

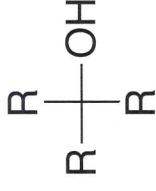
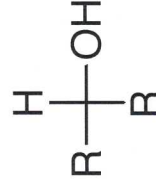
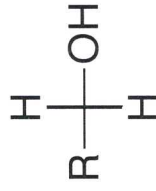
Lecture Outline 3: Alcohols, Ethers, Stereochemistry Review Ketones & Aldehydes

Nomenclature of Alcohols

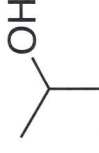
alcohols have hydroxyl group (-OH) bonded to a carbon atom (but not a carbonyl C=O)

alcohols have organic group replace H in water: H-O-H versus R-O-H

classified as primary (1°), secondary (2°), or tertiary (3°)



Select the longest carbon chain containing the alcohol & other important groups replacing the -e of the alkane with -ol
number the chain beginning at the end closest to the hydroxyl group
number the substituents according to their position on the chain



methanol

ethanol

methyl alcohol

ethyl alcohol

wood alcohol

grain alcohol

1-propanol

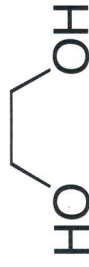
n-propanol

2-propanol

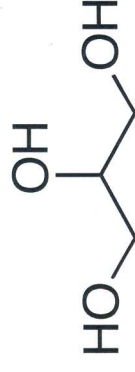
isopropanol

Nomenclature of Alcohols

if there is more than 1 OH group: diol, triol, tetraol etc....polyol



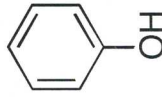
<- know ->



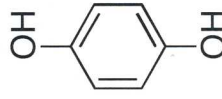
1,2-ethanediol
ethylene glycol (in antifreeze)

1,2,3-propanetriol
glycerol (in metabolism)

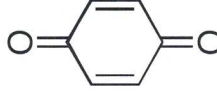
also know the following structures



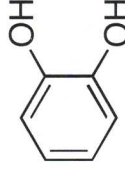
phenol



hydroquinone



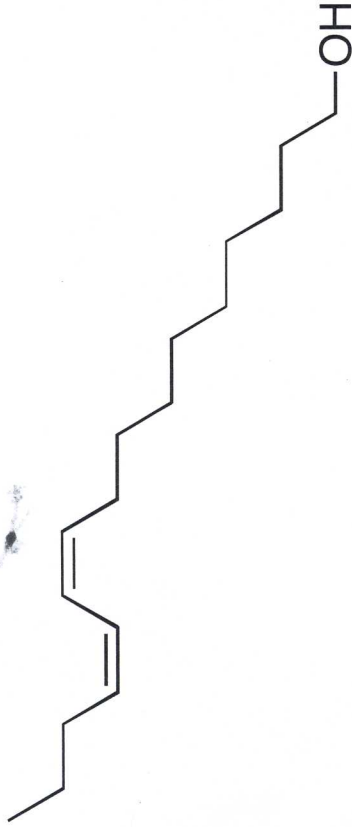
quinone



catechol

Nomenclature of Alcohols

Example: sex pheromone from the silk worm moth
pheromone: pherein horman - to carry excitement - Adolf Butenandt 1959



hexadeca-10Z,12Z-dien-1-ol

Physical Properties of Alcohols and Acidity

Compare ethane and methanol: nearly same molecular weight

Name	Methanol	Ethane
Formula	CH ₃ OH	CH ₃ CH ₃
Molecular Weight (g/mol)	32	30
Boiling Point (° C)	65	-89
State (at room temp)	liquid	gas

Compare propane and ethanol: nearly same molecular weight

Name	Ethanol	Propane
Formula	CH ₃ CH ₂ OH	CH ₃ CH ₂ CH ₃
Molecular Weight (g/mol)	46	44
Boiling Point (° C)	78.5	-44.5

Why are the boiling points so different? Hydrogen Bonding

Review from previous term: 3 fundamental non-covalent bonding forces

1. **Hydrogen bonding** - strongest per atom - H attached to O or N or halogen
2. **Dipole-dipole** - weaker - due to differences in electronegativity
3. **London (dispersion) forces** - weakest per atom - temporary dipole
but large sections can be stronger and overcome H-bonding

Physical Properties of Alcohols

Polar - fully soluble in (or miscible with) water if < 4 carbons

melting point and boiling point for an alcohol is higher than its parent alkane

density of alcohol is less than 1 g/cm³ (and hence less than water)

Acidity: Review



the stronger the acid, the lower the pK_a

$$pK_a = -\log K_a$$

for dissociation of methanol $\text{H}^{\oplus} + \text{OCH}_3^{\ominus}$



$$K_a = [\text{H}^+][\text{CH}_3\text{O}^-] / [\text{CH}_3\text{OH}] = 10^{-16} \quad pK_a = 16$$

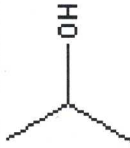
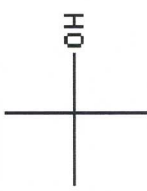
$$\text{for dissociation of water } K_a = 10^{-15.7} \quad pK_a = 15.7$$

Acidity

Name	Structure	pKa	Less acidic
methane	CH ₄	46	
ammonia	NH ₃	36	
water	HOH	15.7	
hydrofluoric acid	HF	3.2	More acidic

the stability of the conjugate anion determines the acidity of a compound.

The more stabilized the anion is, more acidic the molecule is

Name	Structure	pKa	more acidic
methanol	H ₃ C-OH	16	
ethanol	CH ₃ -CH ₂ -OH	17	
isopropyl alcohol		18	
tert-butanol		19	less acidic

Isopropanol dissociates to form isopropoxide anion and a proton. $K_a = 1 \times 10^{-18}$

More alkyl groups donate electrons to alkoxide anion & destabilize