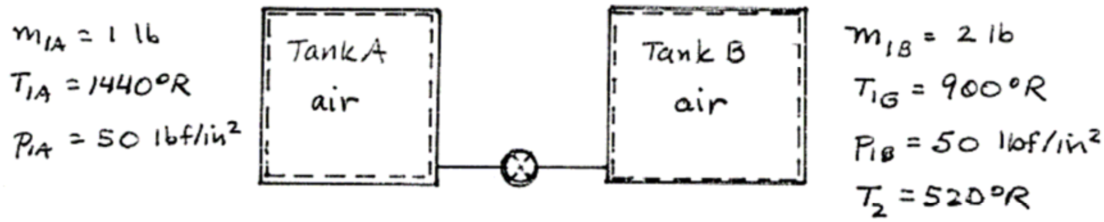
PROBLEM 3.125

KNOWN: The contents of two uninsulated tanks are allowed to mix, and equilibrium is attained at the temperature of the surroundings.

FIND: Determine the amount of energy transfer by heat and the final pressure.

SCHEMATIC & GIVEN DATA:



ENGR. MODEL: (1) The contents of the two tanks are a closed system. (2) There is no work. (3) The air behaves as an ideal gas. (4) Kinetic and potential energy effects can be neglected.

ANALYSIS: To find the heat transfer, begin with the energy balance.

$$\Delta KE^{\,0} + \Delta PE^{\,0} + \Delta U = Q - W^{\,0}$$

Since the final state is an equilibrium state

$$\Delta U = (m_{1A} + m_{1B})u_2 - (m_{1A}u_{1A} + m_{1B}u_{1B})$$

Thus

$$Q = (m_{1A} + m_{1B})u_2 - (m_{1A}u_{1A} + m_{1B}u_{1B})$$

Using data from Table A-22E

$$Q = (3\text{ lb})(88.62\text{ Btu/lb}) - [(1)(254.66) + (2)(154.57)]$$

$$= -297.9\text{ Btu} \longleftarrow Q$$

To find the final pressure, first determine the volume of each tank

$$V_A = \frac{m_{1A} R T_{1A}}{p_{1A}} = \frac{(1\text{ lb})\left(\frac{1545}{28.97}\frac{\text{ft}\cdot\text{lbf}}{\text{lb}\cdot°R}\right)(1440°R)}{(50\text{ lbf/in}^2)\left|144\text{ in}^2/1\text{ ft}^2\right|} = 10.66\text{ ft}^3$$

$$V_B = \frac{(2)\left(\frac{1545}{28.97}\right)(900)}{(50)\left|144/1\right|} = 13.33\text{ ft}^3$$

Thus, at the final state

$$p_2 = \frac{mRT_2}{(V_A + V_B)} = \frac{(3)\left(\frac{1545}{28.97}\right)(520)}{(10.66 + 13.33)\left|144/1\right|} = 24.07\text{ lbf/in}^2 \longleftarrow p_2$$