

a)

$$h_1 = 2675$$

$$v_1 = 1.6941$$

$$\rightarrow h_2 = 2675 + 1.6941 (15 - 1) = 2700.2$$

$$h_3 = 2610.8$$

$$v_3 = .010341$$

$$\rightarrow h_4 = 2610.6$$

$$\eta_{TH} = 26\%$$

$$q_{in} = 89.4$$

$$W_{out} = 10.2$$

b) state 2:

$$.84 = \frac{2700.2 - 2675}{h_c - 2675}$$

$$h_c = \frac{2700.2 - 2675 + (2675) \cdot .84}{.84} = 2705$$

state 4:

$$.9 = \frac{2610.8 - h_u}{2610.8 - 2610.6} \rightarrow h_u = 2610.8 - .9(2610.8 - 2610.6) = 2610.6$$

$$q_{in} = -94.2 \quad W_{out} = .2 \quad \eta = 31.6\%$$

c)

$$h_1 = 3583.1$$

$$h_c = 2422.17 = h_f + x h_{fg}$$

$$s_1 = 6.6796 = s_2$$

$$h_u = 417.51 + x \cdot 2257.5$$

$$W_p = 15.541$$

$$W_T = 1160.93$$

$$\rightarrow W_{net} = 1145.39$$

$$q_{in} = 3165.6$$

$$\eta_{TH} = 36.2\%$$

d

$$s_2 = s_f + X s_{fg} \rightarrow X = 1.14$$

$$h_2 = 3054.49$$

$$\rightarrow h_3 = 3457.2$$

$$s_3 = 7.2359 = s_{f1}$$

$$s_4 = s_f + X s_{fg} \rightarrow X = .96$$

$$\rightarrow h_4 = 2629.46$$

$$w_{net} = (h_1 - h_2) + (h_3 - h_4) = 3442.93$$

$$q_{in} = \frac{w_{net}}{3442.9}$$

$$\eta_{TH} = 33.6\%$$

e)

$$X_2 = 1.06$$

$$h_2 = 2907.73$$

$$s_3 = s_f + X s_{fg} \rightarrow X_3 = .888 \rightarrow h_3 = 2422.17$$

$$h_4(y) + h_5(1-y) = h_6 \rightarrow y = .171$$

$$w_T = (h_1 - h_2) + (1-y)(h_2 - h_3) = 1243.96$$

$$w_p = 16.79 \rightarrow w_{net} = 1227.17 \quad q_{in} = 2722.97$$

$$\eta_{TH} = 45.1\%$$

2)

$$h_1 = 244.5$$

$$x_1 = .93788$$

$$h_2 = 267.34$$

$$x_2 = .91853$$

$$h_3 = h_4 = 94.8$$

$$a) \dot{W} = \dot{m} (h_2 - h_1) = 2.66$$

$$b) \dot{Q}_{in} = \dot{m} (h_1 - h_4) = 17.465 \text{ kW} = 4.97 \text{ tons}$$

$$c) \beta = 6.55$$