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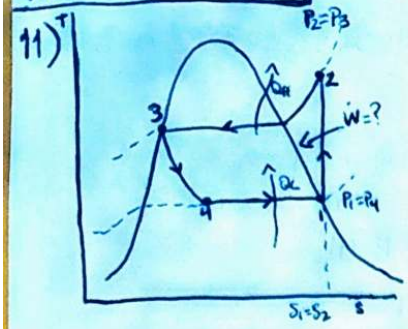
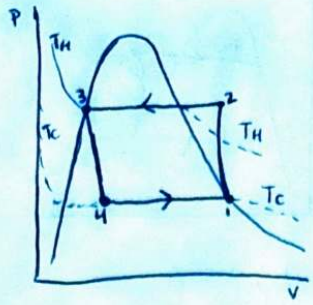
Submitting Member: Ryan Paul

MET 350 - HW 3.1

11)





Given: Refrigent R-134a

$P_1 = 20 psia$ $\quad h_1 = h_{fg@20psia} = 102.74 \frac{Btu}{lbm}$

$P_3 = 80 psia$ $\quad s_1 = s_{fg@20psia} = 0.2257 \frac{Btu}{lbm \cdot R}$

$T_1 = 55°F$

$T_2 = 25°F$

$\dot{m} = 15 \frac{lbm}{h}$

$q = 169 \frac{Btu}{lbm}$

$\dot{W} = ?$

$$h_2 = h_L + \frac{(h)_H - (h)_L}{(s)_H - (s)_L} \cdot [s_1 - (s)_L] = 115.51 + \frac{112.22 - 115.51}{0.22045 - 0.22663} \cdot (0.2257 - 0.22663)$$

$$h_2 = 115.0149 \frac{Btu}{lbm}$$

$h_3 = h_{f@80psia} = 33.391 \frac{Btu}{lbm}$

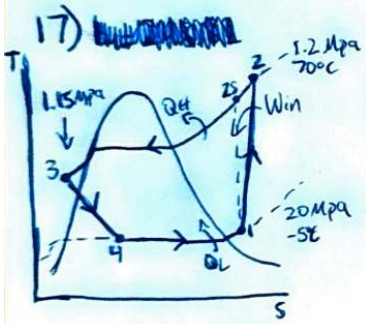
$\dot{Q}_{ice} = q \cdot \dot{m}$
$= (169) \cdot (15)$
$= 2535 \frac{Btu}{h}$

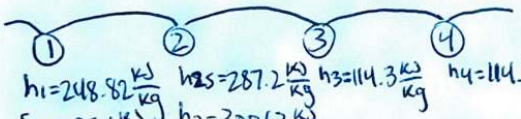
$\dot{m}_r = \frac{\dot{Q}_{ice}}{(h_1 - h_3)}$
$= \frac{2535}{(102.74 - 33.391)}$
$= 36.5542 \frac{lbm}{h}$

$\dot{W} = \dot{m}_r (h_2 - h_1)$
$= (36.5542) \cdot (115.0149 - 102.74)$

$\boxed{\dot{W} = 24.2793}$

17)





$h_1 = 248.82 \frac{kJ}{kg}$ $\quad h_{2s} = 287.2 \frac{kJ}{kg}$ $\quad h_3 = 114.3 \frac{kJ}{kg}$ $\quad h_4 = 114.3 \frac{kJ}{kg}$

$s_1 = 0.954 \frac{kJ}{kgK}$ $\quad h_2 = 300.63 \frac{kJ}{kg}$

$\dot{W} = \dot{m}(h_2 - h_1)$
$= 0.07(300.63 - 248.82)\ kW$

$\boxed{\dot{W} = 3.63\ kW}$

$Q_L = \dot{m}(h_1 - h_4)$
$= 0.07(248.82 - 114.3)\ kW$

$\boxed{Q_L = 9.42\ kW}$

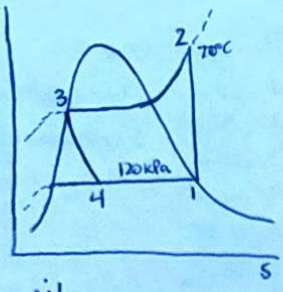
$$COP = \frac{\dot{Q}_L}{\dot{W}} = \frac{9.42}{3.63}$$

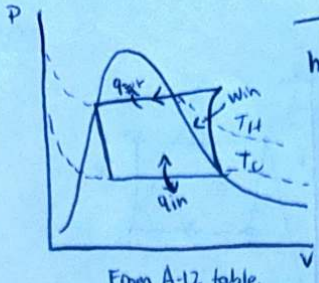
$\boxed{COP = 2.6}$

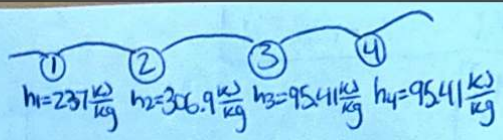
$$\eta_C = \frac{h_{2s} - h_1}{h_2 - h_1} = \frac{287.2 - 248.82}{300.63 - 248.82}$$

$\boxed{\eta_C = 0.741}$

21)







From A-12 table

a) $\dot{m} = \frac{\dot{W}}{h_2 - h_1} = \frac{0.45}{306.9 - 237}$

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

b) $P_2 = P_3$

$= 800 kPa$

$h_4 = h_3 = h_{liq,120} + q_{henP,120}$

$= (22.47 + 0.34 + 214.52) \frac{kJ}{kg}$

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

c) $COP = \frac{\dot{Q}_L}{\dot{W}} = \frac{h_1 - h_4}{h_2 - h_1}$

$= \frac{237 - 95.41}{306.9 - 237}$

$COP = 2.03$

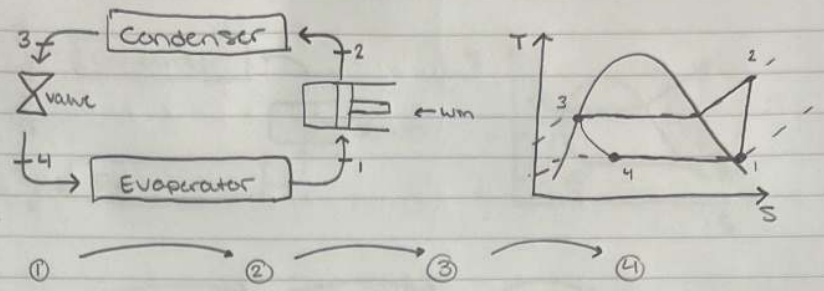
Thermal Apps Homework #38, 43, 44

11-38) Refrigerated space temp = -10°c
Ambient temp = 25°c

Temp difference is maintained through refridgerant

In order to have effecient heat transfer of 10°c, temp should be -20°c for refrigerant and 35°c for ambient. Using the tables the pressure temps is .888 Mpa + .133 mpa these are the suggested pressures for the condeser + evaporator.

#43)



① ② ③ ④

$P_1 = 572.1$ kpa $P_2 = 1400$ kpa $h_3 = h_4$ $T_4 = 20°C$

$h_1 = 261.64$ kJ/kg $s_2 = s_1$ $P_3 = 1400$ kpa $P_4 = 572.1$ kpa

$s_1 = .9225$ kJ/kg $h_2 = 280.05$ kJ/kg $h_3 = 121.25$ kJ/kg $x_4 = .23$

$x_1 = 1$ $T_3 = 48.58°C$ $h_4 = 121.25$ kJ/kg

$h_{w1} = h_f @ 50°C = 209.34$ kJ/kg

$h_{w2} = h_f @ 40°C = 169.53$ kJ/kg

$T_{sat} @ 1400$ kpa $= 52.40°C$

$\Delta T = T_{sat} - T_3 = 52.40 - 48.58 = \boxed{3.82°C}$

B) $Q_L = m_w(h_{w1} - h_{w2}) = 2.718$ kw

$m_R = \frac{Q_L}{h_1 - h_2} = \boxed{.01936 \text{ kg/s}}$

C) $W_m = m_R(h_2 - h_1) + Q_{out} = .6563$ kw

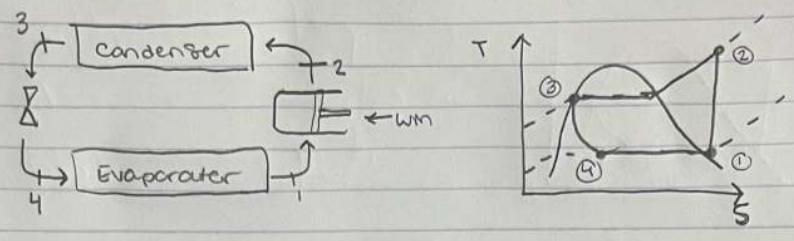
$Q_H = m_R(h_2 - h_3) = \boxed{3.074 \text{ kw}}$

$COP = Q_H / W_m = \boxed{4.68}$

D) $COP_{rev} = \frac{1}{1 - T_L/T_H} = 12.92$ $W_{m\,min} = \frac{Q_H}{COP_{rev}}$

$\boxed{W_{m\,min} = .238 \text{ kw}}$

11-44)



① → ② → ③ → ④

①	②	③	④
$P_1 = 200$ kpa	$P_2 = 800$ kpa	$T_3 = T_{sat}$	$h_4 = h_3$
$T_1 = -6.09°C$	$T_2 = 50°C$	$P_3 = 750$ kpa	
$h_1 = 247.88$ kJ/kg	$h_2 = 286.71$ kJ/kg	$T_3 = 26.09°C$	
$s_1 = .9507$ kJ/kg	$s_2 = s_1$	$h_3 = 87.93$ kJ/kg	
	$h_{2s} = 277.28$		

T_{sat} @ 200 kpa = -10.09°C

$\eta_C = \frac{h_{2s} - h_1}{h_2 - h_1} = \boxed{.757}$

B) $Q_H = \dot{m}(h_2 - h_3) = \boxed{4.373 \text{ kw}}$

C) $W_{in} = \dot{m}(h_2 - h_1) = .8542$ kw

$COP = \frac{Q_H}{W_{in}} = \boxed{5.12}$

D) $h_1 = h_g$ @ 200 kpa = 244.50 kJ/kg

$s_1 = s_g$ @ 200 kpa = .9378 kJ/kgK

$P_2 = 800$ kpa

$s_2 = s_1$

$h_2 = 273.29$ kJ/kg

$h_3 = h_f$ @ 800 kpa = 95.48 kJ/kg

$h_4 = h_3$

$COP = \frac{h_2 - h_3}{h_2 - h_1} = \boxed{6.18}$

$Q_H = \dot{m}(h_2 - h_3) = \boxed{3.91 \text{ kw}}$