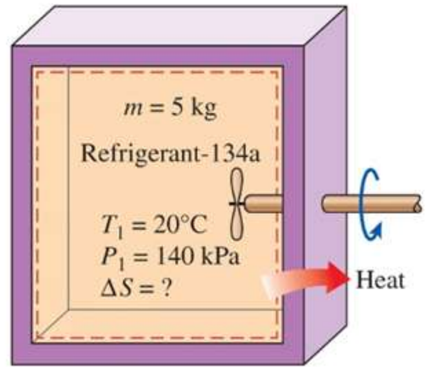
Given:
A rigid tank contains 5 kg of R-134a initially at 20°C and 140 kPa. The R-134a is now cooled while being stirred until its pressure drops to 100 kPa.



Required:
Determine the entropy change of the R-134a during this process.

Solution:
The mass of the R-134a is defined as

$$m_{R134a} := 5\ \text{kg}$$

The initial conditions are defined as

$$T_1 := 20\ °\text{C} = 293.15\ \text{K} \qquad P_1 := 140\ \text{kPa}$$

The final pressure is defined as

$$P_2 := 100\ \text{kPa}$$

Going to Table A-11 @ $T_1 = 20.00\ °\text{C}$ shows

$$P_{sat} := 572.07\ \text{kPa}$$

Since $P_{sat} > P_1$, the state is superheated. Going to Table A-13 @ $T_1 = 20.00\ °\text{C}$ and $P_1 = 0.1400\ \text{MPa}$ shows

$$v_1 := 0.16544\ \frac{\text{m}^3}{\text{kg}} \qquad s_1 := 1.0624\ \frac{\text{kJ}}{\text{kg K}}$$

Since the control volume is a closed system and the tank is rigid,

$$v_2 := v_1 = 0.1654\ \frac{\text{m}^3}{\text{kg}}$$

Going to Table A-12 @ $P_2 = 100.0\ \text{kPa}$ shows

$$v_f := 0.0007259\ \frac{\text{m}^3}{\text{kg}} \qquad v_g := 0.19254\ \frac{\text{m}^3}{\text{kg}} \qquad s_f := 0.07188\ \frac{\text{kJ}}{\text{kg K}} \qquad s_g := 0.95183\ \frac{\text{kJ}}{\text{kg K}}$$

Since vvv the state is in the two phase region so

$$x_2 := \frac{v_2 - v_f}{v_g - v_f} = 0.8587$$

The specific entropy at state 2 is then

$$s_2 := s_f + x_2 \cdot \left(s_g - s_f\right) = 0.8275\ \frac{\text{kJ}}{\text{kg K}}$$

The entropy change for the process is then

$$\boxed{\Delta S := m_{R134a} \cdot \left(s_2 - s_1\right) = -1.174\ \frac{\text{kJ}}{\text{K}}}$$