Announcements

Wednesday, April 22, 2009

Ch 18 MC due Mon, Apr 27.

Discussion assignment 2: Phase 2 due Mon, Apr 27.

No experiment next week.

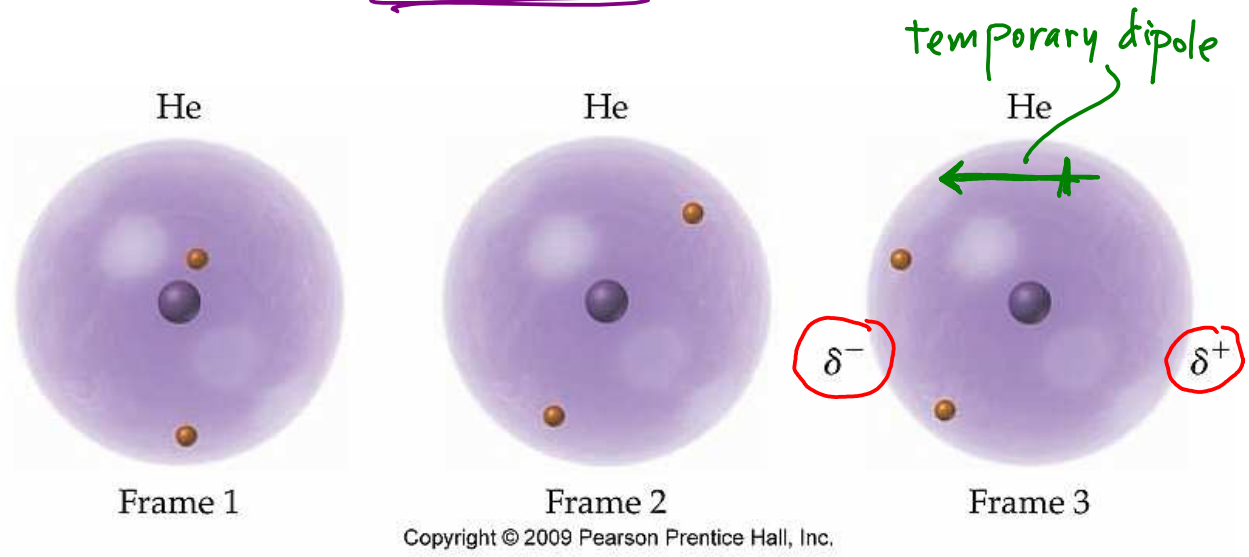
Review sessions:

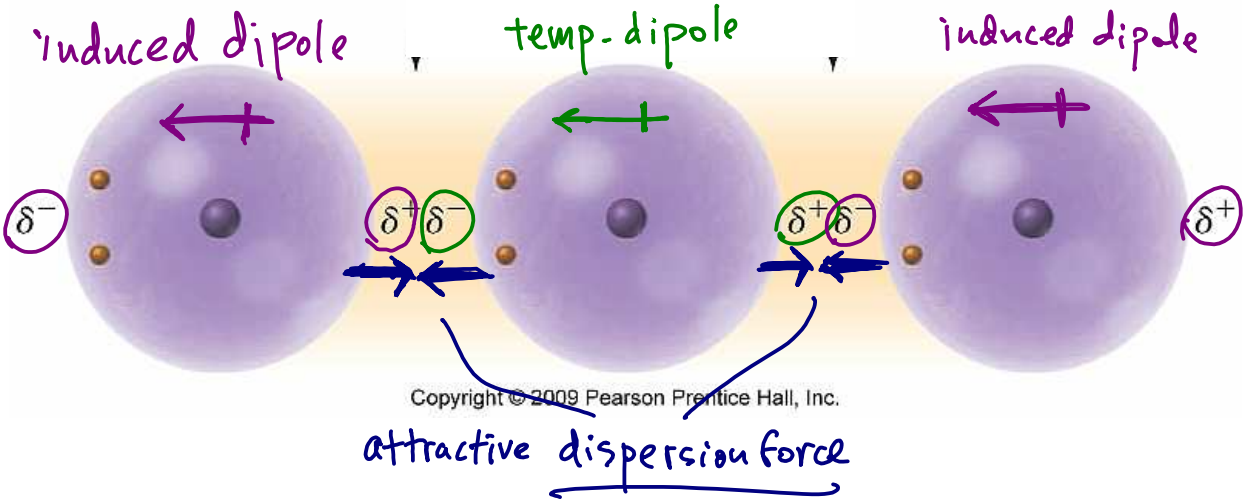
- Mon 3:00 pm
- Tue 1:00 pm
- Wed 8:00 am

There are 3 types of intermolecular forces:

1. Dispersion force
2. Dipole-dipole force
3. Hydrogen bonding

<u>Dispersion force</u>: (sometimes called London force) present between *<u>all molecules</u>*.





You can estimate the strength of a molecule's dispersion force by calculating its **molar mass**.

	MM	Strength of dispersion forces
I_2	~ 254	strongest
Br_2	~ 160	
Cl_2	~ 70	weakest

Boiling point: temp where (ℓ) becomes (g)

If a substance has relatively **strong** intermolecular forces, it will have a relatively high boiling point

(boiling is more difficult)

Which has the highest boiling point, I_2, Br_2, or Cl_2?

strongest dispersion forces

I_2 has strongest disp forces b/c largest MM

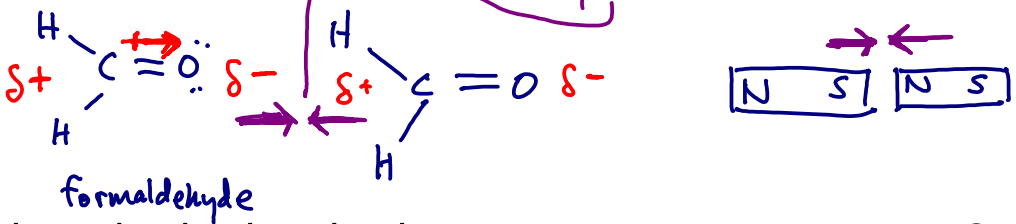
Which has the lowest boiling point, I_2, Br_2, or Cl_2?

easiest to separate molecules from each other

Dipole-dipole forces are attractions between opposite dipoles of **polar** molecules.

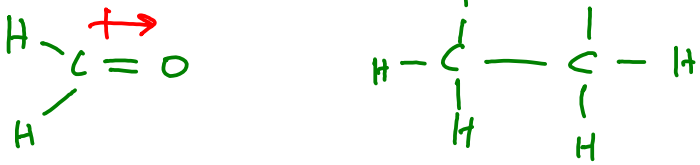
Polar molecules have permanent dipoles

dp-dp force



formaldehyde

Which has the higher boiling point, CH_2O or CH_3CH_3?



Disp. forces MM ~ 30 MM ~ 30 similar strength disp. forces

Dipole-dipole forces: yes! (polar) no (nonpolar) (all hydrocarbons are nonpolar)

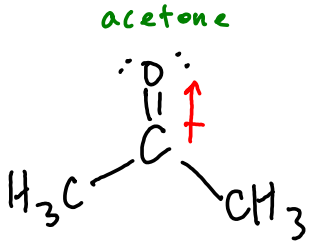
Boiling pt.: higher lower

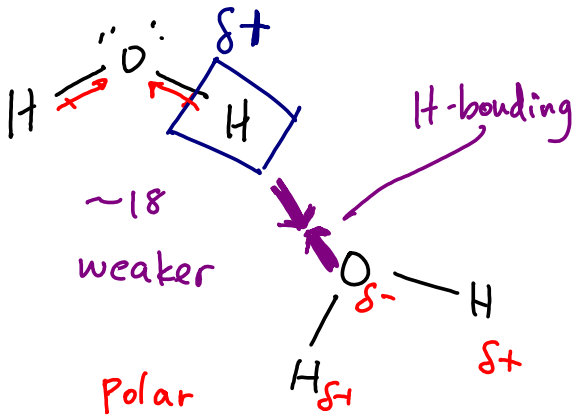
Polarity determines **miscibility** - whether or not two liquids will mix. (misible vs immiscible)

Only substances with similar polarities will mix.

(a) (b) (c)

Consider acetone and water:





MM:	~58	
Dispersion:	stronger	weaker
Polar?	polar	Polar
Dipole forces?	yes	yes
Experimental boiling point:	56 °C	100 °C
H-bonding?	no	yes!

One of these molecules has **hydrogen bonding**, an extra-strong dipole force resulting from an **electropositive H:**

O—H δ+ N—H δ+ F—H δ+

H almost a bare proton – very strong δ+

Hydrogen bonding is much stronger than dispersion forces and regular dipole-dipole forces.

Boiling point practice

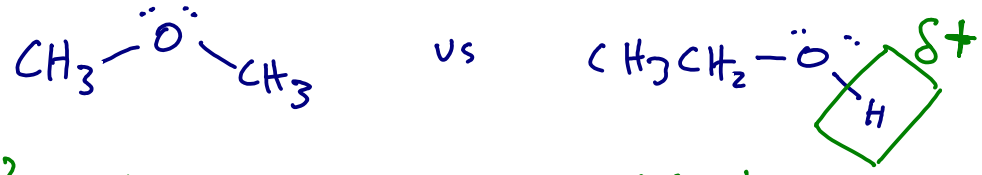
To rank compounds in order of boiling point:

IMFs

1. Find compounds with **H-bonding** - they will have higher bp's than compounds without H-bonding
2. Use molar mass to determine **dispersion forces** (a difference of less than 10 is not significant)
3. Use polarity to determine **dipole-dipole forces**

The compound with the strongest intermolecular forces will have the highest boiling point!

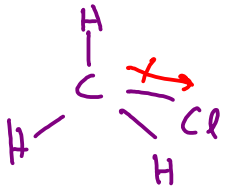
Which has a higher boiling point, dimethyl ether (CH_3OCH_3) or ethanol (CH_3CH_2OH)?

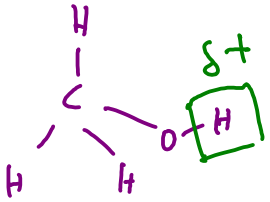


H-bonding?	no	yes!
boiling point	lower	higher
(Disp.)	MM ~ 46	~46
Dp-dp	polar	polar

Boiling point practice

Rank these in order of increasing boiling point, with 1 as the lowest and 3 as the highest:
CH_3Cl, CH_3OH, CH_3CH_3





CH_3CH_3

H-bonding?	no.	yes!	no
Dp-dp	polar	(polar)	nonpolar
Disp.	~50	~32	~30

Rank these in order of increasing boiling point, with 1 as the lowest and 4 as the highest:
CH_2F_2, CH_3OH, CH_3CH_2OH, N_2.