Name: **Solution**

Problem #1

Determine the polytropic index for a process where 0.25 [kg] of air, initially at 25 °C and 150 [kPa], reaches a final state where the volume is double the initial and the temperature is three times higher than the initial.

To determine the polytropic index, we need both pressure and volume at the initial and final states. To determine the volume at State 1:

$$P_1 \forall_1 = mRT_1 \implies \forall_1 = \frac{mRT_1}{P_1} = \frac{(0.25\,[\text{kg}])(0.287\,[\text{kJ/kg-K}])(298.15\,[\text{K}])}{(150\,[\text{kPa}]} = 0.1426\,[\text{m}^3]$$

The pressure at State 2 is found by relating mass:

$$P_2 = P_1 \left(\frac{\forall_1}{\forall_2}\right)\left(\frac{T_2}{T_1}\right) = (150\,[\text{kPa}])\left(\frac{1}{2}\right)(3) = 225\,[\text{kPa}]$$

Thus, the polytropic index is found via:

$$n = \frac{\ln\left(\dfrac{P_1}{P_2}\right)}{\ln\left(\dfrac{\forall_2}{\forall_1}\right)} = \frac{\ln\left(\dfrac{(150\,[\text{kPa}])}{(225\,[\text{kPa}])}\right)}{\ln\left(\dfrac{2\forall_1}{\forall_1}\right)} = -0.585$$