Problem 3-10 solution

(a)
From Curie's law (Eq. (2-13))

$$M \;=\; C_C \frac{\mathcal{H}}{T}$$

we get

$$dM \;=\; \left(\frac{\partial M}{\partial \mathcal{H}}\right)_T d\mathcal{H} + \left(\frac{\partial M}{\partial T}\right)_{\mathcal{H}} dT \;=\; \frac{C_C}{T} d\mathcal{H} - C_C \frac{\mathcal{H}}{T^2} dT$$

Next, from Eq. (3-10)

$$\delta W \;=\; -\mathcal{H} dM$$

we get

$$\delta W \;=\; -\frac{C_C \mathcal{H}}{T} d\mathcal{H} + C_C \frac{\mathcal{H}^2}{T^2} dT$$

(b)

$$dW_H \;=\; C_C \frac{\mathcal{H}^2}{T^2} dT \qquad \Rightarrow \qquad W_H \;=\; \int dW_H \;=\; -C_C \mathcal{H}^2 \left(\frac{1}{T_f} - \frac{1}{T_i}\right)$$

If $T_f > T_i$, $W_H > 0 \;\Rightarrow$ work is done by the system
(c)

$$dW_T \;=\; -\frac{C_C \mathcal{H}}{T} d\mathcal{H} \qquad \Rightarrow \qquad W_T \;=\; \int dW_T = \; -\frac{C_C}{2T}(\mathcal{H}_f^2 - \mathcal{H}_i^2)$$

If $\mathcal{H}_f > \mathcal{H}_i$, $W_T < 0 \;\Rightarrow$ work is done on the system

Problem 3-16 solution

(a)

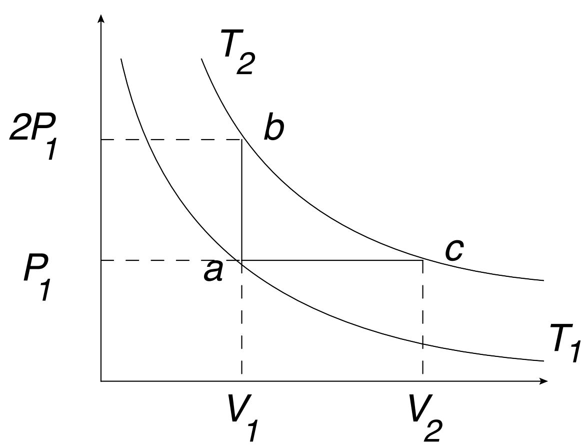

FIG. 1. LO diagrams.

$$T_2 \;=\; \frac{2P_1 V_1}{nR}$$

(b)

$$W \;=\; W_{ab}+W_{bc}+W_{ca} \;=\; 0+nRT_2\ln\frac{V_2}{V_1}+P(V_1-V_2)$$

$$2p_1V_1 \;=\; nRT_2, \quad P_1V_2 \;=\; nRT_2 \quad \Rightarrow \quad V_2 \;=\; 2V_1$$

$$W_{bc} \;=\; nRT_2\ln 2 \;=\; 2\ln 2\frac{P_1V_1}{R} \;=\; 1.1\times 10^6 J, \qquad W_{ca} \;=\; -P_1V_1 \;=\; -8\times 10^5 J$$
$$\Rightarrow\; W \;=\; 3.1\times 10^5 J$$

Problem 3-35 solution

$nRT \sim 5\times 10^5$, $d \equiv d_1-d_2 \;=\; \frac{V_1-V_2}{A} \;=\; 0.1\frac{nRT}{AP_1} \;\simeq\; 1\text{m}$

(a)

$$W \;=\; nRT\ln\frac{V_f}{V_i}-f(d_1-d_2) \;=\; nRT\ln 0.9-f\frac{0.1V_1}{A} \;=\; nRT\ln 0.9-f\frac{0.1nRT}{P_1A} \;\simeq\; -5.25\times 10^4 J$$

(b)

$$W_{\text{conf}} \;=\; nRT\ln\frac{V_f}{V_i} \;=\; nRT\ln 0.9 \;=-5.25\times 10^4 J$$

(c)

$$W_{\text{diss}} \;=\; -fd \;=-10J$$

(c)

$$\Delta W \;=\; mgd \;\simeq\; 9.8J$$