

Problem 2:

- Given: - 0.5 kg of propane initially at 4 bar and 30°C undergoes a process to 14 bar and 100°C
- Heat transfer occurs with the surroundings at 20°C through a thin wall
 - Net work is -72.5 kJ
 - $\Delta KE = \Delta PE = 0$

Determine: Is this net work possible?

$$\Delta \dot{S} = \dot{Q} \frac{1}{T_b} + \sigma \quad \sigma = m(s_2 - s_1) - \frac{Q}{T_b}$$

$$m(u_2 - u_1) = Q - W$$

Table A-18 @ 4 bar + 30°C $\Rightarrow u_1 = 472.2 \text{ kJ/kg}$, $s_1 = 1.969 \text{ kJ/kg}\cdot\text{K}$

@ 14 bar + 100°C $\Rightarrow u_2 = 577.9 \text{ kJ/kg}$, $s_2 = 2.0921 \text{ kJ/kg}\cdot\text{K}$

$$(0.5 \text{ kg})(577.9 \text{ kJ/kg} - 472.2 \text{ kJ/kg}) = Q - (-72.5 \text{ kJ})$$

$$Q = -19.65 \text{ kJ}$$

$$T_b = 20^\circ\text{C} + 273 = 293 \text{ K}$$

$$\sigma = (0.5 \text{ kg}) (2.092 \text{ kJ/kg}\cdot\text{K} - 1.969 \text{ kJ/kg}\cdot\text{K}) - \frac{(-19.65 \text{ kJ})}{293 \text{ K}}$$

$$\sigma = 0.12856 \text{ kJ/K} > 0 \quad \underline{\text{O.K.}}$$