1.2) Energy Analysis of Cycles

Cycles

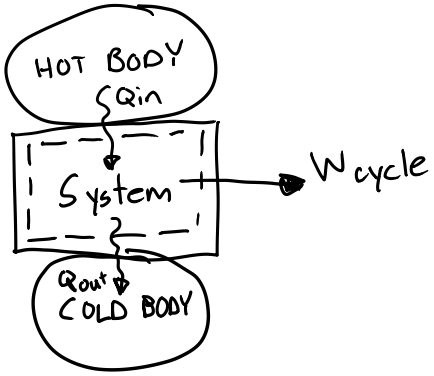
Initial State -> Processes -> Return to the Initial State

$$\Delta E_{cycle} = 0$$

$$\Delta E_{cycle} = (\Delta KE + \Delta PE + \Delta U)_{cycle} = Q_{cycle} - W_{cycle} = 0$$

$$\boxed{Q_{cycle} = W_{cycle}}$$

Power Cycle



$$Q_{in} = Q_{out} + W_{cycle}$$

$$\boxed{W_{cycle} = Q_{in} - Q_{out}}$$

Thermal Efficiency for a Power Cycle

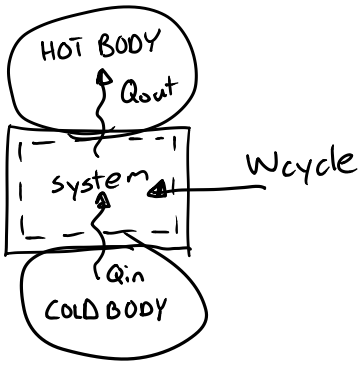
$$\eta = \frac{W_{cycle}}{Q_{in}}$$

η: Thermal Efficiency

$$W_{cycle} = Q_{in} - Q_{out}$$

$$\boxed{\eta = \frac{Q_{in} - Q_{out}}{Q_{in}} = 1 - \frac{Q_{out}}{Q_{in}}} \qquad \boxed{\eta < 1}$$

Refrigeration and Heat Pump Cycles



$$W_{cycle} + Q_{in} = Q_{out}$$

$$\boxed{W_{cycle} = Q_{out} - Q_{in}}$$

Coefficient of Performance for a Refrigeration Cycle

$$\beta = \frac{Q_{in}}{W_{cycle}} = \frac{Q_{in}}{Q_{out} - Q_{in}}$$

Coefficient of Performance for a Heat Pump Cycle

$$\gamma = \frac{Q_{out}}{W_{cycle}} = \frac{Q_{out}}{Q_{out} - Q_{in}}$$

$$\gamma > 1$$