P. Chem I Lecture Notes (1/20/23)

first law (ch19) second law (Ch20)

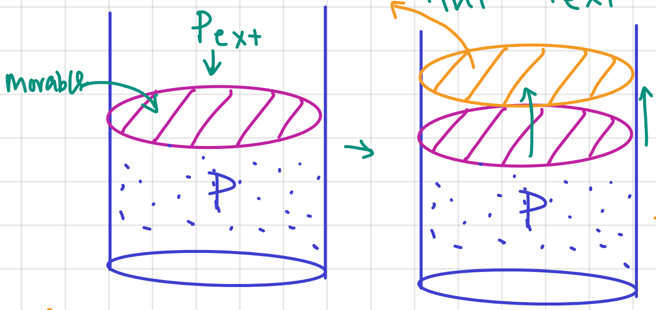
Broad course outline:

Chapter 22: free energy → combines enthalpy & entropy
Chapter 26: equillibrium constant (effects of concentration on ΔG)
Chapter 23-25: Raoult's Laws, Henry's Laws, Osmotic pressure
Chapter 28-29: Kinetics

Chapter 19: Define heat q and work w
as energy transfer between system and surroundings
as a result of
- temperature difference
- unbalanced forces

We will now focus on PV work mainly but there are other kinds of work such as:
- mechanical work of muscle contraction
- transport work of moving Na^+ ions against a concentration gradient.

PV work



dot product

work = force • displacement

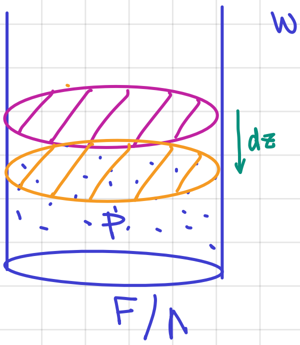
$w = -P_{ext} \cdot A\,dz$ = V

$w = -P_{ext} dV$

Although we are pushing down, lid goes up bc $P_{int} > P_{ext}$ loses energy, thats why w is neg

* example: you put a ball on the surface, when it goes up, it stores energy as potential energy, which means the system loses energy.
∴ energy has gone down in energy.

Next, consider $dz < 0$ the lid is pushed down



w

$w = -P_{ext} A\,dz$ → remember this is negative bc we are pushing lid down.

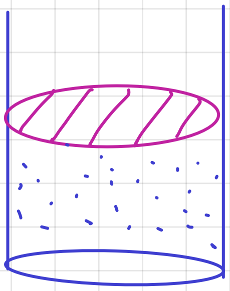
↓

$w = -P_{ext} dV$ → consistent formula indifferent of volume change.

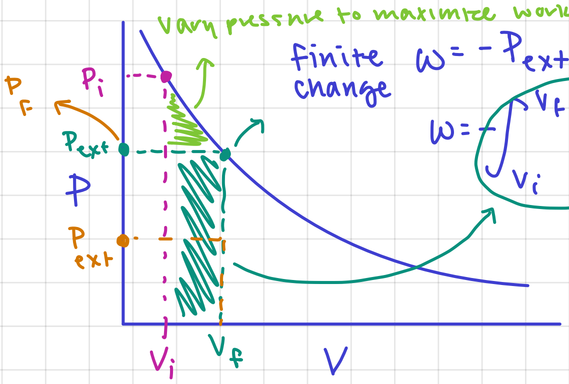
∴ system has gone up in energy

Constant T (isothermal conditions)

thats how defrosting chicken works, you put it in a bath so it defrosts at even temp, preventing uneven throughout temp, preventing food poisoning



$PV = nRT = \text{constant} = PV \Rightarrow P \propto 1/V$



finite change $w = -P_{ext}\, dV$

$w = -\int_{V_i}^{V_f} P_{ext}\, dV$

initial is less than final, negative

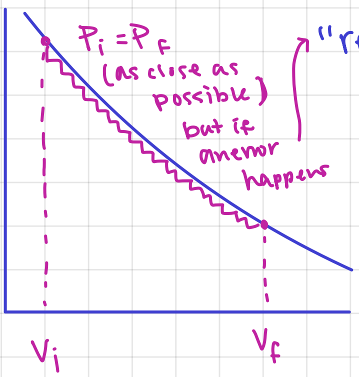
work is path-dependent

in a vacuum, $w = 0$ because $P = 0$

imagine adding a weight, think of how it moves up/down this helps imagine potential work being stored

Theoretical

Maximize work that we can extract by the gas expanding $w_{max} = -\int_{V_f}^{V_i} P\, dV$



"reversible conditions"