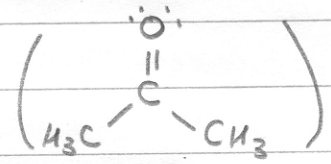
Primer on Intermolecular Forces

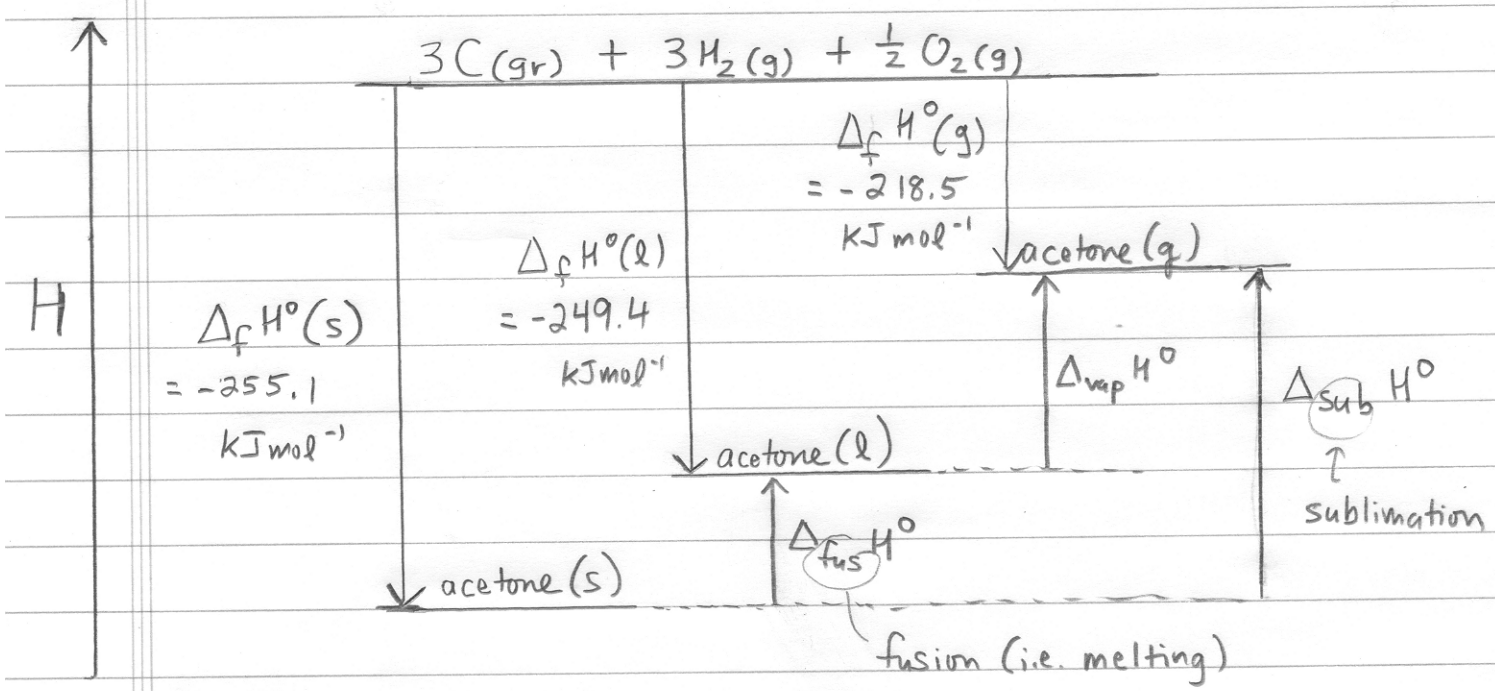
Let's continue our obsession with acetone 

$\Delta_f H^\circ(s) = -255.1$ $\Delta_f H^\circ(l) = -249.4$ $\Delta_f H^\circ(g) = -218.5$

(all in $kJ\,mol^{-1}$)

What do these numbers mean ① thermodynamically and ② structurally?

① Thermo: Recall the definition of standard enthalpy of formation



So the lower something's $\Delta_f H^\circ$ is, the lower its enthalpy and thus the more stable are its bonds/intermolecular forces

solids - lowest H

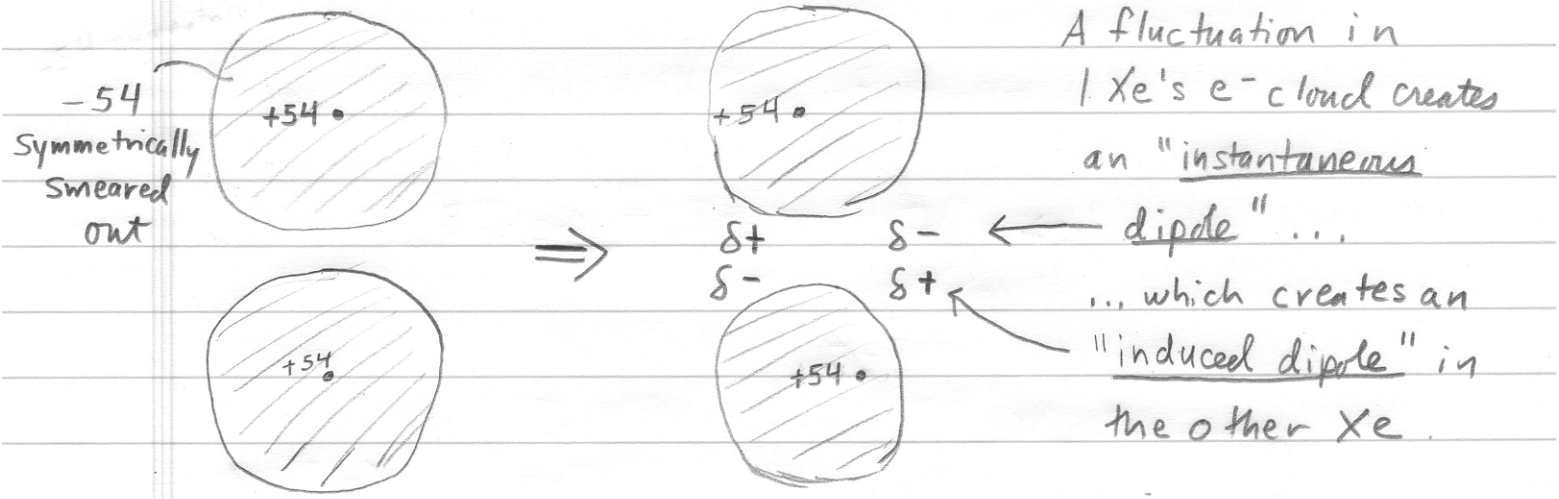
liquids - somewhat higher H due to rotations which disrupt

gases - highest H; atoms/molecules too far away to feel

② So, what's up with "intermolecular forces" and how do they reflect the structure of a substance?

* Attraction btwn atoms/molecules not due to either covalent or ionic bonding
* Three main origins:

(1) Dispersion - present btwn all atoms/molecules
eg consider a pair of Xe atoms:

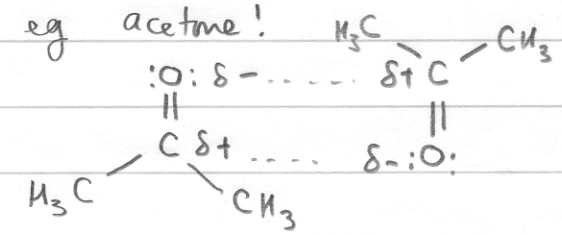


Opposite (albeit temporary) charges attract!

↑ dispersion w/ ↑ size of e⁻ cloud

(2) Dipole - Dipole - present btwn only polar molecules

eg acetone!



For molecules of comparable size, dipole - dipole is more stabilizing than dispersion

(3) Hydrogen Bonding - attractive interaction btwn a {H-F, H-O, H-N} bond and a lone pair on a {F, O, N}

most stabilizing of all 3 effects