Chp. 7 Alcohols, Phenols and Thiols

[1] Alcohols have a general formula R-OH.

-OH is called hydroxyl group.

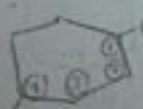
[2] IUPAC and Common Names

- The name is ending by "-ol" → IUPAC syste
- Use the word "alcohol" after the name "alkyl" → Comm

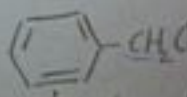
CH_3OH — Methanol (Methyl alcohol)

CH_3CH_2OH — Ethanol (Ethyl alcohol)

CH_3CHCH_3 (OH) — 2-propanol (Isopropyl alcohol)



4-methyl Cyclohexanol



phenyl methanol (benzyl alcohol)

$CH_3-C\equiv C-CH_2-CH_2-OH$

3-Pentyn-1-ol

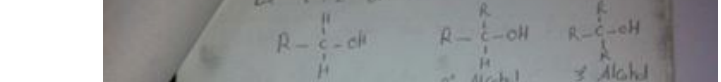
$H_2C=CH-CH_2OH$

2-propen-1-ol (Allyl alcohol)

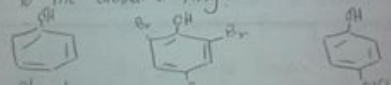
$CH_3CH(OH)CH(CH_2Br)$

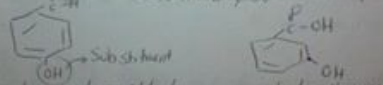
4-Brom-2-butanol

Classification of Alcohols Alcohols could be 1°, 2° or 3°



4) Phenols: the (OH) group is attached directly to the aromatic ring.



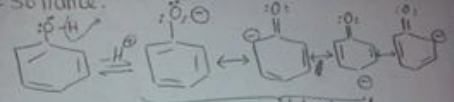


5) Physical properties of alcohols and phenols:

a) Boiling point: Due to the hydrogen bonds. they have a higher boiling point than ethers or hydrocarbons with similar molecular weight.

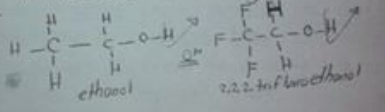
- Phenols are stronger acids than alcohols.

Since the phenoxide ions are stabilized by resonance.



-ve charge is delocalized.

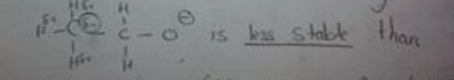
Example: Which one is a stronger acid?



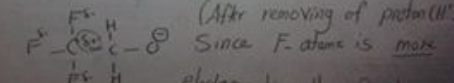
ethanol

2,2,2-trifluoroethanol

The answer: 2,2,2-trifluoroethanol. Justify.



is less stable than



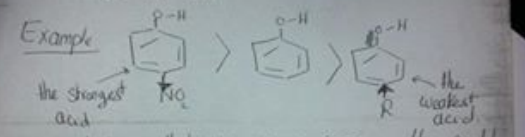
(After removing of proton (H+))

Since F- atoms is more electronegative than C-atom ⇒ Carbon-atom becomes partial positive charge, it stabilizes the -ve charge on oxygen-atom.

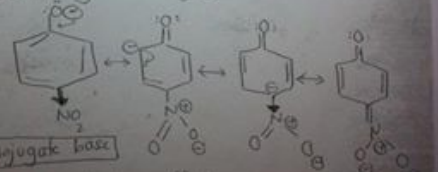
This is called Inductive effect. It means

Polar bonds that place a partial positive charge near the negative charge on an alkoxide ion stabilize the ion.

Example



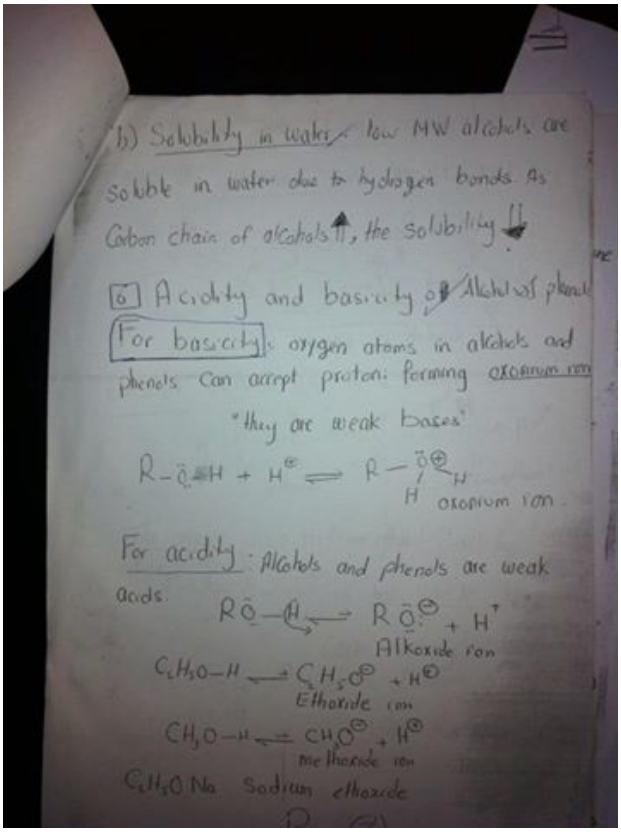
- Electron-withdrawing groups increase the acidity by stabilizing the conjugate base; Electron-donating groups decrease the acidity by destabilizing the conjugate base.



Conjugate base

- Due to inductive effect and resonance effect

- The NO_2 groups ↑ on the aromatic ring are acidity ↑



5) Solubility in water: low MW alcohols are soluble in water due to hydrogen bonds As Carbon chain of alcohols ↑, the solubility ↓

6 Acidity and basicity of Alcohols phenols

For basicity: oxygen atoms in alcohols and phenols can accept proton forming oxonium ion

"they are weak bases"

$$R-\ddot{O}-H + H^{\oplus} \rightleftharpoons R-\overset{\oplus}{\underset{H}{\underset{|}{\ddot{O}}}}-H$$

oxonium ion

For acidity: Alcohols and phenols are weak acids

$$R\ddot{O}-H \rightleftharpoons R\ddot{O}^{\ominus} + H^{+}$$

Alkoxide ion

$$C_2H_5O-H \rightleftharpoons C_2H_5O^{\ominus} + H^{\oplus}$$

Ethoxide ion

$$CH_3O-H \rightleftharpoons CH_3O^{\ominus} + H^{\oplus}$$

methoxide ion

C_2H_5ONa Sodium ethoxide