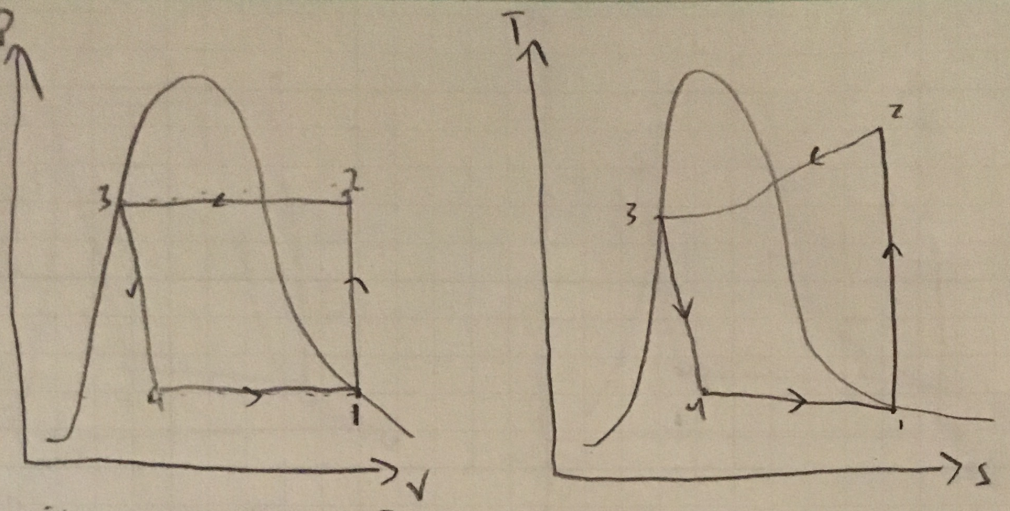
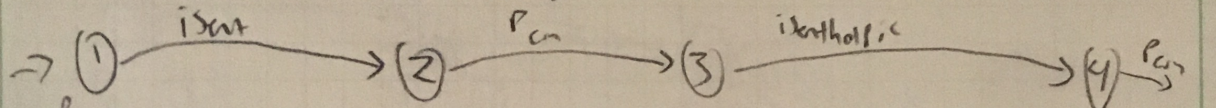
HW 3.1 Ch. 11 # 11, 17, 21, 38, 43, 49

11.11)





$P_1 = 20$ psi
$T_1 = 55°F$

$P_2 = 80$ psi

$P_3 = 60$ psi

$P_4 = 20$ psi

Tables

$h_1 = 102.74$ Btu/lbm

$h_2 = 115.01$ Btu/lbm

$h_3 = 33.39$ Btu/lbm

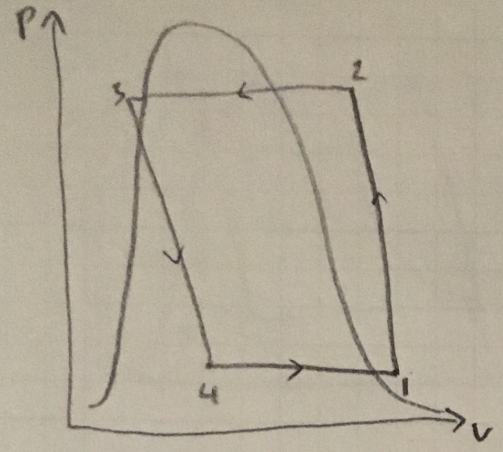
$h_4 = 33.39$ Btu/lbm

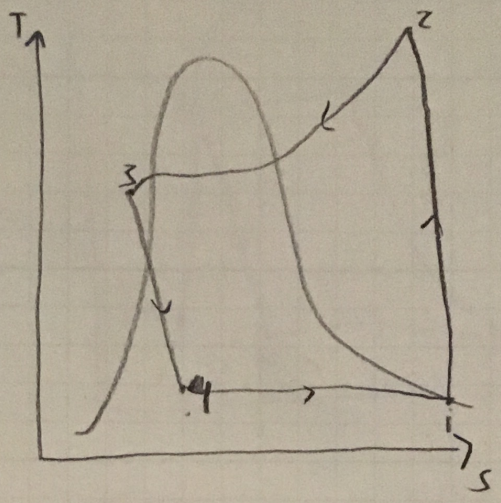
$$Q_L = \dot{m}_{ice}(\Delta h)_{ice} = (15/360 \text{ lbm/s})(169 \text{ Btu/lbm}) = .7042 \text{ Btu/s}$$

$$\dot{m}_e = \frac{Q_L}{h_1 - h_4} = \frac{.7042}{102.74 - 33.39} = .01015 \text{ lbm/s}$$

$$\dot{W}_{in} = \dot{m}_e(h_2 - h_1) = (.01015)(115.01 - 102.74)\left|\frac{1 \text{ hr}}{.7068 \text{ Btu/s}}\right. = .176 \text{ hp}$$

11.17)





① → ② → ③ → ④

$T_1 = -5°C$ $T_2 = 70°C$ $T_3 = 44°C$ $P_4 = .21 MPa$

$P_1 = .2 MPa$ $P_2 = 1.2 MPa$ $P_3 = 1.15 MPa$

Superheated tables

$h_1 = 248.745 \text{ kJ/kg}$ $h_2 = 300.61 \text{ kJ/kg}$ $h_3 = 114.30 \text{ kJ/kg}$ $h_4 = 114.30 \text{ kJ/kg}$

$s_1 = .9537 \text{ kJ/kg-K}$ $s_2 = .9936 \text{ kJ/kg-K}$

a) $\dot{Q}_L = \dot{m} q_L = \dot{m}(h_1 - h_4)$

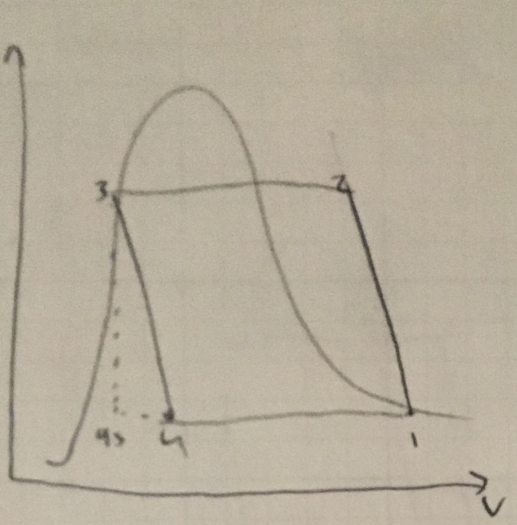
$= .07(248.745 - 114.30) = 9.4161 \text{ kW}$

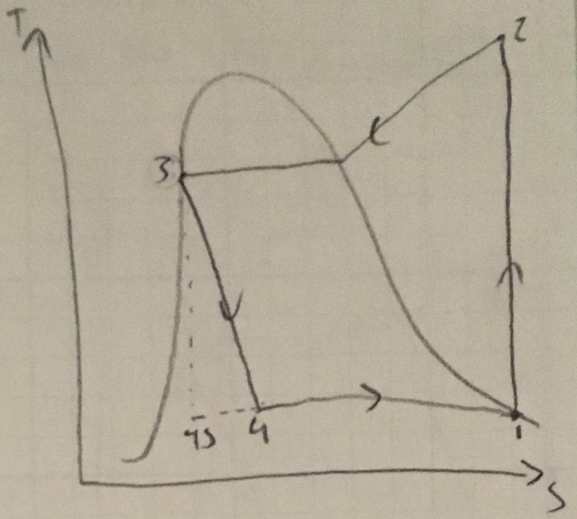
$\dot{W}_{in} = \dot{m} W_{in} = \dot{m}(h_2 - h_1) = .07(300.61 - 248.745) = 3.6271 \text{ kW}$

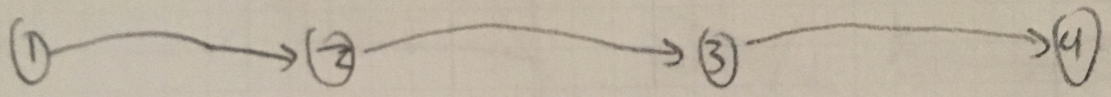
b) $\eta = \frac{h_{2s} - h_1}{h_2 - h_1} = \frac{287.102 - 248.745}{300.61 - 248.745} = .7409$

c) $COP = \frac{q_L}{w_{in}} = \frac{Q_L}{W_{in}} = \frac{9.4161}{3.6271} = 2.596$

11.21)







$P_1 = 120 kPa$ $P_2 = 799 kPa$ $P_3 = 799 kPa$ $P_4 = 120 kPa$

$x_1 = 1$ $T_2 = 70°C$ $x_3 = 0$ $x_4 = .34$

Saturated table

$h_1 = 236.04 kJ/kg$ $h_2 = 306.92 kJ/kg$ $h_3 = 95.41 kJ/kg$ $h_4 = 95.41 kJ/kg$

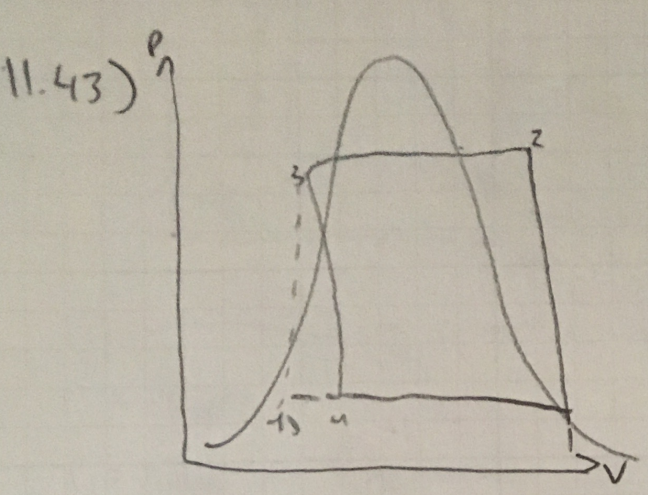
a) $\dot{m} = \frac{\dot{W}_{in}}{h_2 - h_1} = \frac{.45 kW}{306.92 - 236.04} = .00635 kg/s$

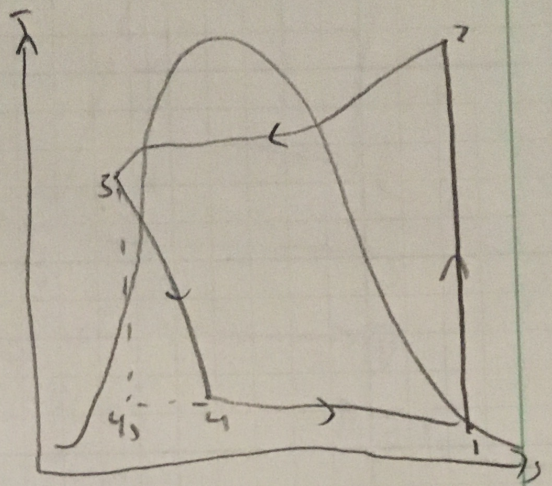
b) $\dot{Q}_L = \dot{m}(h_1 - h_4) = (.00635 kg/s)(236.04 - 95.41) = .911 kW$

c) $COP = \frac{\dot{Q}_L}{\dot{W}_{in}} = \frac{.911 kW}{.45 kW} = 2.03$

11.38)
Condenser Pressure between .1353 MPa —— .888 MPa for compressing refrigerant.

11.43)





(1) → (2) → (3) → (4)

$P_1 = 572.1 kPa$

$x_1 = 1$

$h_1 = 261.64 kJ/kg$

$s_1 = .9225 kJ/kg K$

$h_{w1} = 209.34 kJ/kg$

$P_2 = 1400 kPa$

$h_2 = 280.05 kJ/kg$

$h_{w2} = 167.53 kJ/kg$

$P_3 = 1400 kPa$

$h_3 = 121.25 kJ/kg$

$h_4 = 572.1 kPa$

$x_4 = .23$

$h_4 = 121.25 kJ/kg$

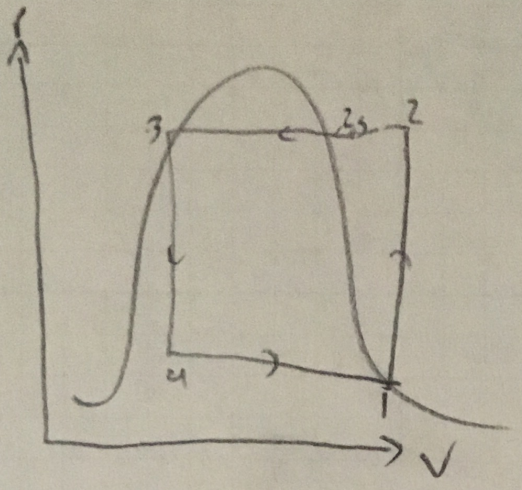
a) $\Delta T_{sub} = T_{3at} - T_3 = 52.40°C - 48.50°C = 3.02°C$

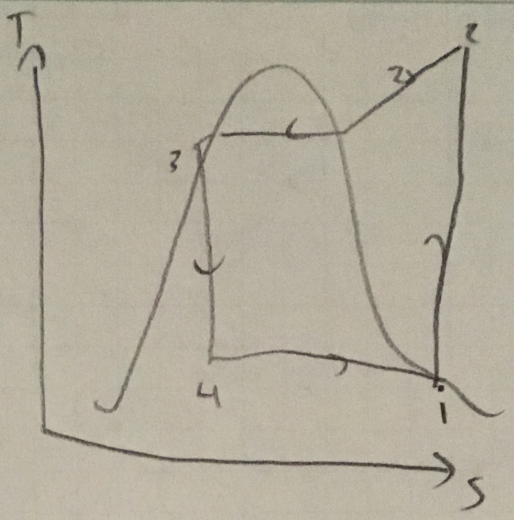
b) $\dot{Q}_L = \dot{m}_w (h_{w1} - h_{w2}) = (.065 kg/s)(209.34 - 167.53) = 2.716 kW$

c) $COP = \frac{q_H}{w_{in}}$

d) =

11.99)





① → ② → ③ → ④

$T_1 = -6.0°C$ $T_2 = 50°C$ $T_3 = 26.9°C$ $P_4 = P_1$

$P_1 = 240 kPa$ $P_2 = 800 kPa$ $P_3 = 750 kPa$

Tables

$h_1 = 247.88 kJ/kg$ $h_2 = 286.71 kJ/kg$ $h_3 = 87.93$ $h_4 = h_3$

$h_{2s} = 277.28$

a) $\eta_c = \dfrac{h_{2s} - h_1}{h_2 - h_1} = \dfrac{277.28 - 247.88}{286.71 - 247.88} = .757$

b) $\dot{Q}_{in} = \dot{m}(h_2 - h_3) = (.52 kg/s)(286.71 - 87.93)\ 4.373 kW$

c) $\dot{W}$