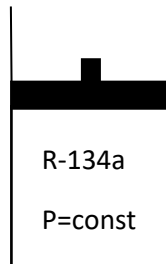


# ME211 THERMODYNAMICS I

## Quiz #2-Soln

A frictionless piston-cylinder initially contains  $0.1 \text{ m}^3$  saturated liquid refrigerant R-134a. The piston is free to move, and its mass is such that, it maintains a pressure of  $1 \text{ MPa}$  on the refrigerant. The refrigerant is now heated until its temperature rises to  $60^\circ \text{C}$ .

- Find the initial temperature of the refrigerant
- Find the work done during the process.
- Draw the P-v and T-v diagrams with respect to saturation lines



Solution.

R134a State 1  $P_1 = 1 \text{ MPa} = 10 \text{ bar}$   
 saturated liquid  
 From Table A.11  
 $T_1 = 39.39^\circ \text{C}$   
 $v_1 = v_f @ 10 \text{ bar} = 0.8695 \cdot 10^{-3} \text{ m}^3/\text{kg}$

State 2  $P_2 = 1 \text{ MPa} = 10 \text{ bar}$   
 $T_2 = 60^\circ \text{C}$   
 From Table A.12  
 $v_2 = 0.0231 \text{ m}^3/\text{kg}$

$$m = \frac{V_1}{v_1} = \frac{0.1}{0.8695 \cdot 10^{-3}} = 115 \text{ kg}$$

$$W_b = \int_{v_1}^{v_2} P dV = \int_{v_1}^{v_2} P \cdot m \cdot dv = P \cdot m \cdot (v_2 - v_1)$$

$$\Rightarrow W_b = 1000 \cdot 115 (0.0231 - 0.8695 \cdot 10^{-3})$$

$$\Rightarrow W_b = \underline{\underline{2556.7 \text{ kJ}}}$$

