(16) **Today**

Section 2.12
Noncovalent Interactions Between Molecules

Next Class (17)

Section 3.1
Functional Groups

Section 3.2
Alkanes and Isomers

Section 3.3
Alkyl Groups

Section 3.4
Nomenclature

(18) **Second Class from Today**

Section 3.3 Alkyl Groups

Section 3.4 Nomenclature

Section 3.5 - 3.7 Properties and
Conformations of Alkanes

Third Class from Today (19)

Section 3.5 - 3.7 Properties and
Conformations of Alkanes

Chap 4 Cycloalkanes

Please rework test 1 and hand in on Monday, Oct 23

Noncovalent Interactions

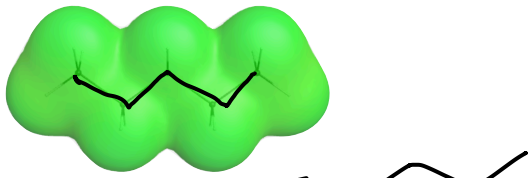
not covalent bonds between atoms

not talking about ionic interactions between $Na^+ + Cl^-$

Collectively referred to as...

intermolecular forces, van der Waals forces, or noncovalent interactions

weaker than covalent bonds + ionic "bonds"

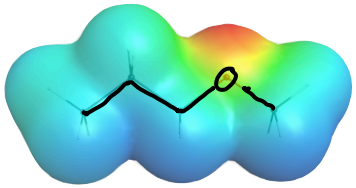


35.9 °C

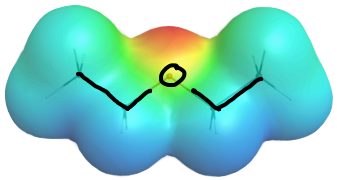
separate liquid molecules into gaseous molecules

Low BP indicates weak IMF between pentane molecules.

The molecules are relatively easy to separate from each other.

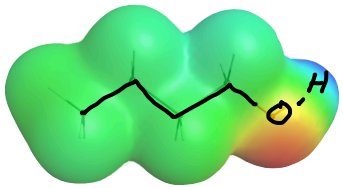


40.2 °C



36.4 °C

slightly higher BP indicates slightly stronger IMFs between the molecules



117 °C

Highest BP of the 3... strongest IMFs of the 3

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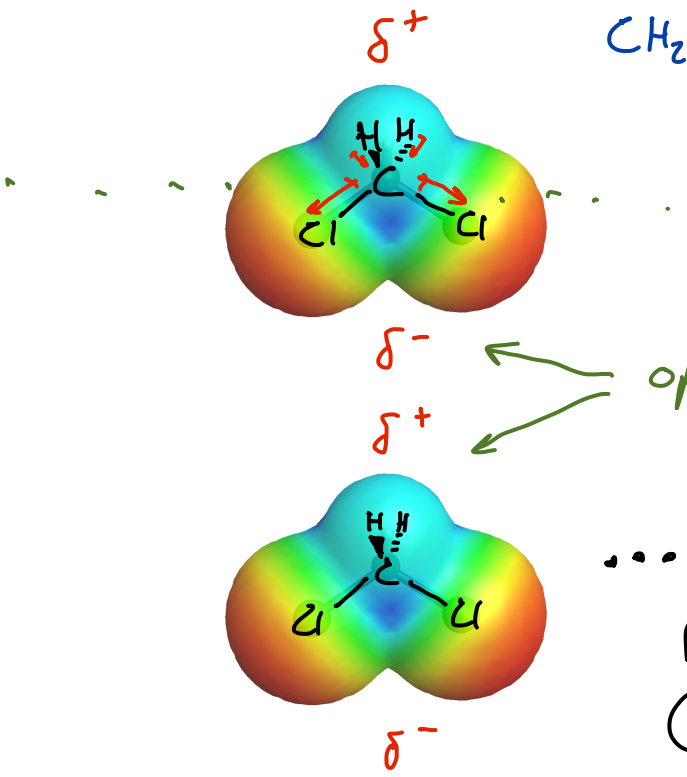
intermolecular forces, van der Waals forces, or noncovalent interactions

dipole-dipole interactions . . .



CH_2Cl_2 has opposite charges on opposite sides

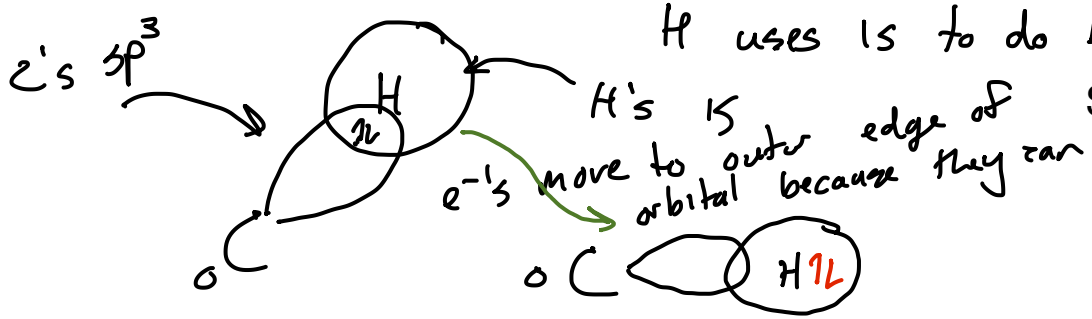
δ^+ on top / δ^- on bottom

opposites attract

. . . occur when the positive end of one polar molecule's permanent dipole interacts (is attracted to) the negative end of another molecule's permanent dipole

Noncovalent Interactions

Section 2.12



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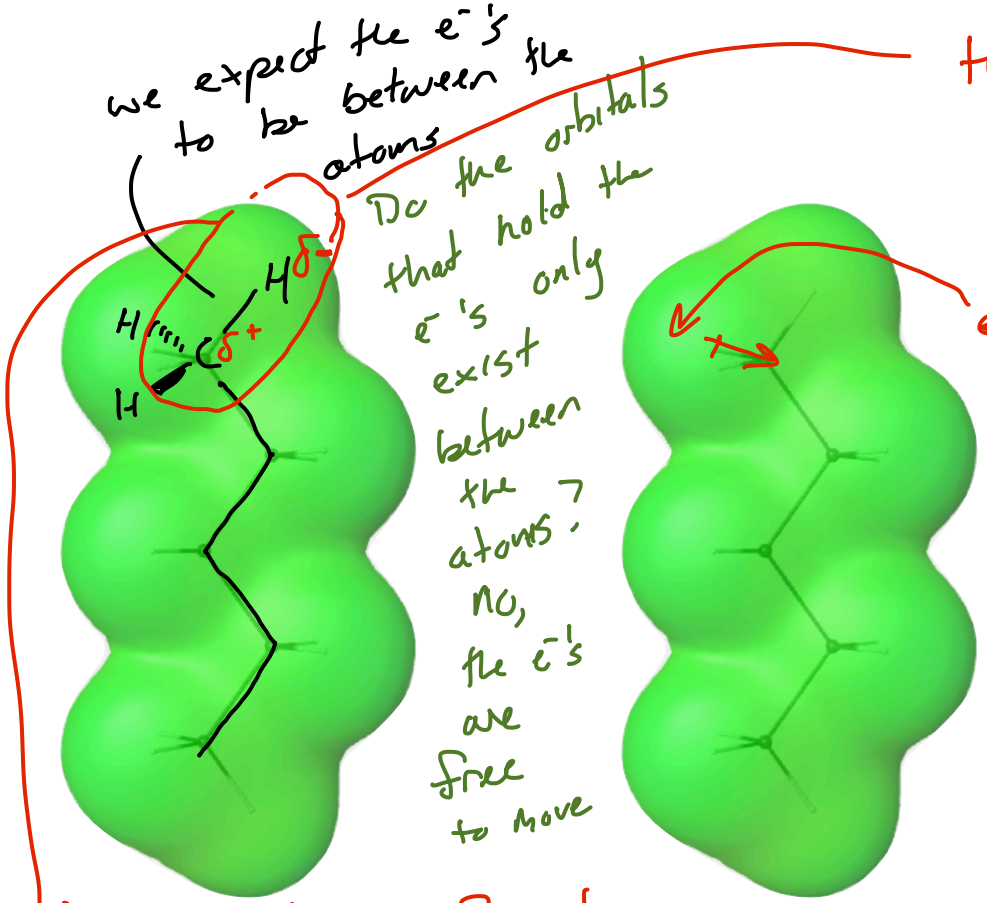
London dispersion forces (sometimes called dispersion forces)



because e-'s are free to move they can move away from the C and form a spontaneous dipole

this dipole that just form will induce a dipole in a neighboring molecule

e-'s here get pushed away and a dipole is induced in the 2nd molecule

1. spontaneous dipole forms 2. induces dipole in another molecule 3. the spontaneous dipole + the induced dipole briefly experience attraction

more e- more chance for spontaneous dipoles large surface area

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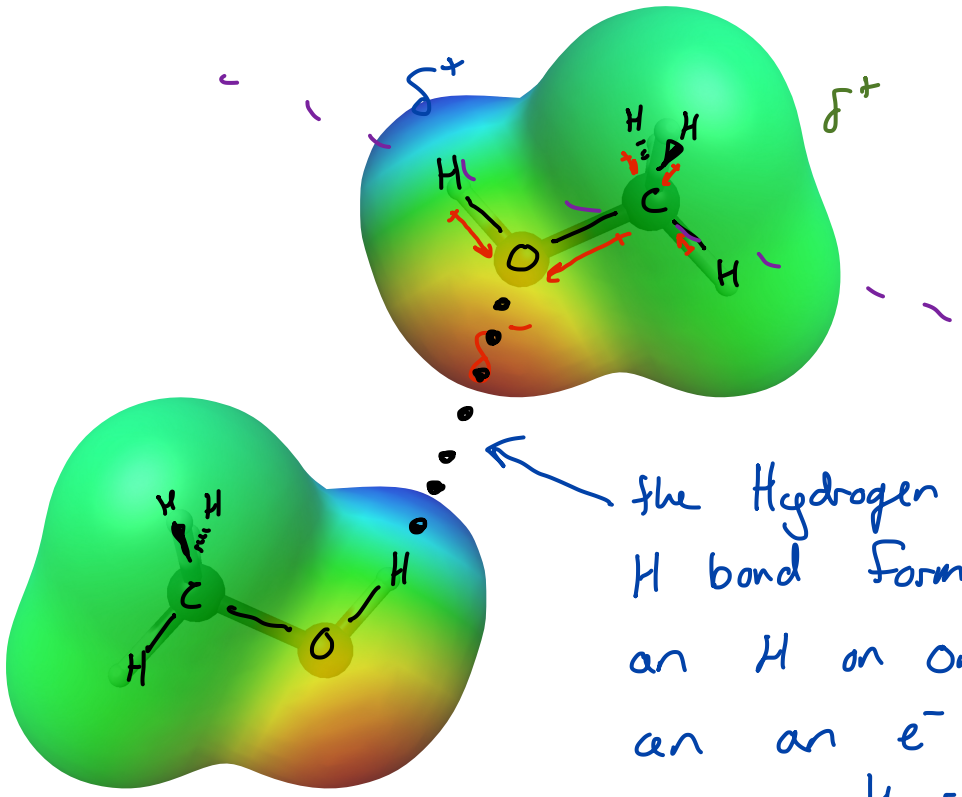
Hydrogen bonds or H-bonds



the Hydrogen bond or H bond forms between an H on one molecule an an e⁻ rich atom on another molecule

when H is covalently bonded to an atom like O, the H becomes very positively charged.

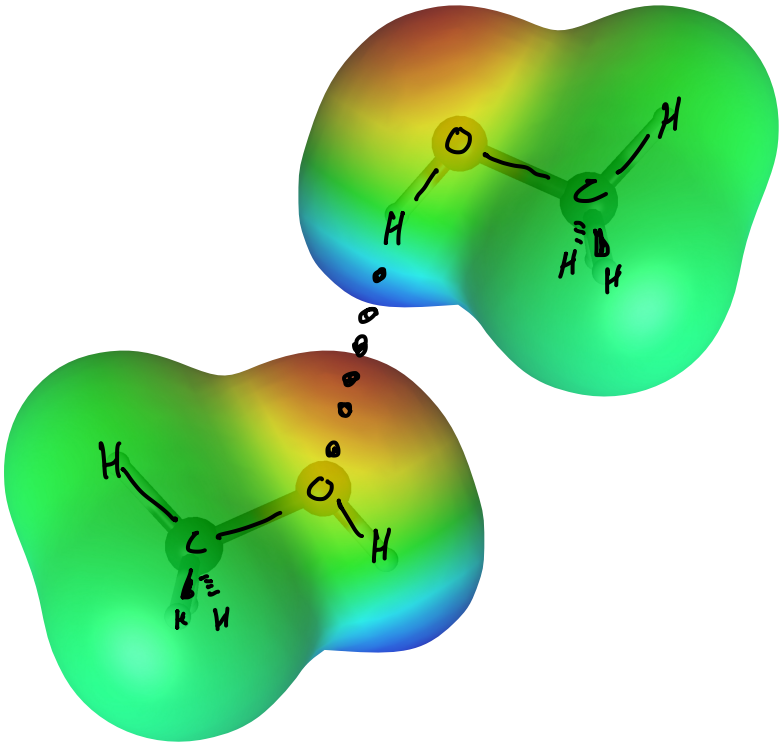
Because the H is so positive the interact with a δ⁻ O on another molecule is very strong

≈ 5% as strong as a C–H bond

Collectively referred to as...

intermolecular forces, van der Waals forces, or noncovalent interactions

A hydrogen bond requires an H-Bond donor and an H-bond acceptor



H-bond donor

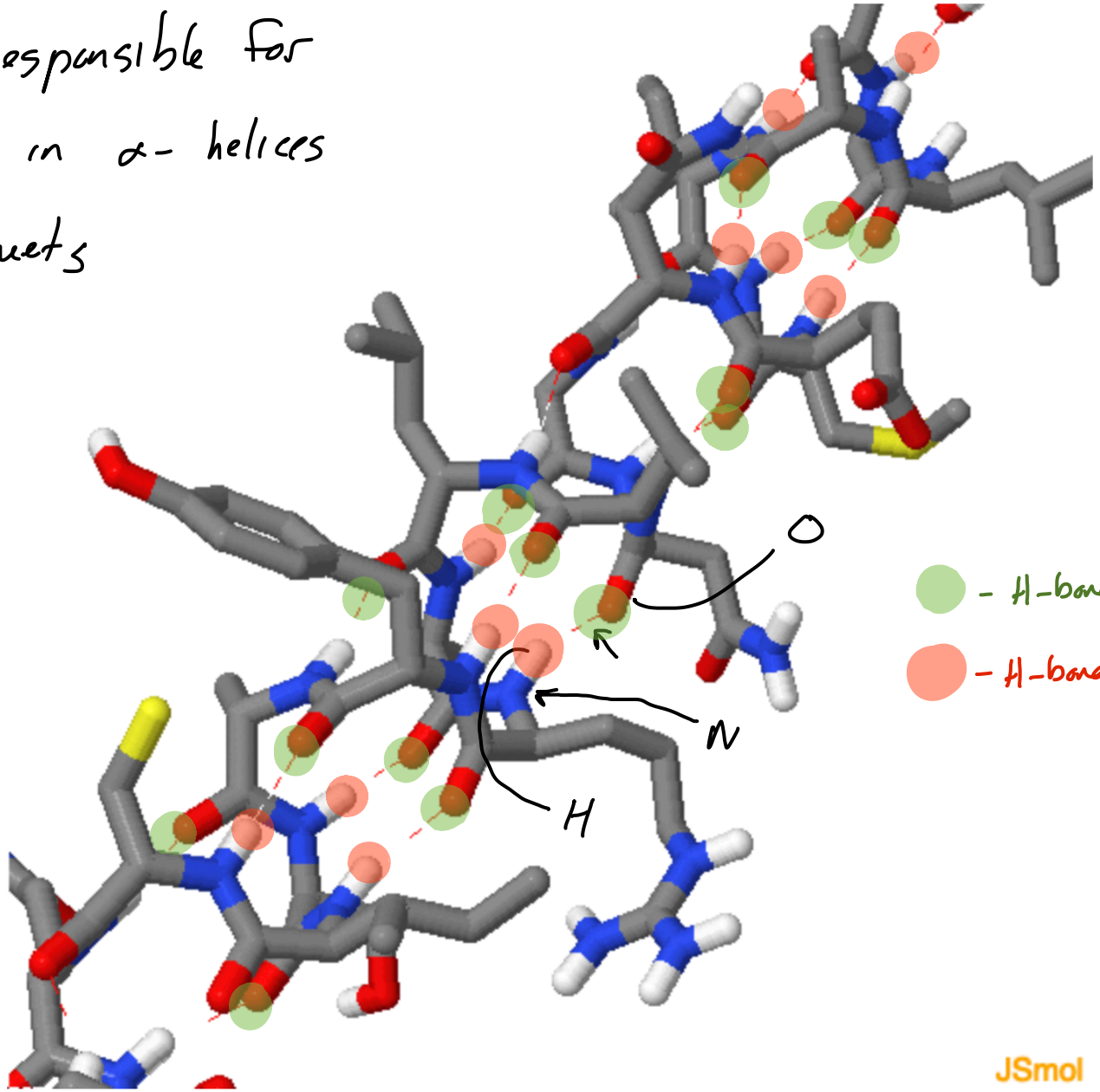
any H atom that is covalently bonded to an N, O, or F atom

O-H , N-H , or H-F

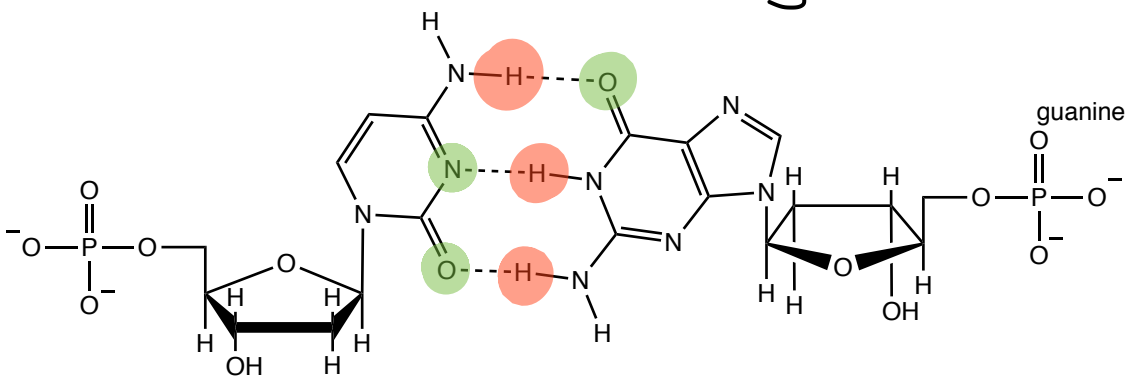
H-bond acceptor

any N, O, or F atom

H-bonds are responsible for folding proteins in α-helices β-strands + sheets

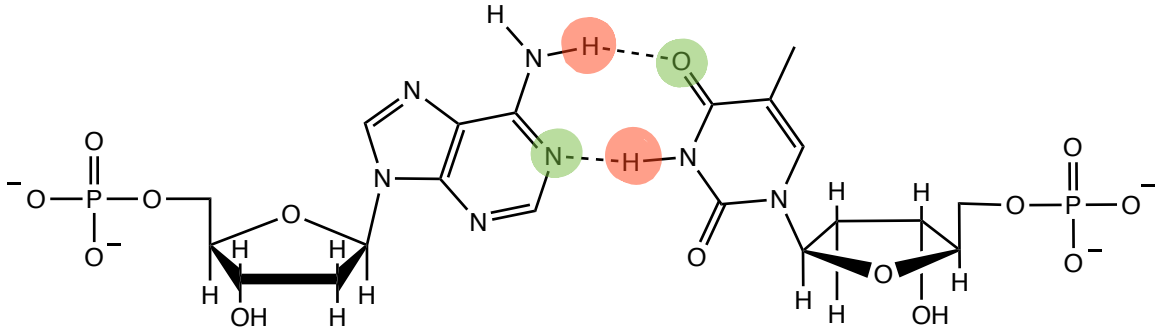


H-bond donor/acceptor interactions in DNA base pairing



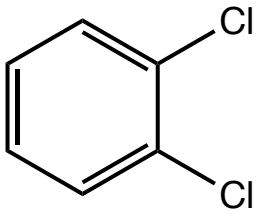
deoxycytidine monophosphate

deoxygaunosine monophosphate



deoxyadenosine monophosphate

deoxythymidine monophophate

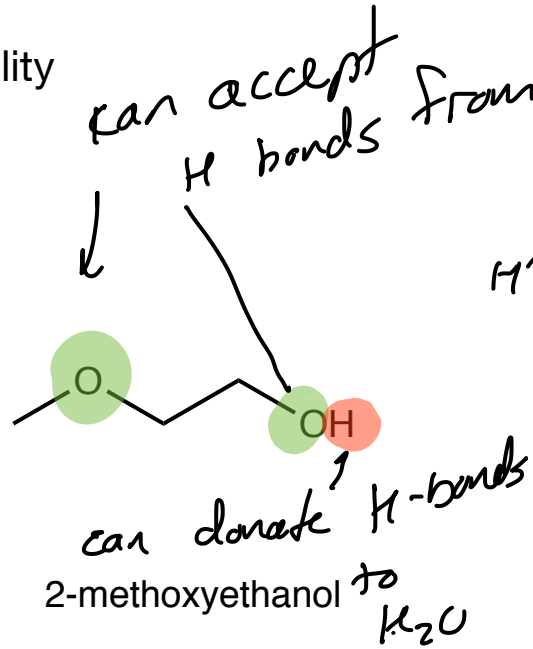


1,2-dichlorobenzene

dipole moment = 2.14 D*

not soluble in H_2O

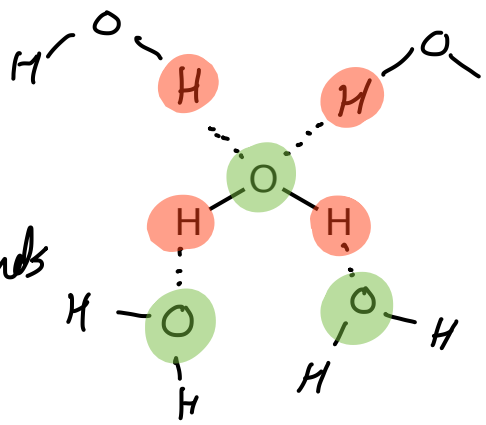
.001 g/L



2-methoxyethanol

dipole moment = 2.04 D*

miscible in all proportions with water



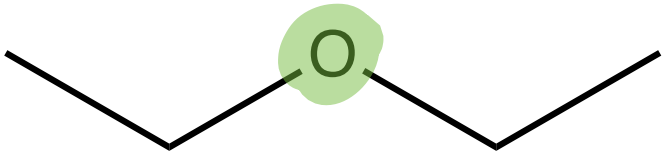
dipole moment = 1.87 D*

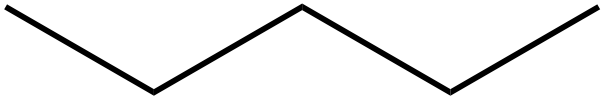
water solubility is "all about" the H-bond

molecules that are soluble sliding in between without disrupting H-Bond

*https://macro.lsu.edu/Howto/solvents/dipole%20moment.htm accessed Oct. 16, 2023

H-bond acceptor makes ether more water soluble





60 g/L in H_2O

0.038 g/L in H_2O

60 g/L and 0.038 g/L

Collectively referred to as...

intermolecular forces, van der Waals forces, or noncovalent interactions

London Dispersion Forces (LDF)

- All molecules interact with other molecules using LDFs
- Interaction between spontaneous, random dipoles and induced dipoles
- Weak for molecules with few valence electrons and low surface area
- Strength increases with increasing valence electrons, surface area, and volume

Dipole-dipole interactions

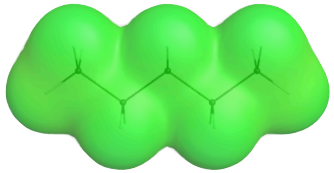
- Occurs between opposite ends of dipoles on polar molecules
- Presence of dipole dipole interactions can have a substantial affect on attraction between molecules

H Bond interactions

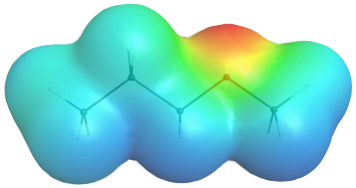
- Occurs between H-bond donors and H-bond acceptors
- The strongest of these intermolecular forces (on an interaction by interaction basis)
- Important for water solubility and in biochemistry

Collectively referred to as...

intermolecular forces, van der Waals forces, or noncovalent interactions



35.9 °C



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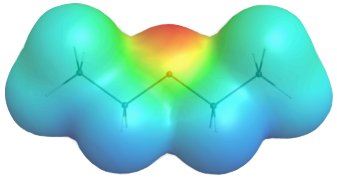

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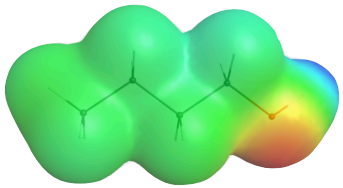

117 °C

only LDFs acting

LDF + weak dipole-dipole

LDF + dipole-dipole + H-bonding

similar size, similar # of e^-'s
magnitude of LDFs are similar

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