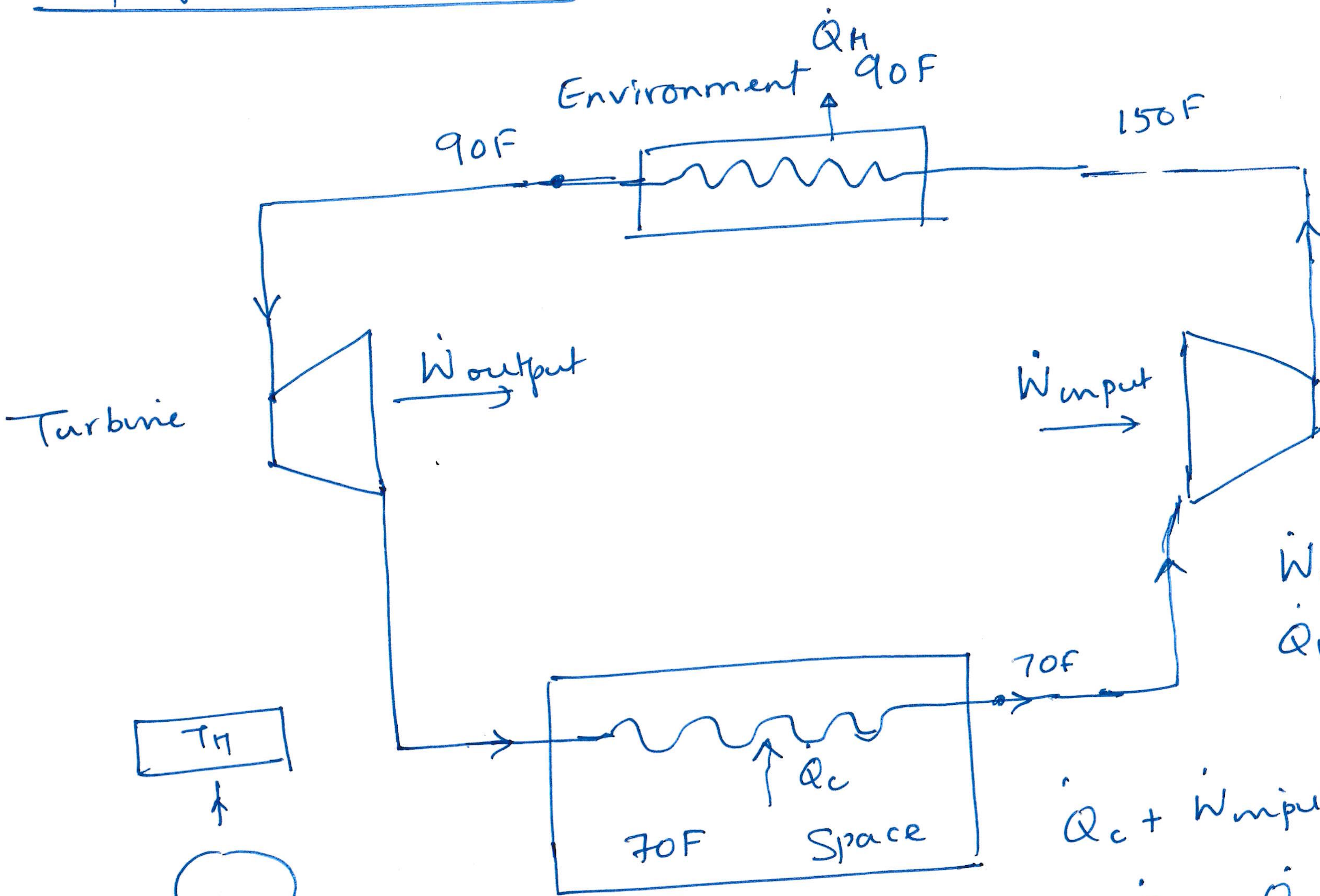
Refrigeration / AC



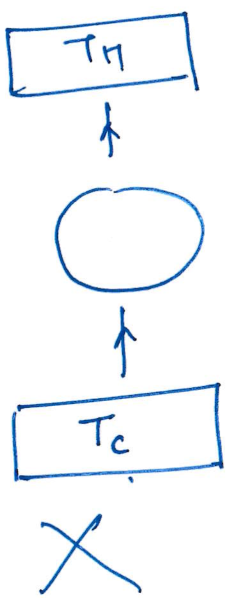
$\dot{W}_{in} > \dot{W}_{out}$

$\dot{Q}_H > \dot{Q}_c$

$$\dot{Q}_c + \dot{W}_{input} - \dot{W}_{out} - \dot{Q}_H = 0$$

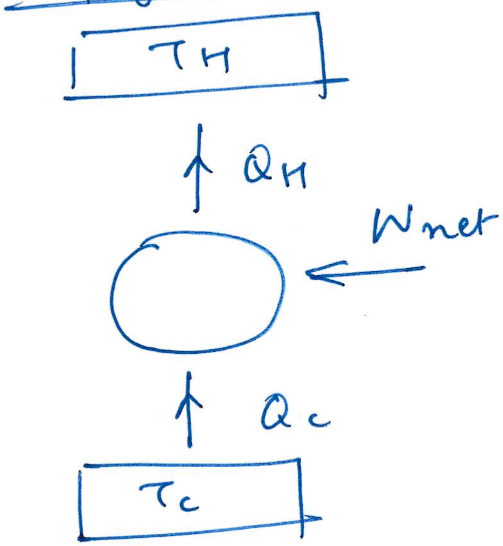
$$\dot{Q}_H = \dot{Q}_c + \dot{W}_{net}$$

$$\dot{W}_{net} = \dot{W}_{input} - \dot{W}_{out}$$



Clausius Statement of 2nd law.

Refrigerator



Coefficient of performance $= \dfrac{Q_C}{W_{net}}$

For ideal cycle (Carnot engine). $\dfrac{Q_c}{T_c} = \dfrac{Q_H}{T_H}$

$$COP_{carnot} = \frac{Q_c}{Q_H - Q_c}$$

$$= \frac{1}{\frac{Q_H}{Q_c} - 1}$$

$$= \frac{1}{\frac{T_H}{T_c} - 1} = \frac{T_c}{T_H - T_c}$$

Heat pump

Coefficient of performance $= \dfrac{Q_H}{W_{net}}$

$$COP_{carnot} = \frac{T_H}{T_H - T_c}$$

Property → $P, \forall, T, H, U, S, m$

Intensive vs Extensive:

P, T $\qquad$ $\forall, H, U, m, S$

$v = \frac{\forall}{m}$, $h = \frac{H}{m}$, $u = \frac{U}{m}$, $s = \frac{S}{m}$

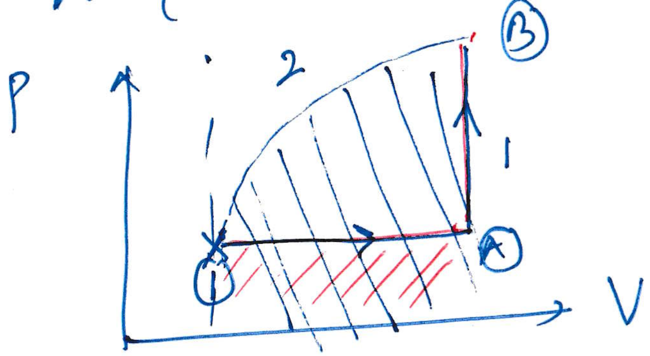
Specific volume, specific enthalpy, Specific internal energy, Specific entropy.

State. → set of properties.

Process: - transition from one state to another.

The properties above are state variables ie only depends upon the state, not the process

Q & W (heat & work) depend upon the process.



$1 - A - B$ → Path 1

$1 \to B$ → Path 2

$$W = \int P\, d\forall$$

~~$H = U + Pv$~~ $\quad H = U + P\forall$

$$\frac{H}{m} = \frac{U}{m} + \frac{P\forall}{m} \Rightarrow h = u + Pv$$

Entropy: $\quad ds = \frac{\delta Q}{T} \quad ; \quad \Delta s = \int \frac{\delta Q}{T}$

Equation of state for ideal gas.

$$P\forall = n\bar{R}T$$

n = # of moles

$\bar{R}$ = universal gas constant

= 8.314 kJ/kmol K

$n = \frac{m}{M}$ ← molar mass

$$P\forall = \frac{m}{M}\bar{R}T$$

$$= m\left(\frac{\bar{R}}{\bar{M}}\right)T$$

$$P\forall = mRT$$

R ← gas constant