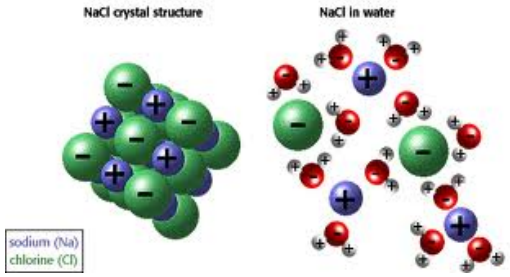
6.5 Polar Molecules



Bond Character

Chemical bonds are not totally ionic orcovalent: it depends on how atoms attract electrons.

Absolute difference in electronegativity (atom's ability to attract electrons in a bond) defines bond type. (Resources Page 5)

Note: in formulas, the least electronegative element is written first, followed by the most electronegative.
Ex: HCl

Table of Bonds (Resource P. 5)

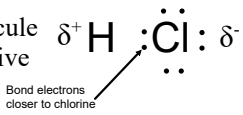
Electronegativity Difference	Bond Character
> 1.7	Mostly Ionic
0.4 – 1.7	Polar Covalent
<0.4	Mostly Covalent
0	Nonpolar Covalent

Polar Covalent Bonds

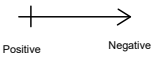
When two elements share electrons unequally, the result is a dipole: a molecule with charged ends.

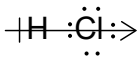
Partial charges are present on a molecule due to lopsided electron distribution.

The charged ends of the molecule are labeled with δ^+ if it's positive or δ^- if it's negative (delta).



A dipole is denoted with an arrow pointing towards the negatively charged end.
1. Draw HCl, showing positive and negative ends.

Symbol: 



Properties of Covalent Compounds

A. Polar compounds dissolve in polar solvents (acetone, water, ammonia - etc).

B. Non-polar compounds dissolve in non-polar solvents. (vegetable oil, gasoline, turpentine, mineral oil, etc.)

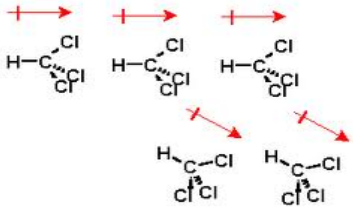
C. Dissimilar compounds tend not to dissolve in each other (oil and water, lava lamp).

Mix This!!

Properties of Covalent Compounds

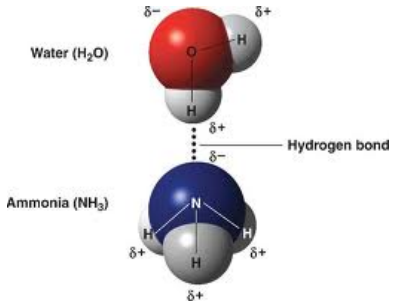
D. Covalent compounds have lower melting and boiling temperatures than ionic compounds.

E. Exhibit different intermolecular forces:
I. Dipole–dipole: attraction between positive and negative ends of molecules.



Properties of Covalent Compounds

II. Hydrogen bond. A dipole-dipole force where the positive end is a hydrogen atom; the negative end is either fluorine, oxygen, or nitrogen



Determining Polarity Process

Two things determine polarity:

1. Absolute electronegativity difference between central and at least one terminal atom must be between 0.4 and 1.7.

2. Make Lewis structure; molecule must be asymmetric, either by:

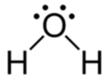
A. shape: linear diatomic,  bent, 

trigonal pyramidal,  t-shaped, 

seesaw,  or square pyramidal; 

B. composition: different terminal atoms.

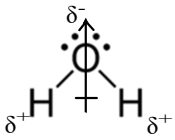
2. Is H_2O Polar?

What is the electronegativity difference? 

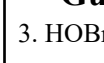
Oxygen - hydrogen:
3.5 - 2.1 = 1.4: polar covalent bond.

What's the shape?

H_2O is bent (asymmetric), so it is polar.

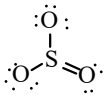


Guided Practice: Polar or not?

3. HOBr 

Electronegativity Differences:
H vs O = 1.4; Br vs. O = 0.7: Could be polar

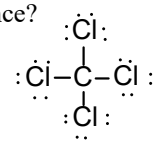
Shape: Bent: It's Polar

4. SO_3 

Electro. difference:
S vs. O = 1.0: Could be polar.
Shape: Trig. Planar: Not Polar

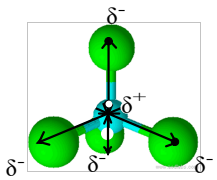
5. Is CCl_4 Polar?

What is the electronegativity difference?

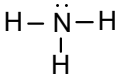
Chlorine - carbon:
3.0 - 2.5 = 0.5: polar covalent bond. 

What's the shape?

CCl_4 is tetrahedral with same terminal atoms: it is non-polar.

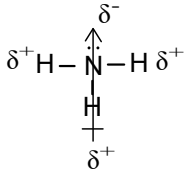


6. Is Ammonia (NH_3) Polar?

Are there polar bonds?
What's the shape? 

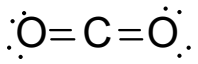
Electronegativity difference:
nitrogen - hydrogen
3.0 - 2.1 = 0.9: polar covalent bonds.

Shape is trigonal pyramidal: it is polar.



7. CO_2 Example!

Is carbon dioxide polar?

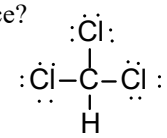


Electronegativity difference:
oxygen - carbon: 3.5 - 2.5 = 1.0: polar covalent.

Shape?
The shape is linear: non-polar.

8. Is $CHCl_3$ Polar?

What is the electronegativity difference?



Chlorine - carbon:
3.0 - 2.5 = 0.5: polar covalent bond.
Hydrogen - carbon:
2.1 - 2.5 = non-polar bond

What's the shape?

$CHCl_3$ is tetrahedral with <u>different</u> terminal atoms: it is polar.

Homework

6.5 Problems in your Booklet
Due: Next Class

Unit 6 Test Review Problems