

Intermolecular Forces - Secondary Force

Oct 23

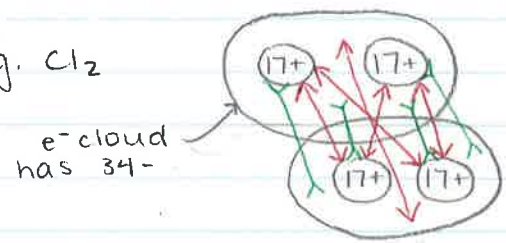
- Between discrete covalent molecules in the solid & liquid state

van der Waals Force ~ v.d.w

- weakest intermolecular force
- default force - always present
- attraction between the electron cloud on one molecule with the nuclear charge on a second molecule

* proportional to # of e⁻

e.g. Cl₂



= attraction
 = repulsion

also observe:

	B.Pt. (K)	# of e ⁻
He	4.216	2
Ne	27.07	10
Ar	87.5	18
Kr	119.93	36
Xe	165.11	54
Rn	211.4	86

↳ -62°C

↓

increase in attractive force as indicated by boiling point (or melting point)

1st Factor

- the greater number of electrons, the stronger the v.d.w.s (∴ higher BP/MP)
- dominant factor
- increase with carbon chain length in alkanes

	M. Pt. (°C)	B. Pt. (°C)
n-pentane	-130	36
neopentane	-16	10

better forces *
better forces **

2nd Factor

- how well can the molecules fit together in a solid?
- how well can the molecules interact in a liquid?

- * symmetrical molecules make better solids (crystal lattice arrangement maximizes attraction between particles)
- ** long snakey molecules achieve better attractions in the liquid state

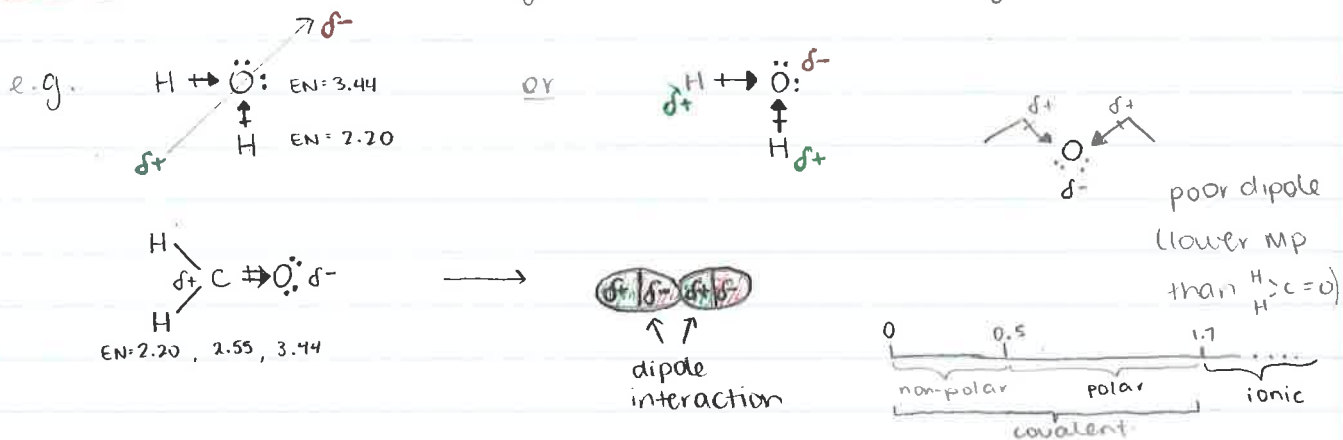
* 1st Factor would make these molecules equal

* there may be induced dipoles ;

continued Intermolecular Forces

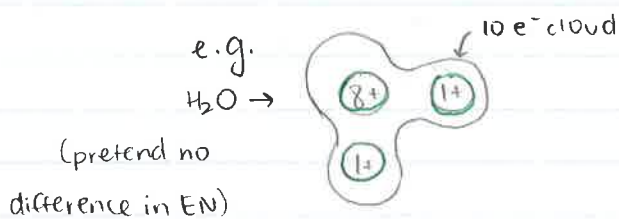
Dipole Interaction

- is in addition to the underlying (default) v.d.w. force
- if v.d.w. is a 1* on the strength scale, dipole is 3-5 (on a per-atom basis)
- * however, really large molecules have an accumulation of v.d.w. that can become significant
- dipole: interaction between regions of δ^+ and δ^- on adjacent molecules



Hydrogen Bond

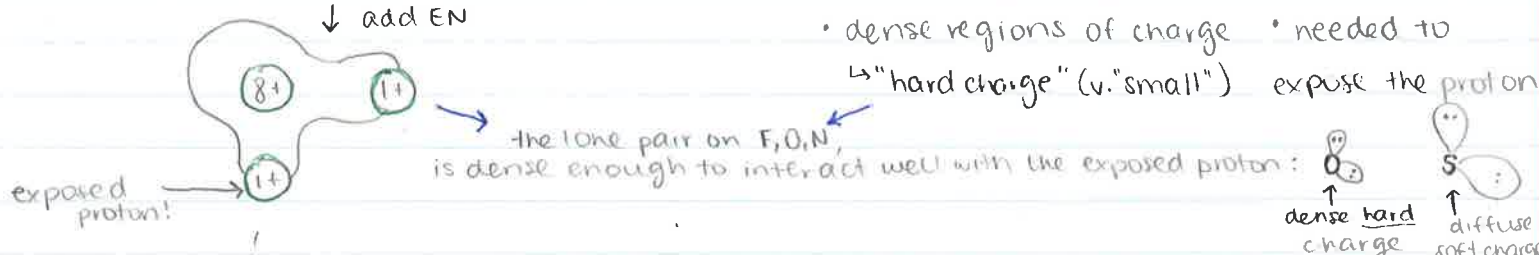
- is really just an incredibly good dipole on top of underlying v.d.w.
- is H-bond / dipole / v.d.w. \hookrightarrow 10 on the strength scale
- * BE CAREFUL - PRECISE CRITERIA - DON'T OVERUSE



1. Need an H bonded to **F, O, or N**
2. Need a lone pair on a second molecule such that the lone pair is on **F, O, or N**

WHY? \rightarrow **F, O, and N** are all small & electronegative

- dense regions of charge \hookrightarrow "hard charge" (v. "small")
- needed to expose the proton



exposed proton + dense hard charge \rightarrow H-bond.

$\therefore H_2O$ has a much higher MP & BP than other molecules of the same size.

