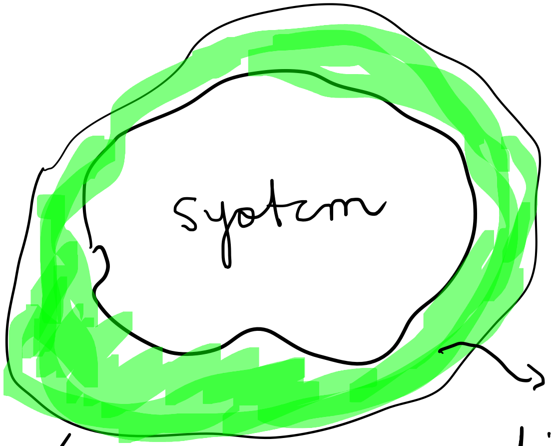
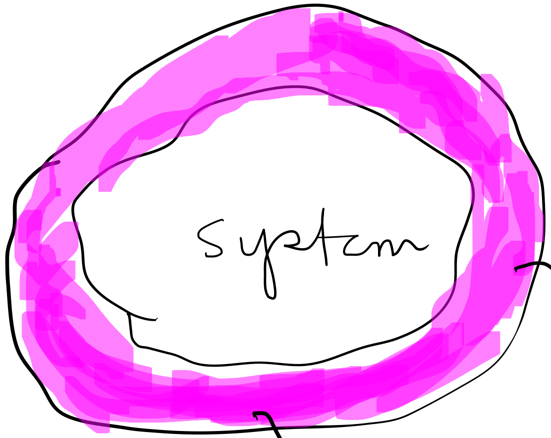
Temperature and Equilibrium

Universe = system + surroundings



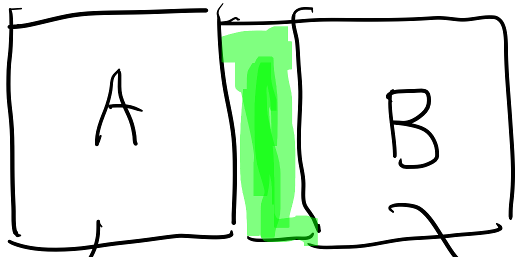
adiabatic boundary

no exchange of particles or energy



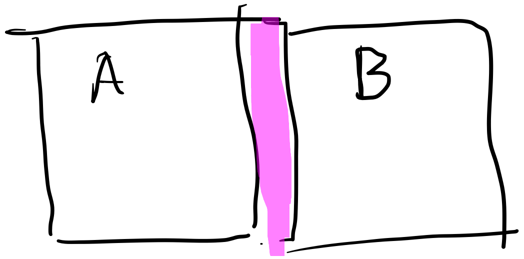
diathermal boundary

no exchange of particles but can exchange energy



$$\underbrace{\underbrace{X_A, Y_A} \qquad \underbrace{X_B, Y_B}}_{\text{initial}}$$

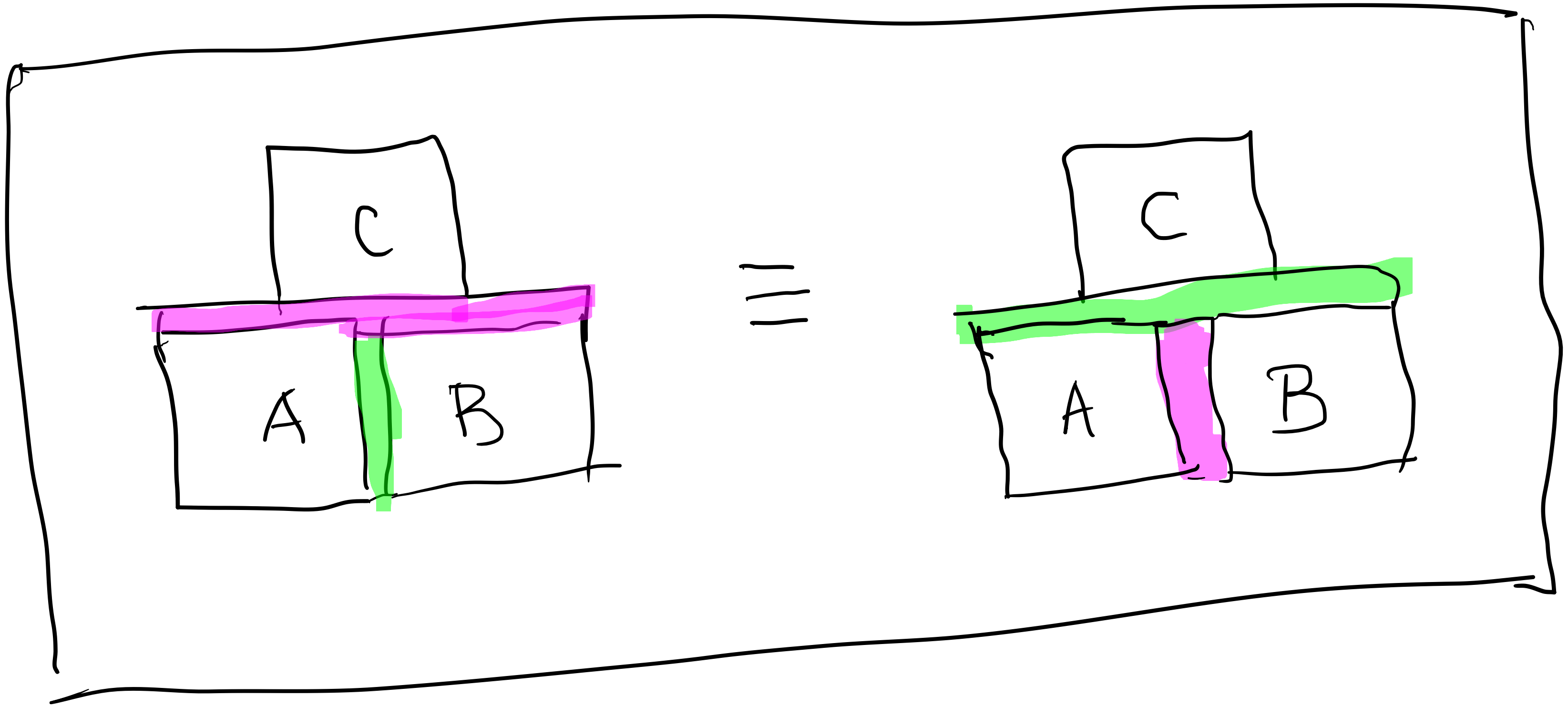
$$\underbrace{(X_A, Y_A), \quad (X_B, Y_B)}_{\text{final}}$$



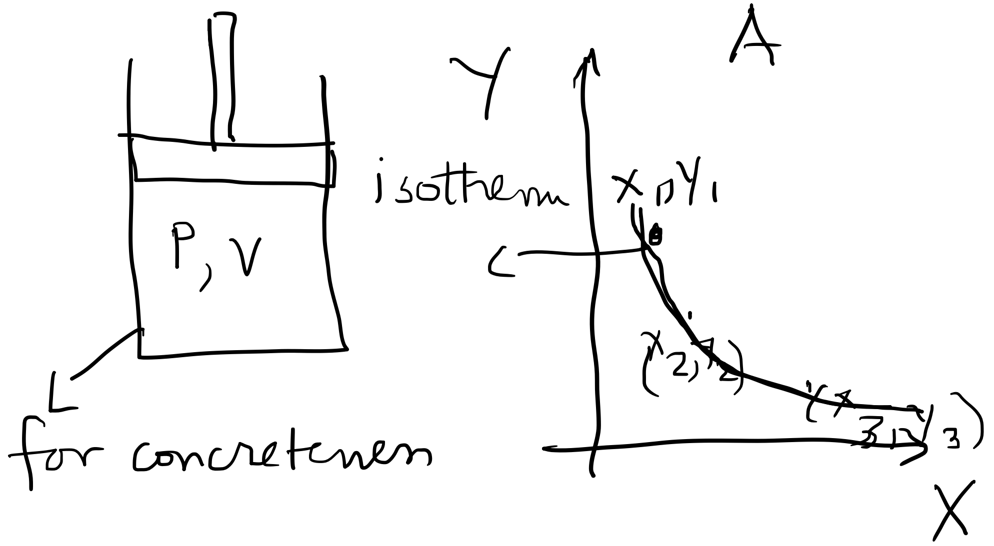
$$\underbrace{(X_A, Y_A) \; (X_B, Y_B)}_{\text{initial}}$$

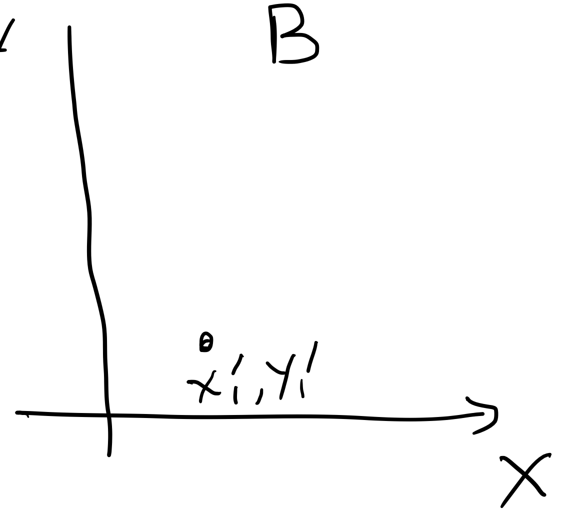
$$\underbrace{(X_A', Y_A') \; (X_B', Y_B')}_{\text{final}}$$

new equilibrium



Zeroth Law: Two systems in equilibrium with a third system a in eq. with each other



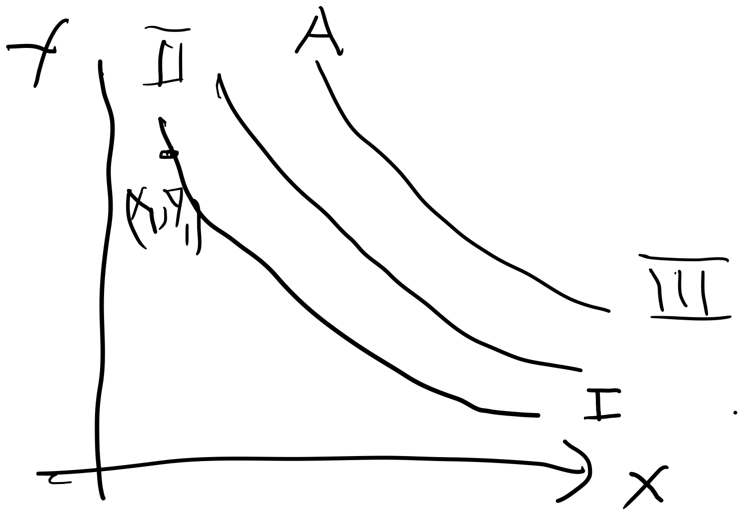


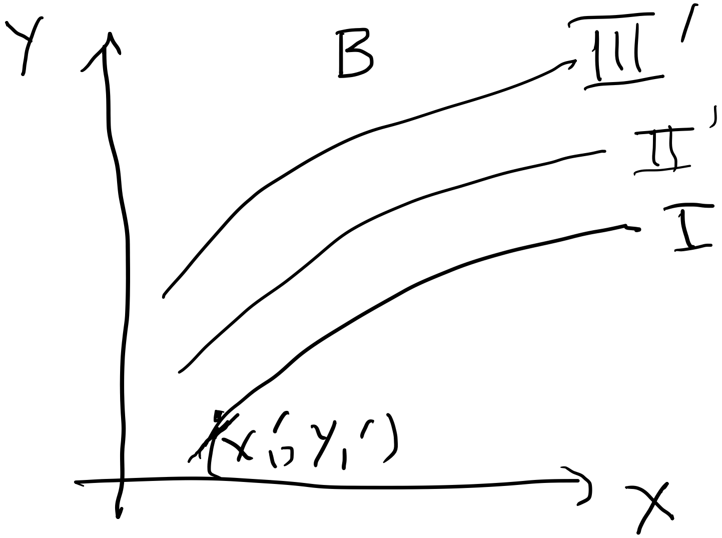
Let B be in a state (X_1', Y_1')

Put A in contact through diathermic wall

$\longrightarrow (X_1, Y_1)$

> **Isotherm: locus of all pts representing states of a system that is in thermal equilibrium with one state of another system**





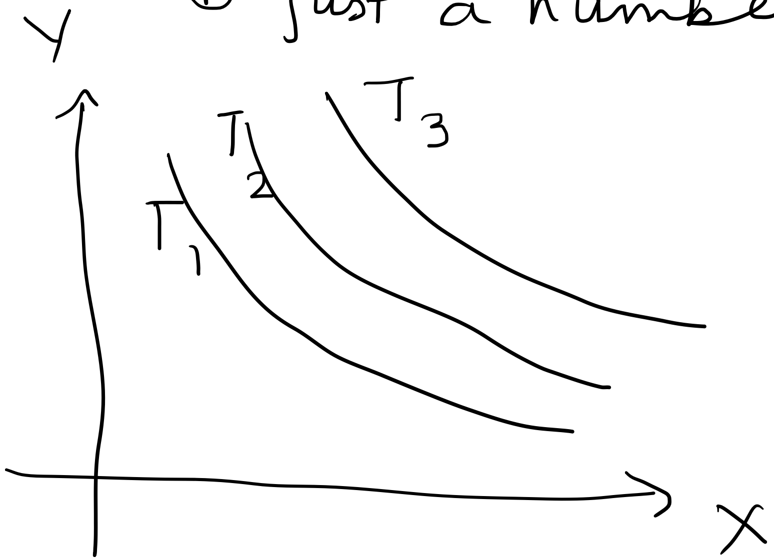
I – I′ corresponding isotherms

zeroth law: ALL states on isotherm I are in equilibrium with all states on isotherm I′

common property of corresponding isotherms: all states are in each other common property of isotherm defined as <u>temperature</u>.

temperature is a scalar ∴ zeroth law

↓ just a number



Rule for assignment of numbers representing temp. to each isotherm

→ temp scale.

Once a scale is assigned

A necessary & suff condn for two systems to be in eq. $T_A = T_B$

(P, V, T) $\quad$ (J, l, T)

not all independent

connected by an eqn of state

$$f(P, V, T) = 0$$

input to thermodynamics comes ~~fo~~ from expt.

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