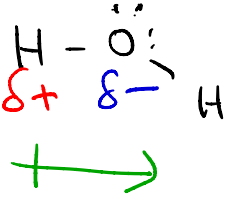
4/22/20



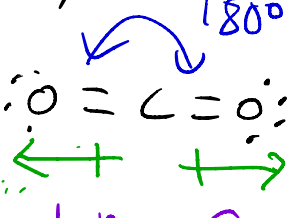



A **bond** is polar when there is a difference in the ENs of the atoms in the bond.

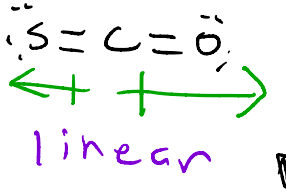
Molecular shape has no impact on bond polarity.

A **molecule** is polar when there is asymmetry in the bond dipoles.

$CO_2$




In carbon dioxide, the bond dipoles are equal in magnitude but opposite in direction. Therefore, they cancel each other out so the molecule is non-polar. (The vector sum is zero.)




In this molecule the bond dipoles point point opposite directions but they are not equal in magnitude, so they do not cancel. Therefore, the molecule is polar.

HCN H-C≡N: Although HCN is linear, both bond dipoles point in the same direction, so the molecule is polar.

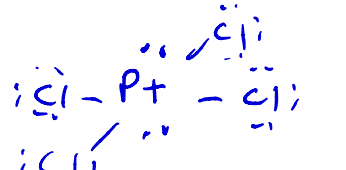
If all atoms attached to the central atom are the same, certain shapes are automatically polar or non polar.

All shapes without lone pairs are non-polar.

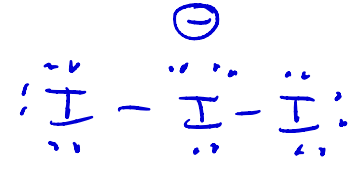
linear, trigonal planar, tetrahedral, trigonal bipyramidal, octahedral

Electron pair geometry - Ignores the differences between bonding pairs and lone pairs of electrons.

Only two shapes with lone pairs are non-polar;



square planar

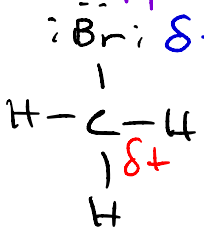


linear

All other shapes with lone pairs are polar, bent, trigonal pyramidal, T-shape, see saw, square pyramidal

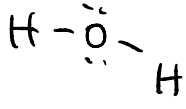
Intermolecular forces – Attractive electrostatic forces that draw molecules together

Opposite charges attract.




bromomethane

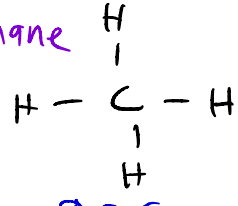
Permanet molecular dipole
- A dipole that is generated due to the shape of the molecule.



liquid

MM = 18

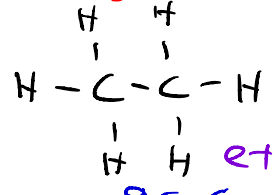
methane



gas

MM = 16

25°C, 1 atm

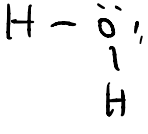


ethane

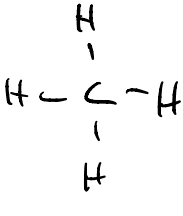
gas

MM = 30

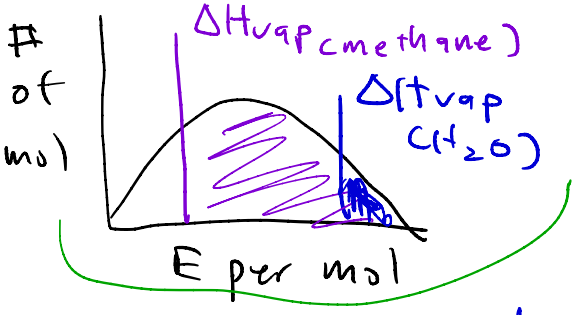
Water is a liquid at normal lab conditions even though more massive molecules like ethane are gases at the same conditions.



Water not only has very polar bonds, it has asymmetry in its structure due to its lone pairs, so it is polar and has a large permanent dipole.



Methane has slightly polar bonds, but it is entirely symmetric, so it has no permanent dipole.




ΔHvap - heat of vaporization - the energy necessary to convert a liquid into a gas,

Because water has a polar, asymmetric structure, it has much stronger IMFs, so it takes much more energy for it to be able to evaporate,

Because methane has a non-polar, symmetric structure, it has weak IMFs, it takes much less energy for it to evaporate,

At room temperature, the fraction of molecules of methane with the energy to evaporate is much greater than the fraction of molecules of water with enough energy to evaporate,

This is why water is a liquid at room temperature, while methane is a gas,