89. (a) The work done in a constant-pressure process is $W = p\Delta V$. Therefore,

$$W = \left(25\,\mathrm{N/m^2}\right)\left(1.8\,\mathrm{m^3} - 3.0\,\mathrm{m^3}\right) = -30\ \mathrm{J}\ .$$

The sign conventions discussed in the textbook for Q indicate that we should write -75 J for the energy which leaves the system in the form of heat. Therefore, the first law of thermodynamics leads to

$$\Delta E_{\mathrm{int}} = Q - W = (-75\,\mathrm{J}) - (-30\,\mathrm{J}) = -45\ \mathrm{J}\ .$$

(b) Since the pressure is constant (and the number of moles is presumed constant), the ideal gas law in ratio form (see Sample Problem 20-1) leads to

$$T_2 = T_1\left(\frac{V_2}{V_1}\right) = (300\,\mathrm{K})\left(\frac{1.8\,\mathrm{m^3}}{3.0\,\mathrm{m^3}}\right) = 180\ \mathrm{K}\ .$$

It should be noted that this is consistent with the gas being monatomic (that is, if one assumes $C_V = \frac{3}{2}R$ and uses Eq. 20-45, one arrives at this same value for the final temperature).