Chap 19 temperature

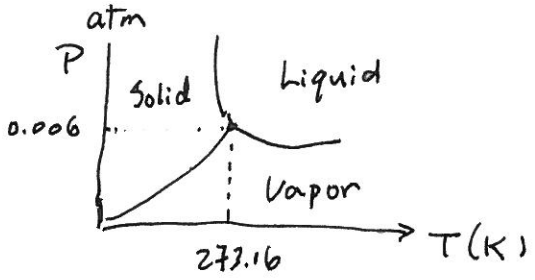
Thermaldynamics – deals with internal energy
– thermo energy

1 Zeroth law – If both A and B bodies are in thermal equilibrium with a third body, at temperature T, then they are in thermal equilibrium with each other.

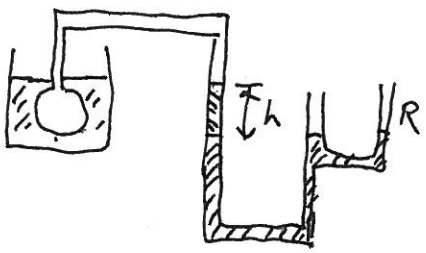
2. Temperature is the basis of many properties, as temperature changes, Many of the properties also change, Some are linear. That can be used to measure the temperature of a body

Measuring temperature – pick some reproducible thermal phenomenon and assign temperature Then calibrate.

Kelvin – define water's triple point as $T_3 = 273.16K$



– Constant volume gas thermometer.



By raising or lowing R we can keep the level of Mecury at zero

$T = C \cdot P$ of gas $\quad P = P_0 - \rho g h$

$T_3 = C \cdot P_3$ → immersed in a triple point cell

$\therefore T = 273.16K \left(\lim_{m \to 0} \frac{P}{P_3}\right)$ $m \to 0$ gas → ideal

$m \to 0$, Since different gas will result in different temperature. Using some amount m will converge to the same reading in temperature

2. Thermal Expansion

- Add heat, the energy will make atoms to vibrate faster and faster than their equilibrium positions. The sizes of the volume will be enlarged

— thermometers, thermostats. → Using bimetal strip

— Linear Expansion

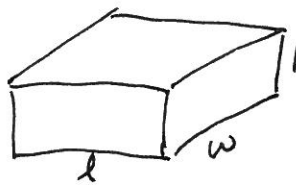
$$\Delta L = L \alpha \Delta T$$

$\alpha \equiv$ Coefficient of linear expansion

$[\frac{1}{deg}, \frac{1}{K}]$

— Volume expansion

$$\Delta V = V \beta \Delta T \quad , \quad \beta = 3\alpha$$



at T_i $V_i \equiv \ell w h$

$T \to T_i + \Delta T$

$V \to V_i + \Delta V$

$$V_i + \Delta V = (\ell + \Delta\ell)(w + \Delta w)(h + \Delta h)$$

$$= (\ell + \alpha \ell \Delta T)(w + \alpha w \Delta T)(h + \alpha h \Delta T)$$

$$\simeq \ell w h (1 + \alpha \Delta T)^3$$

$$= V_i [1 + 3\alpha\Delta T + 3(\alpha\Delta T)^2 + (\alpha\Delta T)^3]$$

$$\therefore \frac{\Delta V}{V_i} \simeq 3\alpha\Delta T + 3(\alpha\Delta T)^2 + (\alpha\Delta T)^3$$

neglect higher order terms

$$\frac{\Delta V}{V_i} \simeq 3\alpha \Delta T$$

$$\therefore \beta = 3\alpha$$