

# Announcements

To join clicker to class today  
(Clickers with LCD display  
join automatically):

- Turn on the Clicker (the red LED comes on).
- Push “Join” button followed by “20” followed by the “Send” button (switches to flashing green LED if successful).

- Exam scores not available yet, hopefully tomorrow.
- Newest reading and problems were sent to the e-mail discussion list.

- Please continue to wear appropriate clothing to lab.

# Intermolecular Forces and Macroscopic Behavior

- Dipole interactions (ion-dipole, dipole-dipole, dipole-induced dipole, induced dipole-induced dipole, Hydrogen bonding)
- How this explains water's unusual properties (surface tension, meniscus, capillary action, viscosity, structure of ice).
- Ion-Ion interactions (Coulomb's law, Lattice Energy)
- Solubility
- Vapor Pressure (Raoult's law, relation to boiling point elevation...)
- Phase diagrams

# Van der Waals gas equation

$$P = nRT/(V-nb) - a(n/V)^2$$

- P, V, n, R, T same as ideal gas law
- b = volume taken up by 1 mole of molecules (increases P)
- a = attraction factor (decreases P)

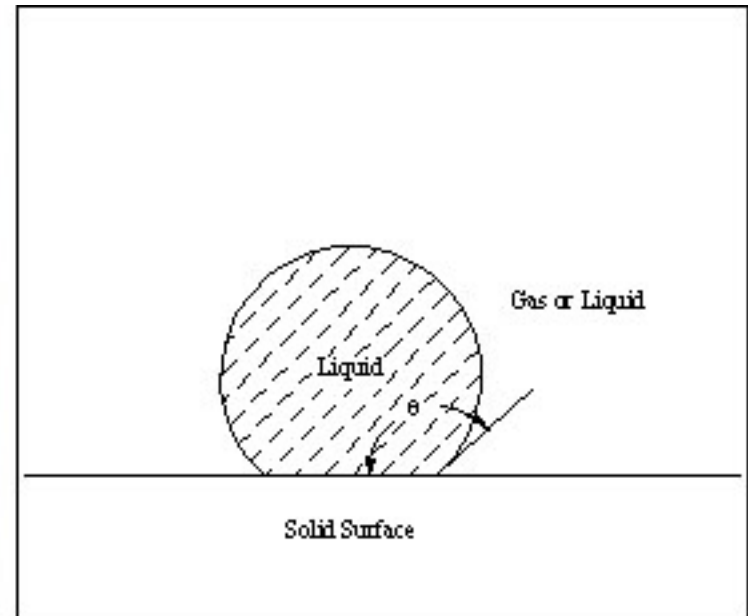
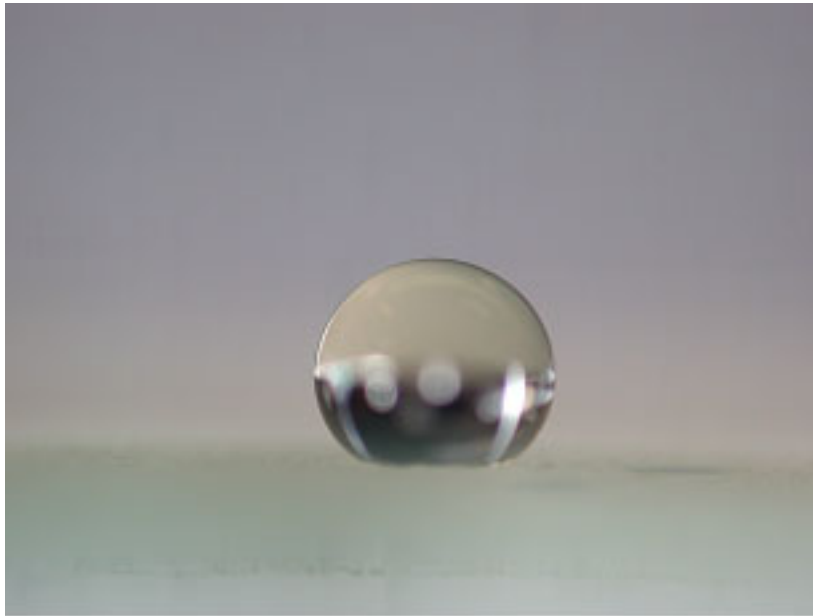
## Implications

- If V is small ( $\approx nb$ ) P will be much higher than expected.
- If a is larger P will be lower than expected.
- At close distances the molecules repel each other (there is a minimum distance of approach)
- When separated the interaction is attractive.

# Effect of H-bonding

Chang figure 12.6

# Water on a hydrophobic (nonpolar) surface



Picture courtesy of: The University of British Columbia Structured Surface Physics Laboratory

# Surface Tension and Meniscus

Chang Figs. 12.8 and 12.10