

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)

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

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

(c)

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

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

Problem 3-16 solution

(a)

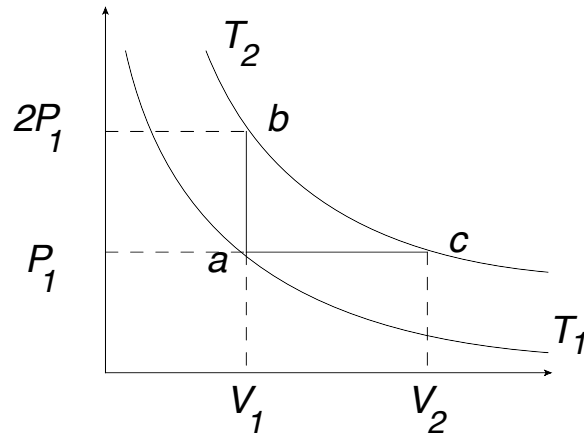


FIG. 1. LO diagrams.

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

(b)

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

$$2p_1 V_1 = nRT_2, \quad P_1 V_2 = nRT_2 \Rightarrow V_2 = 2V_1$$

$$W_{bc} = nRT_2 \ln 2 = 2 \ln 2 \frac{P_1 V_1}{R} = 1.1 \times 10^6 J, \quad W_{ca} = -P_1 V_1 = -8 \times 10^5 J$$

$$\Rightarrow W = 3.1 \times 10^5 J$$

Problem 3-35 solution

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

(a)

$$W = nRT \ln \frac{V_f}{V_i} - f(d_1 - d_2) = nRT \ln 0.9 - f \frac{0.1V_1}{A} = nRT \ln 0.9 - f \frac{0.1nRT}{P_1 A} \simeq -5.25 \times 10^4 J$$

(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)

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