Entropy defined in thermodynamics, and in statistical mechanics

Stat mech: Entropy is the log of the probability of the states.

k: Boltzmann's constant. PV = nRT = NkT

Third law of thermo: S = 0 at T = 0.
Apparent violation of this for N_2O

Carnot cycle. Reversable cycles

- Isothermal expansion: being heated, doing work
- Adiabatic expansion: does work
- Isothermal compression: cooled and compressed
- Adiabatic compression

Efficiency: $\varepsilon = 1 - \frac{q_2}{q_1}$.
Kelvin used efficiency to define temperature.
We can never get to T = 0.

We spoke about two definitions of entropy:
Boltzmann:

$S = k \ln \Omega$, where Ω is the number of equally probable microscopic arrangements

$dS = dq / T$ for reversible

ΔS : For change in temperature and no phase: $\int \frac{CdT}{T}$

For phase change: $\frac{\Delta H}{T}$

Third law of thermo: S = 0 at T = 0.

We expect everything to be a solid at T = 0. Reason: p_i is the probability to find a molecule at energy E_i. That is: $p_i = \mathrm{e}^{\frac{E_i}{kT}}$

At T = 0, everything at zero energy, and should be a solid, with the particles in a lattice. We noticed that He remains a liquid. Attached is the PV diagram we showed in class. We said that T < 2.17 K, we cannot talk about individual molecules of He. It is just a single substances. Raise the temperature, and the molecules reappear.

We discussed how to study:

- Understanding
- Organization
- Review
- Become familiar (reread, do many problems)

How to do things:

- Start from the beginning. Be sure you are starting from something clear.
- Focus on assumptions and principles used.
- Examples: Homogenous functions, Joule free expansion
- Finish: Answer the problem. Just working, but not answering the problem, is not finishing.
- Check: Check that you indeed answered the problem

We discussed understanding and organization.

Understanding:

- The logic must be clear
- Understand the principles
- Be familiar with the notation
- Look at examples and counterexamples
- Picture in your mind what is going on
- Look at simple numerical examples

Organization.

- You must see the relationship with the older material
- Be able to summarize the key points
- Explicitly write principles

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