Summary

The energy balance for *any system* undergoing *any process* can be expressed as:

$$\underbrace{E_{in} - E_{out}}_{\text{Net energy transfer by heat, work, and mass}} = \Delta E_{system}$$

For a *closed system*, there is no mass transfer and the energy balance becomes:

$$(Q_{in} - Q_{out}) + (W_{in} - W_{out}) = \Delta E_{system}$$

where

$$\Delta E_{system} = \Delta U + \Delta KE + \Delta PE$$
$$\Delta U = m(u_2 - u_1)$$
$$\Delta KE = \frac{1}{2} m(V_2^2 - V_1^2)$$
$$\Delta PE = mg(z_2 - z_1)$$

The *ideal-gas equation of state* is given as:

$$PV = mRT$$

For an *ideal gas* with constant specific heats:

$$u_2 - u_1 = c_{v,av}(T_2 - T_1)$$

Question

Consider a rigid, insulated tank with a movable piston. Initially side A contains 25 kg of air at 250°C and 500 kPa, while side B contains 5 kg of air at 70°C and 50 kPa. The piston then moves to a new position where the pressures on each side will be equal. Since the piston is NOT adiabatic, the temperatures on each side will eventually equalize.

a) Determine the final temperature
b) Determine the final pressure