17.6. Model: Helium is an ideal gas that undergoes isobaric and isothermal processes.
Solve: **(a)** Since the pressure ($p_i = p_f = p$) is constant the work done is

$$W_{\text{on gas}} = -p\Delta V = -p(V_f - V_i) = -\frac{nRT_i}{V_i}\left(V_f - V_i\right)$$

$$= -(0.10 \text{ mol})(8.31 \text{ J/mol K})(573 \text{ K})\frac{\left(1000 \text{ cm}^3 - 2000 \text{ cm}^3\right)}{2000 \text{ cm}^3} = 238 \text{ J}$$

(b) For compression at a constant temperature,

$$W_{\text{on gas}} = -nRT \ln\left(V_f / V_i\right)$$

$$= -(0.10 \text{ mol})(8.31 \text{ J/mol K})(573 \text{ K})\ln\left(\frac{1000 \times 10^{-6} \text{ m}^3}{2000 \times 10^{-6} \text{ m}^3}\right) = 330 \text{ J}$$

(c) For the isobaric case,

$$p = \frac{nRT_i}{V_i} = 2.38 \times 10^5 \text{ Pa}$$

For the isothermal case, $p_i = 2.38 \times 10^5$ Pa and the final pressure is

$$p_f = \frac{nRT_f}{V_f} = 4.76 \times 10^5 \text{ Pa}$$