

Name: KEY
 Date: _____

Intermolecular Forces

Adopted from 'Preparation For Organic Chemistry', I David Reingold, Juniata College.

1. Show the geometry of each molecule. Label the polar bonds (arrow) and determine if the molecule is polar or nonpolar.

Molecule	3-D Lewis Structure (Label Polar Bonds)	Polar or Nonpolar
SF ₂ (6+14=20)		Nonpolar (charges cancel)
CCl ₂ F ₂ (4+14+14=32)		Polar (F is more electronegative)
CH ₃ OCH ₃ (4+3+6+4+3)=20		Polar (Although the charges cancel each, the lone pairs add extra '-' charge)
NH ₃ (5+3=8)		Polar. (lone pair adds more '-' charge)
(CH ₃)CN (4+3+4+5=16)		Polar
CO ₂ (4+12=16)		Nonpolar (charges cancel)
BF ₃ (3+21=24)		Nonpolar (charges cancel)

2. What pairs of the above molecules can form H-Bonds BETWEEN them?

Hydrogen Bond = F/O/N — H ... F/O/N —

4) (CH₃)CN with NH₃

2) CCl₂F₂ with NH₃

3) CH₃OCH₃ with NH₃

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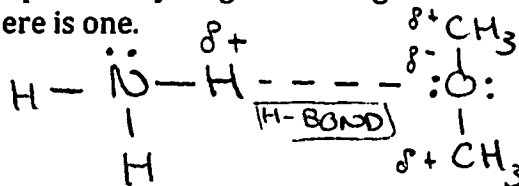
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3. Determine if the following molecules are polar. Drawing the geometry of the molecule will help.

Molecule	Polar (Yes or No)	Reasoning
BF ₃	No	Charges cancel out
NF ₃	Yes	Lone pair
CCl ₄	No	Charges cancel out
CHCl ₃	Yes	Dipole
AlCl ₃	Yes	Lone pair
CH ₃ OCH ₃	Yes	Lone pairs
CH ₃ CH ₂ OH	Yes	Dipole
CH ₃ CH ₂ CH ₂ CH ₃	No	No dipole (Hydrocarbons)

4. Which of the following pairs are capable of hydrogen bonding with each other? Illustrate the hydrogen bond if there is one.

a. NH₃ and CH₃OCH₃



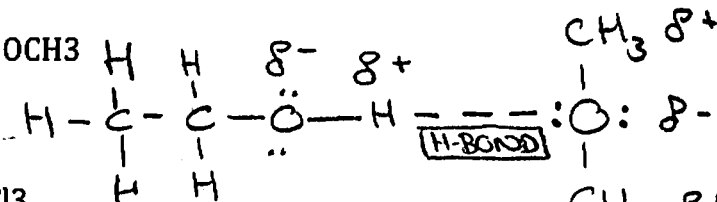
b. NF₃ and CH₃OCH₃

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c. CH₃CH₂OH and CH₃OCH₃

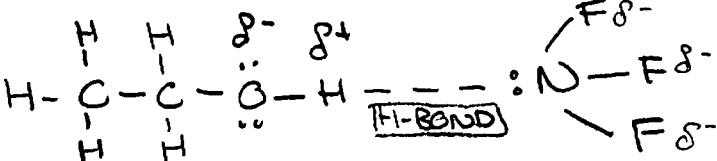


d. CH₃CH₂OH and CHCl₃

No

→ not an F/O/N
→ It will form a Dipole-Dipole interaction.

e. CH₃CH₂OH and NF₃



5. Within each group rank the molecules from 1 to 3 (1 = highest) with respects to their melting or boiling point. Give the IMF for each molecule and if the IMF's are the same, explain your reasoning. Group 1 is done for you to help guide you.

GROUP 1.

Ar - 1 He - 3 Ne - 2

All have London Dispersion Forces because they are nonpolar. However, since Argon is the largest atom, it has more surface area ('sloshability') and hence more ability to stick to other Argon molecules

GROUP 2.

2	3	1
CCl ₄	CH ₄	CCl ₂ H ₂
Nonpolar	Nonpolar	Polar
LDF	LDF	D-D.

GROUP 3.

2	1	3
H ₂ S	H ₂ O	H ₂
Polar	Polar	Nonpolar
O-D	H-bond	LDF

GROUP 4. (Crystals - Ionic Cpds)

KCl	CaS	SrS
K ⁺ Cl ⁻	Ca ²⁺ S ⁻²	Sr ²⁺ S ⁻²
3	1	2

Ca is smaller than Sr and so has a 'tighter' bond to 'S'.

GROUP 5.

BCl ₃	BI ₃	BF ₃
Nonpolar	—————→	—————→
LDF	—————→	—————→
2	1	3

Size, Sloshability

* Note:

the H bonded to F/O/N will create

a 'Naked' hydrogen
↳ this tends to ATTRACT to a lone pair on F/O/N.

↳ tough one