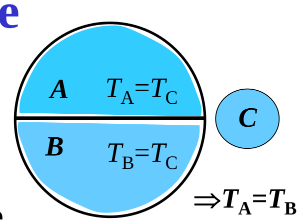
Zeroth Law of TD

- **History**
  - as a “formal” postulate of TD in came after 1st and 2nd Laws
  - was implicitly buried in common thinking of temperature
- **Observation**
  - Sets of bodies can be ordered according to their degree of “hotness” (e.g., how hot they “feel”)
- **Postulate**
  - if bodies A and B are in thermal equil. with a 3rd body C, then A&B are in thermal equil. with each other

Temperature



- Must be a TD property that is a measure of (quantifies) “hotness” – call it **temperature**
- Under this definition, temperature is a property of matter and can only be defined when a body (matter) is in equilibrium
- Defining a temperature scale
  - later we will examine TD defn. and scale for temperature
  - for now look at earlier (historical) scale, the “**perfect-gas temperature scale**” ***“luckily” it agrees with TD temp. scale***

PG Temperature Scale

- Empirical observation
  - the temperature of a gas confined at a contant volume is a monotonically increasing function of gas pressure

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PG Temperature Scale

- We can "choose" to use these isotherms to define temperature $T \equiv pv/c$ ***T is inten. (fn of 2 inten. props.)***
- Then
  1. $T \geq 0$
  2. T monotonic with "hotness"
  3. a simple function
- Temperature scale (c=?)
  - since we can accurately measure ratios of temps., it is sufficient to select a temperature of just one point on the scale (effectively defines c)

SI (PG) Temperature Scale

- The *SI* scale (one of various single point scales) uses the triple-point of water
  - the temperature at which three phases of water (liquid, gas and solid-ice) all exist in thermal equilibrium
  - easily reproducible standard
  - "declared" (by Intl. agreement) to be 273.16 K
- Why such a "strange" value?
  - chosen to agree with earlier two-point scale
  - $T_{H2O,boil}$-$T_{H2O,freeze}$=100K(=100C)