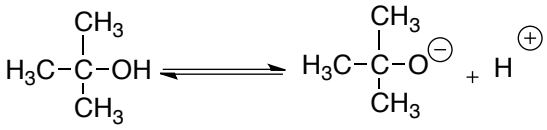
$$K_A = \frac{[CH_3O^-][H^+]}{[CH_3OH]} = 10^{-16}\,;\mathrm{pKa} = 16$$

There are two alkyl groups attached to the central carbon bearing oxygen in isopropanol. The alkyl groups (methyls) donate electron density to that carbon (an inductive effect) that is already next to a negative charged center (O^-). Since negative charges repel each other, the anion is less stabilized. Therefore, the anion is even less likely to form (less stabilized than if the alkyl groups (methyls) in isopropanol were missing.

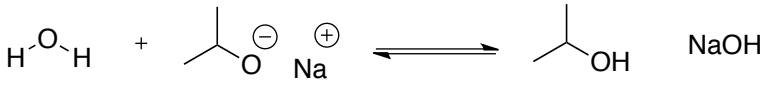
Methanol (pK_a 16) is 100 times (10^2) more acidic than isopropanol, since it has only hydrogens (a less donating group) attached to the carbon bearing the negative oxygen in the corresponding anion)



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).

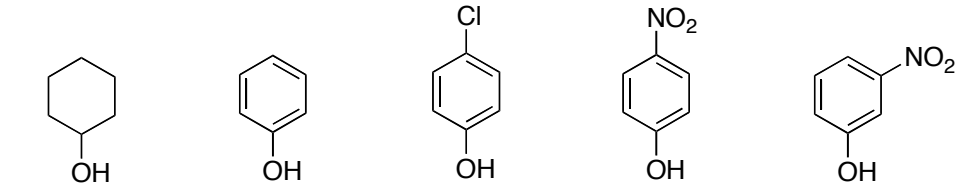


Consider the example below:



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**.



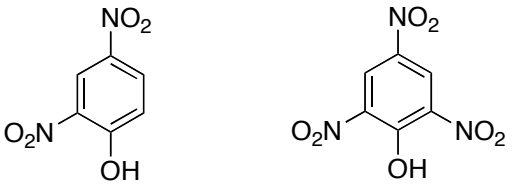
cyclohexanol
pK_a = 18

phenol
pK_a = 10

4-chlorophenol
pK_a = 9.3

4-nitrophenol
pK_a = 7

3-nitrophenol
pK_a = 9.3



2,4-dinitrophenol
pK_a = 4.5

2,4,6-trinitrophenol
picric acid
pK_a = 0.5

What is the influence of substituents? inductive & resonance