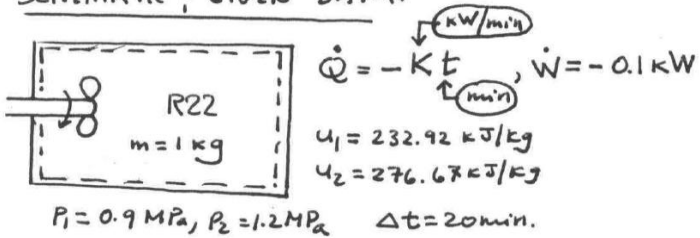


## PROBLEM 2.64

**KNOWN:** Data are provided for a rigid, closed tank fitted with a paddle wheel. The tank contains Refrigerant 22.

**FIND:** (a)  $Q$  and  $W$  for the refrigerant. (b) Evaluate the constant  $K$  in the heat transfer relation provided.

**SCHEMATIC & GIVEN DATA:**



**ENGR. MODEL:**

1. The Refrigerant 22 is the closed system.
2. No overall changes in kinetic or potential energy occur.

**ANALYSIS:** (a)  $W = \int_1^2 \dot{W} dt = -(0.1 \text{ kW})(20 \text{ min}) \left| \frac{60 \text{ s}}{1 \text{ min}} \right| \left| \frac{1 \text{ kJ/s}}{1 \text{ kW}} \right| = -120 \text{ kJ}$  ←

Energy Balance:

$$\Delta U + \cancel{\Delta KE} + \cancel{\Delta PE} = Q - W \Rightarrow Q = \Delta U + W \Rightarrow Q = m(u_2 - u_1) + W$$

$$\therefore Q = 1 \text{ kg} (276.67 - 232.92) + (-120 \text{ kJ}) = -76.25 \text{ kJ}$$
 ←

(b)  $Q = \int_1^2 \dot{Q} dt = \int_0^t -Kt dt = -\frac{Kt^2}{2} \Rightarrow$

$$K = -\frac{2Q}{t^2} = -\frac{2(-76.25 \text{ kJ})}{(20 \text{ min})^2} \left| \frac{1 \text{ kW}}{1 \text{ kJ/s}} \right| \left| \frac{1 \text{ min}}{60 \text{ s}} \right|$$

$$= 6.354 \times 10^{-3} \frac{\text{kW}}{\text{min}}$$
 ←