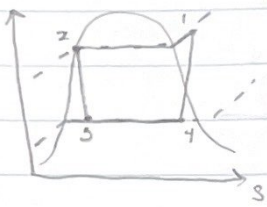
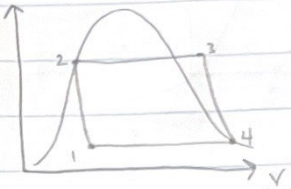
Chpt 11 - 11, 21, 43 Kayla - 17, 38, 44

11) T




P




1 ~isen~> 2 ~t=con~> 3 ~isen~> 4 ~t=con~>

$P = 20$ psia — $s_1 = s_2$ — $h_3$ @ 80 psia — $h_3 = h_4$

R-134a table — interpolation — $= 33.391$

$h_1 = 102.74$ — $h_2 = 115.02$

$s_1 = 0.2257$

$$Q_L = m_{ice} \Delta_{ice} \Rightarrow \frac{15}{3{,}600} \cdot 169 = 0.7042 \frac{Btu}{s}$$

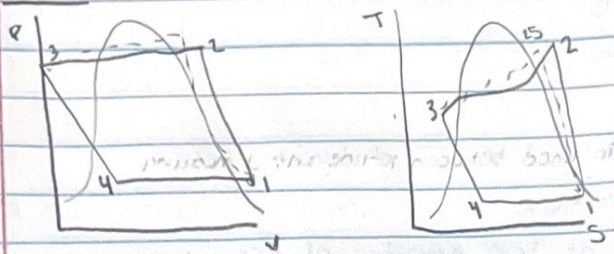
$$m_r = \frac{Q_L}{h_1 - h_4} \Rightarrow \frac{0.7042}{(102.74 - 33.39)} = 0.01015 \frac{lbm}{s}$$

$$W = m_r (h_2 - h_1) \Rightarrow 0.01015 (115.02 - 102.74) = 0.12642 \frac{Btu}{s}$$

$$0.12642 \frac{Btu}{s} \; \frac{1.4148532}{1 \frac{Btu}{s}} = 0.1789 \text{ hp}$$

HW 3.1 - MET350-

11-17




$\dot{m} = 0.07$ kg/s

| ① | ② | ③ | ④ |
|---|---|---|---|
| $P_1 = 0.20$ mPa | $P_2 = 1.2$ mPa | $P_3 = 1.15$ mPa | $h_4 = h_3$ |
| $T_1 = -5°C$ | $T_2 = 70°C$ | $T_3 = 44°C$ | |
| $h_1 = 248.8 \frac{kJ}{kg}$ | $h_2 = 300.61$ | $h_3 = 114.28$ | |
| $S_1 = 0.9539$ | $S_{2S} = S_1$ | | |
| | $h_{2S} = 287.18$ | | |

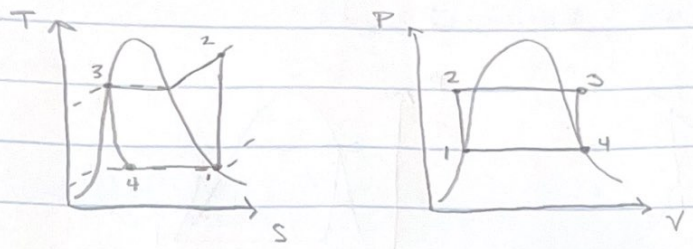
A) $Q_L = \dot{m}(h_1 - h_4) = 0.07(248.8 - 114.28) = \boxed{9.42 \text{ kW}}$

$\dot{W}_{in} = \dot{m}(h_2 - h_1) = 0.07(300.61 - 248.8) = \boxed{5.03 \text{ kW}}$

B) $\eta_{compressor} = \frac{h_{2S} - h_1}{h_2 - h_1} = \frac{287.18 - 248.8}{300.61 - 248.8} = 0.73$ $\boxed{73\%}$

C) $COP_R = \frac{Q_L}{W_{in}} = \frac{9.42}{3.63} = \boxed{2.59}$

21)




| 1 | 2 | 3 | 4 |
|---|---|---|---|
| $P_1 = 120 kPa$ | $T_2 = 70^c$ | $h_3 = h_4$ | $P_4 = 120 kPa$ |
| R-134a table | | | |
| $h_f = 22.49$ | $h_2 = 306.88 \frac{kJ}{kg}$ | $P_3 = 800 kPa$ | $h_g = 236.97$ |

$h_4 = h_f + (x_4(h_g - h_f)$

$h_4 = (22.49) + (0.34(236.97 - 22.49))$

$h_4 = 95.41 \frac{kJ}{kg}$

$W_{comp} = m(h_2 - h_1)$

$m = \frac{450}{(306.88 - 236.97) \times 10^3}$

$m = 0.00644 \frac{kg}{s}$

$COP = \frac{h_1 - h_4}{h_2 - h_1} \Rightarrow \frac{(236.97 - 95.41)}{(306.88 - 236.97)} = 2.026$

HW 3.1 - MET 350

11-38

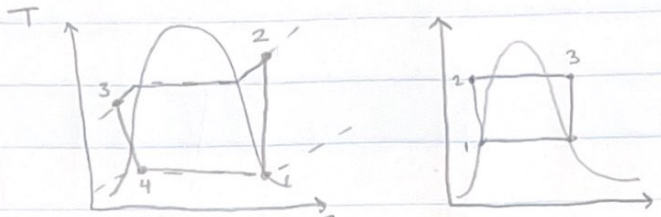
refrigerated space temp: -10°C

ambient temp: 25°C

*temp difference should be maintained between refridgerant & medium

In order to have an efficient heat transfer of 10°C, temps should be -20°C for refrig. and 35°C for ambient. Using the tables, the pressure at these temps is 0.888 MPa & 0.133 mPa. These are the suggested pressures for the condenser & evaporator.

43)




1 isen → 2 t=con → 3 isent → 4 t=con

$P_1 = 572.1\ kPa$ $P_2 = 1400 kPa$ $h_3 = h_4$ $T_4 = 20^\circ C$ R-134a table

$h_1 = 261.59 \frac{kJ}{kg}$ $h_2 = 280.00 \frac{kJ}{kg}$ $P_3 = 1400 kPa$ $x_4 = 0.23$

$x_1 = 1$ (sat vapor) $S_2 = S_1$ $h_3 = 121.24$ $h_4 = 121.24$

$S_1 = 0.9223 \frac{kJ}{kg}$ $T_3 = 48.59^\circ C$ $P_4 = 572.1 kPa$

Steam table A-4

$h_{w_1} = h_f @ 50^\circ C = 209.34 \frac{kJ}{kg}$ $T_{sat} @ 1400 kPa = 52.40^\circ C$

$h_{w_2} = h_f @ 40^\circ C = 167.53 \frac{kJ}{kg}$

$\Delta T_{subcool} = T_{sat} - T_3 = 52.40 - 48.59 = 3.81^\circ C$

$Q_L = m_w (h_{w_1} - h_{w_2}) \Rightarrow (0.065)(209.34 - 167.53)$

$Q_L = 2.718 kW$

$m_r = \frac{Q_L}{h_1 - h_4} = \frac{2.718}{(261.59 - 121.24)} = 0.01936 \frac{kg}{s}$

$W_{in} = m_r (h_2 - h_1) \Rightarrow (0.01936)(280 - 261.59)$

$= 0.6564 kW$

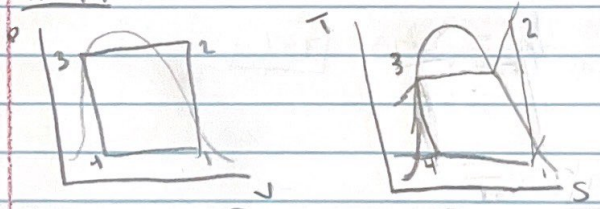
$Q_H = m_r (h_2 - h_3) \Rightarrow (0.01936)(280 - 121.24) = 3.074 kW$

$COP = \frac{Q_H}{W_{in}} \Rightarrow \frac{3.074}{0.6564} = 4.68$

$COP_{revers} = \frac{T - T_L}{T_H} \Rightarrow \frac{1}{1 - \frac{25+273}{50+273}} = 12.92$

$W_{in\,min} = \frac{Q_H}{COP_{rev}} \Rightarrow \frac{3.074}{12.92} = 0.238 kW$

11-44




| ① | ② | ③ | ④ |
|---|---|---|---|
| $P_1 = 200$ kPa | $P_2 = 300$ kPa | $P_3 = 750$ kPa | $h_4 = h_3$ |
| $T_{sat} = -10.09°C$ | $T_2 = 50°C$ | $T_{sat} = 29.06°C$ | |
| $T_1 = -6.09°C$ | $h_2 = 287$ | $T_3 = 26.06°C$ | |
| $h_1 = 247.87$ | $h_{2s} = 277.26$ | $h_3 = 87.91$ | |
| $s_1 = 0.95$ | $s_2 = s_1$ | | |

A) $\eta_c = \frac{h_{2s} - h_1}{h_2 - h_1} = \frac{277.6 - 247.87}{287 - 247.87} = 0.75$ **75%**

B) $Q_H = \dot{m}(h_2 - h_3) = 0.022(287 - 87.91) =$ **4.37 kW**

C) $W_{in} = \dot{m}(h_2 - h_1) = 0.022(287 - 247.87) =$ 0.86 kW

$COP = \frac{4.37}{0.86} =$ **5.08**

D) $h_1 = h_g = 244.96$ @ 200 kPa

$s_1 = s_g = 0.9377$

$P_2 = 300$ kPa $\rightarrow h_2 = 273.25$ kJ/kg

$h_3 = h_f = 95.47$ @ 300 kPa

$COP = \frac{273.25 - 95.47}{273.25 - 244.46} =$ **6.18**

$Q_H = 0.022(273.25 - 95.47)$

$Q_H =$ **3.92 kW**