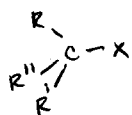


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Chapter 8: Alkyl halides, alcohols, etc...

Recommended Problems: 2, 4, 6, 12, 14-20, 23, 24, 26-32, 33-34 (not c), 39-44, 46, 48, 49, 52, 53, 55-62.



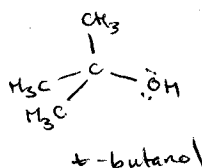
X = Electronegative Atom
 - Halogen, oxygen, sulfur, etc...

• "Alkyl Halides"

ex: H_3CCH_2Br (Ethyl Bromide), many others

• "Alcohols"

ex: $H_3CH_2C-\ddot{O}H$
 Ethanol

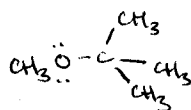


• "Ethers" - $R-\ddot{O}-R'$

ex:
 $CH_3CH_2\ddot{O}CH_2CH_3$
 diethyl ether



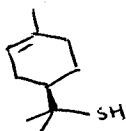
THF



methyl tbutyl ether

• "Thiols"

ex:
 Isobutyl-SH



• "Thioethers" $R-\ddot{S}-R'$

ex:
 Diethyl-S

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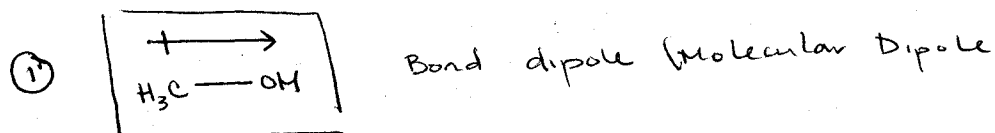
Properties of Alkyl halides, Alcohols & Ethers as Solvents:

* Key distinction: Polar vs. Nonpolar

- Important Parameters:

① Dipole Moment (μ) - property of an individual molecule

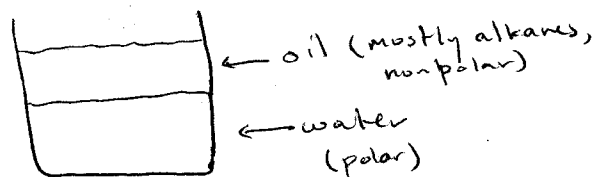
② Dielectric Constant (ϵ) - Property of the bulk liquid
(solvent)



Generally - large dipole moments at molecular level
give larger dielectric constants

② Larger Dielectric constant $\Rightarrow$ More polar solvent

"Like dissolves like" - Important for predicting solubilities

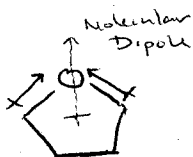


Immiscible
liquids

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Examples:

Tetrahydrofuran (THF)



$$\mu = 1.7 \text{ D} \quad (\text{D} = \text{Debye})$$
$$\epsilon = 7.6$$

(Miscible with H_2O)

Compare to Cyclopentane



$$\mu = 0 \text{ D}$$

$$\epsilon = 2$$

(Immiscible with H_2O)

- Small alkyl chlorides are common solvents:

CH_2Cl_2 - Dichloromethane, Methylene chloride

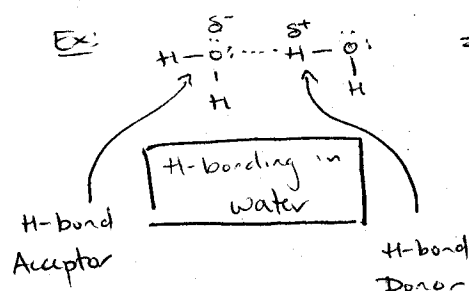
HCCl_3 - Chloroform

CCl_4 - Carbon tetrachloride

"Nonpolar" solvents

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Hydrogen Bonding: Strong influence on solvent properties

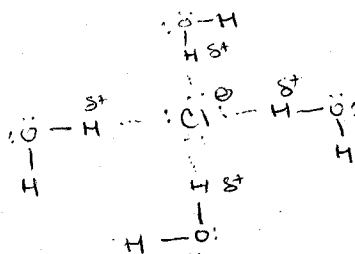
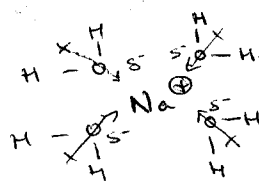


⇒ Should occur in solvents with OH groups (alcohol solvents)

→ H-bond donor groups typically have a $pK_a \leq \sim 20$

* H-bonding solvents are good at solvating (dissolving) ionic solutes → Both cations & anions

Ex: Na^+Cl^-



Note: Small alcohols also dissolve salts to some extent
 (CH_3-OH , CH_3CH_2-OH)

* A Second Solvent Distinction

"Protic" vs. "Non-protic" (Aprotic)

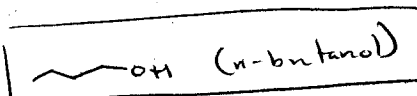
↳ Contains a good H-bond donor (ex: OH) and a moderately acidic proton - ($pK_a \sim 16$)

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Protic vs. Aprotic
↓
Polar vs. Nonpolar

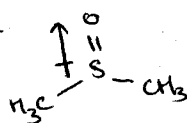
} often, but not always, parallel classifications

ex of an exception:



protic, but not polar

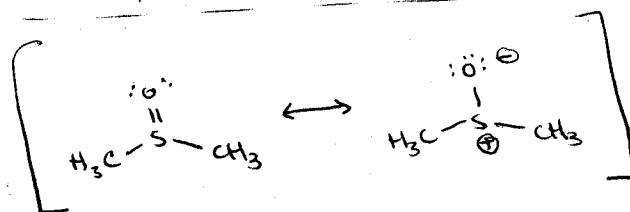
Dimethyl sulfoxide
(DMSO)



very strong dipole

* polar, but aprotic *

($\epsilon = 43$) high dielectric constant

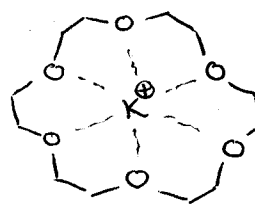


"Molecular Engineering:"

Design of ion-binding agents with low intrinsic polarity

"Crown ethers"

ex:



"18-crown-6"

not polar, but
binds (& solvates)
 K^+ ions in
nonpolar solvents