

Given:

Helium gas is compressed by an adiabatic compressor from an initial state of 14 psia and 50°F to a final temperature of 320°F in a reversible manner.

$$P_1 := 14 \text{ psi} \quad T_1 := 50 \text{ }^\circ\text{F} = 509.7 \text{ }^\circ\text{Ra} \quad T_2 := 320 \text{ }^\circ\text{F} = 779.7 \text{ }^\circ\text{Ra}$$

Required:

Determine the pressure of the helium at the exit.

Solution:

Going to Table A-2E @ Helium shows

$$k_{He} := 1.667$$

Since the compressor is adiabatic (i.e., no Q) and it operates in a reversible manner, the compressor is isentropic (i.e., $\Delta s = 0$). Thus the following relationship is true.

$$\left(\frac{T_2}{T_1} \right)_{s=\phi} = \left(\frac{P_2}{P_1} \right)^{\frac{k-1}{k}}$$

Rearranging yields

$$P_2 := P_1 \cdot \left(\frac{T_2}{T_1} \right)^{\frac{k_{He}}{k_{He}-1}} = 40.51 \text{ psi}$$