

Homework # 9:

5-10:

$$a): Q_{in} = \Delta u + W_{out}$$

$$= \int p dv$$

$$= \int p d\left(\frac{nRT}{p}\right)$$

$$= nRT \cdot (-1) \int_{p_1}^{p_2} \frac{1}{p} dp$$

$$= nRT(-1) \cdot \ln \frac{p_2}{p_1}$$

$$= \frac{3}{32} \cdot 8.314 \cdot (273.15 + 80) \cdot \ln \frac{250}{110}$$

$$= 225.98 \text{ KJ}$$

$$b): Q_{in} = 225.98 \times 0.85 = 192.08 \text{ KJ}$$

5-17:

$$a): Q_{add} = W_{out}$$

$$= \int_{v_1}^{v_2} p dv = \int_{v_1}^{v_2} \frac{nRT}{v} dv = nRT \ln \frac{v_2}{v_1}$$

$$= \frac{p_1 v_1}{RT} \cdot \ln \frac{v_2}{v_1}$$

$$= 500 \cdot 0.05 \ln \frac{0.1}{0.05} = 17.33 \text{ KJ}$$

$$b): \frac{Q_{in}}{T_H} + \frac{Q_L}{T_L} = 0 \Rightarrow Q_L = -\frac{Q_{in}}{T_H} \cdot T_L = -17.33 \cdot \frac{273.15}{273.15 + 90}$$

$$= -13.03 \text{ KJ}$$

5-58):

$$300\text{F} = 148.89^\circ\text{C}.$$

$$100\text{F} = 82.2^\circ\text{C}$$

$$100\text{B} = 105.5\text{KJ}$$

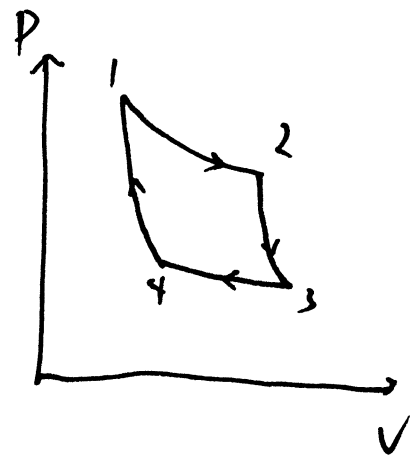
$$\frac{W_{\text{act}}}{Q_H} = \frac{T_H - T_L}{T_H}$$

$$Q_H = W_{\text{act}} \cdot \frac{T_H}{T_H - T_L} = Q_L \cdot \frac{T_H}{T_L}$$

$$\Rightarrow Q_L = \frac{W_{\text{act}} \cdot T_H}{T_H - T_L} \cdot \frac{T_L}{T_H}$$

$$= \frac{105.5 \cdot 148.89}{148.89 - 82.2} \cdot \frac{82.2}{148.89}$$

$$= 130.03\text{KJ}$$



5-66):

$$\beta_{\text{HP}} = \frac{|Q_H|}{W_{\text{in}}} = \frac{|Q_H|}{|Q_H| - |Q_L|} = \frac{T_H}{T_H - T_L}$$

$T_L^\circ\text{C}$	$T_H^\circ\text{C}$	β_{HP}
-5	30	8.66
-5	20	11.7
-5	10	18.9
-50	20	4.2
-150	20	1.7
-250	20	1.1

Ex:

$$\beta_{\text{HP}} = \frac{273.15 + 30}{35} = 8.66$$