Exam #1

- phases of matter
  - microscopic / macroscopic
- Gases
  - Units of pressure
  - No H_2 lab
  - Ideal gas law and variations
    - moles, density, molar mass, change in condition
  - "The Graph" – molecular E distribution
  - Vapor pressure
  - No Clausius–Klapeyron equation
  - effusion/diffusion
  - relative speeds of gases
  - real gas law

Real gas law

van der Waals equation

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

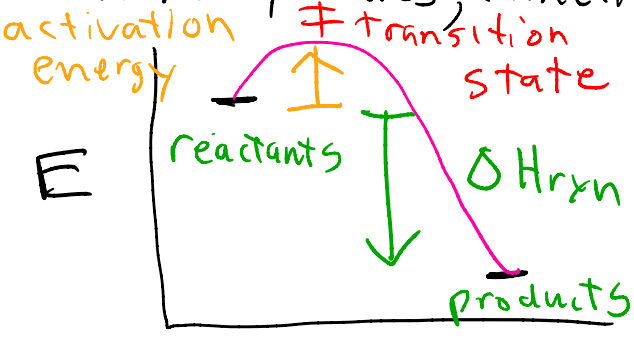
$\frac{n^2 a}{V^2}$ → IMF

nb → volume of the gas particles

IMF

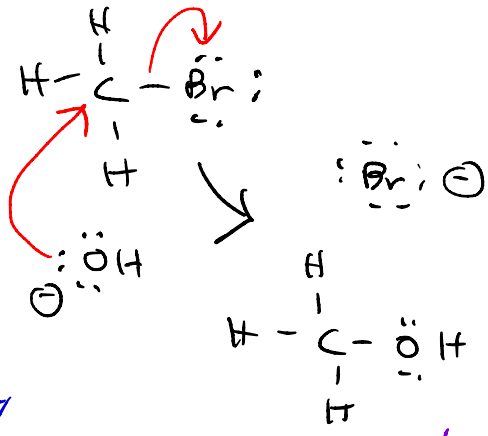
- VSEPR (symmetry ⟷ polarity)
- bond versus molecular dipoles
- IMF ⟷ phase water vs. methane
- IMF ⟷ vapor pressure ⟷ boiling point
- Types of IMF
  - ions
  - permanent dipoles → structure
    - hydrogen bonding
  - temporary dipoles
    - induced
    - instantaneous (London)
- Phase diagrams
  - triple point, critical point
- water
- energy changes in phase/temperature changes
- phase changes (6)
- no solids

Thermodynamics, Kinetics, Equilibrium



(most likely pathway through a reaction)

thermodynamics



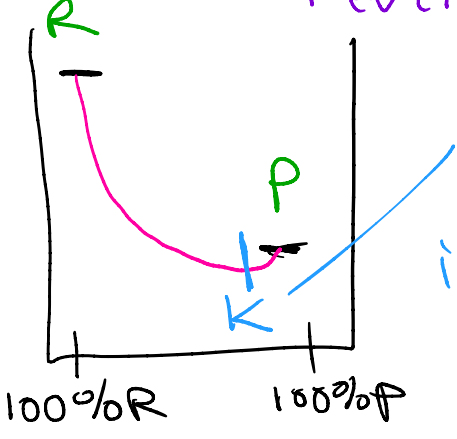
methanol

kinetics

Equilibrium - the balance in energy of reactants and products in a reversible reaction.

$$2\,SO_2(g) + O_2(g) \rightleftharpoons 2\,SO_3(g)$$

reversible reaction



equilibrium - the lowest in energy in a reversible reaction.

The quantity of reactants and products at equilibrium depends on the difference in energy between them, $\Delta G^\circ = -RT \ln K$

ΔG°: free energy (difference in energy between reactants and products)

K: equilibrium constant

Equilibrium constant: $K = \frac{[\text{products}]}{[\text{reactants}]}$

$aA + bB \rightleftharpoons cC + dD$

Stoichiometry

Substances

$$K = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

$$K = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

$$= 279$$