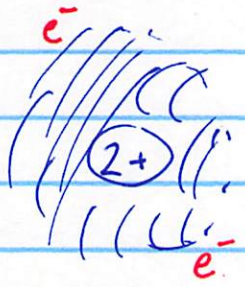
How? A (#p⁺ + #n°)

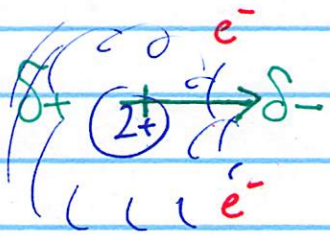
$^{4}_{2}He$

Z (#p⁺) — symbol

$2p^+, 2n^\circ, 2e^-$ ≡ weak LDF.



e⁻s are normally on opposite sides

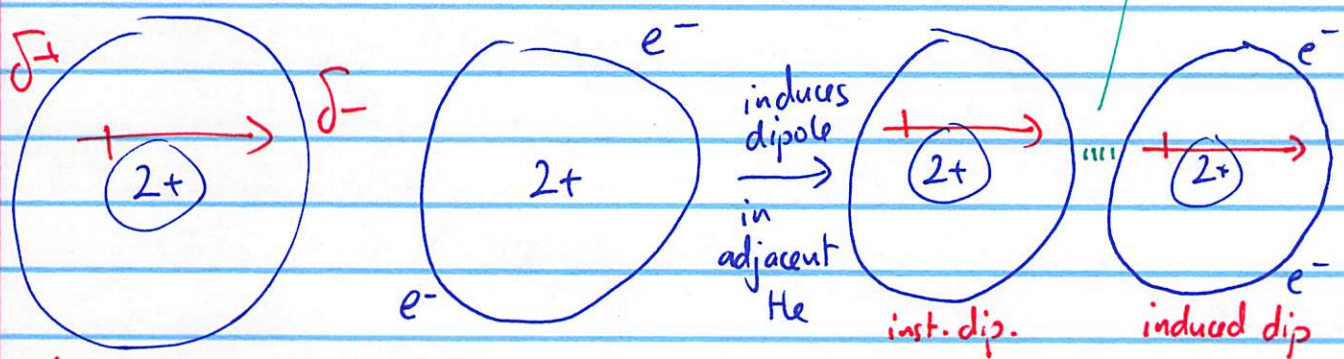


for an instant, they can find themselves on same side.

- creates an instantaneous dipole.

1/16/2019

LDF (attraction)



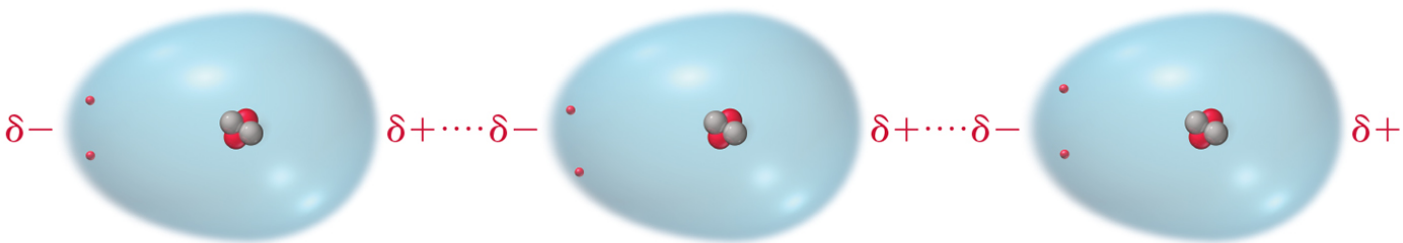
instantaneous dipole

IMF

Youtube video with LDF animation

Dispersion Force

An instantaneous dipole on any one helium atom induces instantaneous dipoles on neighboring atoms, which then attract one another.



How do we know LDF $\propto$ #e⁻s

Predict:

Strongest LDF? He, Ar, or Xe

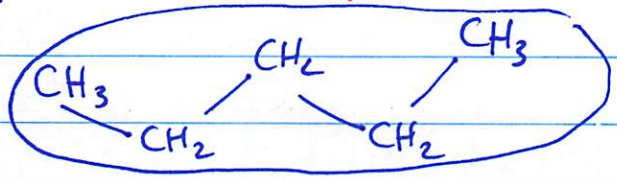
	He	Ar	Xe
BP(K)	4K	87K	165K

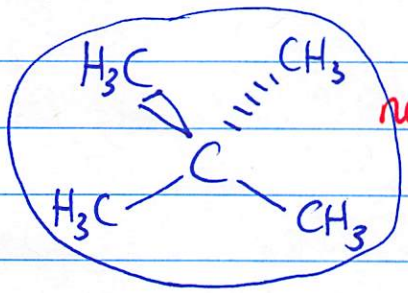
BP(K) = boiling point

higher bp = stronger IMF

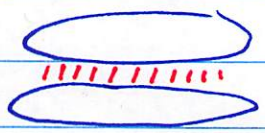
London $\propto$ contact surface area.

ex: C_5H_{12}



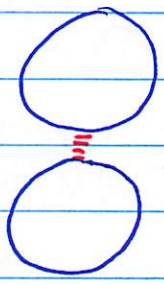


n-pentane



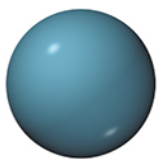
bp = 36.1°C

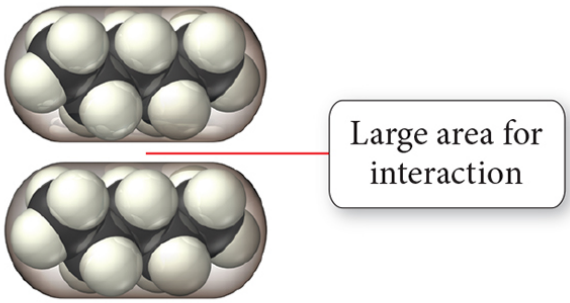
neopentane

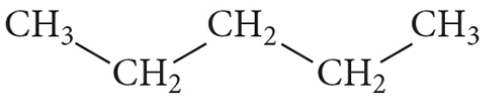


bp = 9.5°C

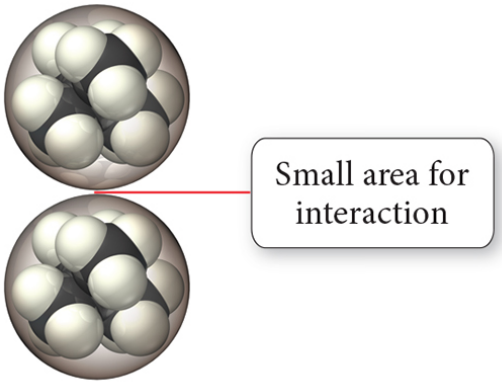
TABLE 11.3 Boiling Points of the Noble Gases

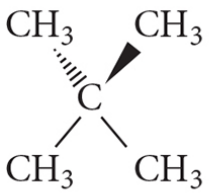
Noble Gas		Molar Mass (g/mol)	Boiling Point (K)
He		4.00	4.2
Ne		20.18	27
Ar		39.95	87
Kr		83.80	120
Xe		131.30	165





(a) *n*-Pentane

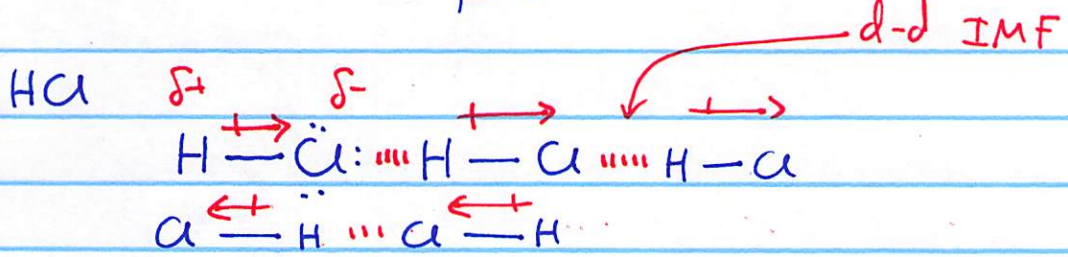




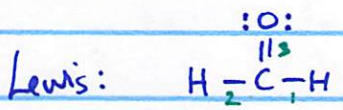
(b) Neopentane

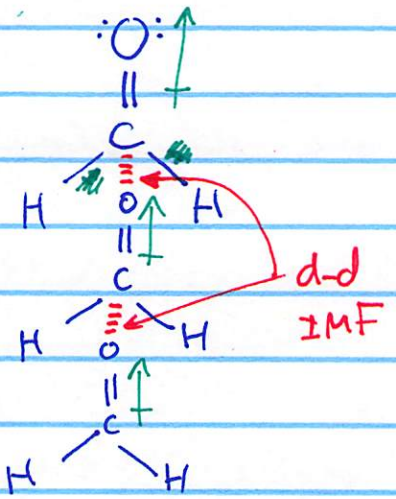
▷ Dipole-dipole (d-d) force

Present between all polar molecules.

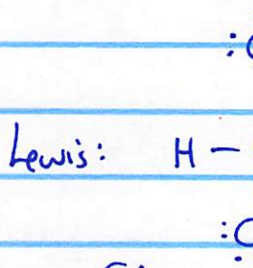


ex: CH_2O

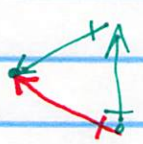


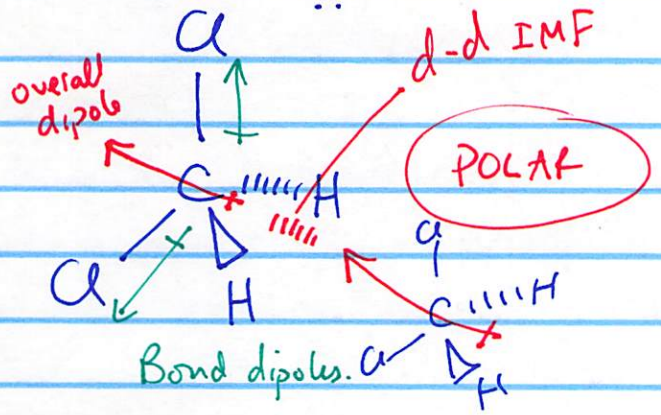


ex: CH_2Cl_2



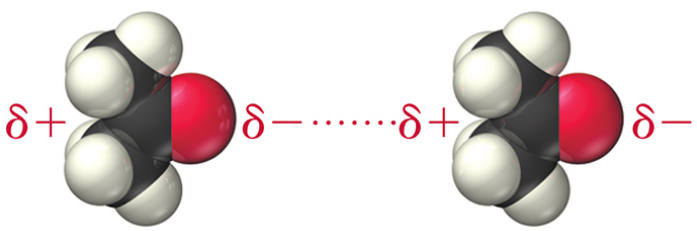
- VSEPR
- bond-dipoles.
- Molecule: POLAR/NON-POLAR?



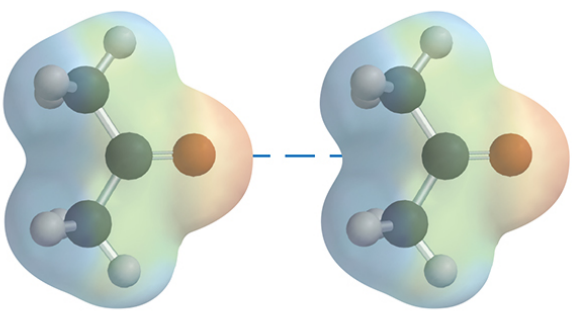


Dipole–Dipole Interaction

The positive end of a polar molecule is attracted to the negative end of its neighbor.



Space-filling model



Electrostatic potential map

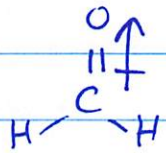
CH_2O $\mathcal{M} = 30.03\ g/mol$ bp = -19.5°C

almost 70°C higher bp!

vs. LDF (similar?) - stronger overall IMF

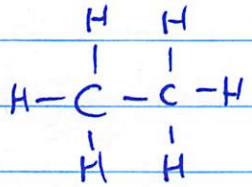
C_2H_6 $\mathcal{M} = 30.09\ g/mol$ bp = -88°C

CH_2O has d-d and LDF



C_2H_6 has LDF but no d-d.

Lewis:



both C-C, C-H } non-polar bonds!

□ Hydrogen bonding

"super-strong" d-d IMF (~ 1/20 strength of covalent bond)

Need 2 things:

H-Bond donor + H-Bond acceptor