Given: $kJ := 1000J$

A Carnot refrigeration cycle is executed in a closed system in the saturated liquid-vapor mixture region using 0.8 kg of R-134a as the working fluid. The maximum and minimum temperatures in the cycle are 20°C and -8°C, respectively. It is known that R-134a is a saturated liquid at the end of the heat rejection process, and the net work input to the cycle is 15 kJ.

Required:

Determine the mass that vaporizes during the heat addition process and the pressure at the end of the heat rejection process.

Solution:

The maximum and minimum temperatures in the cycle are defined as

$$T_H := 20\,°C = 293.15\,K \qquad T_L := (-8)\,°C = 265.15\,K$$

The net work input to the cycle is defined as

$$W_{net,in} := 15kJ$$

The COP of the cycle is found by

$$COP_{R,rev} := \frac{1}{\frac{T_H}{T_L} - 1} = 9.47$$

The heat accepted by the cycle is found by

$$Q_{L,rev} := COP_{R,rev} \cdot W_{net,in} = 142.045 \cdot kJ$$

Going to Table A-11 @ $T_L = -8 \cdot °C$ shows that the amount of energy to varporize R-134a is

$$h_{fg} := 204.52 \frac{kJ}{kg}$$

Thus the mass that varporizes in the cycle is given by

$$\boxed{m_{vap} := \frac{Q_{L,rev}}{h_{fg}} = 0.695\,kg}$$

The pressure at the end of the heat rejection process is then just the saturation pressure at the minimum temperature so going to Table A-11 @ $T_H = 20 \cdot °C$ shows

$$P_{sat} := 572.07kPa \qquad \text{so} \qquad \boxed{P_4 := P_{sat} = 572.1 \cdot kPa}$$