

Homework 12

7-22E $Q = 36,000 \text{ Btu/h}$ $T_1 = 70^\circ \text{F}$ $T_2 = 110^\circ \text{F}$
 $T_c = 20 + 459.67 = 579.67^\circ \text{R}$ $T_h = 110 + 459.67 = 569.67^\circ \text{R}$
 $DS_c = \frac{Q_c}{T_c} = \frac{36000}{579.67} = 62.107$

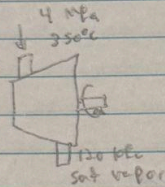
To find $DS_h \rightarrow \text{COP}_e = \frac{T_c}{T_h - T_c} = 17.24$ $W_{in} = \frac{Q_c}{\text{COP}_e} = \frac{36000}{17.24} = 2090.03$
 $Q_h = W_{in} + Q_c = 2090.03 + 36000 = 38090.03$
 $DS_h = \frac{-Q_h}{T_h} = \frac{-38090.03}{569.67} = -67.03$

7-50 $P_1 = 150 \text{ kPa}$ $T_1 = 120^\circ \text{C}$ $V_1 = 550$ $P_2 = 300 \text{ kPa}$ $Q = 0$
 Process is steady flow

From steam table, $P_1 = 150$ + $T = 120^\circ \text{C}$
 $h_1 = 2726.3 \text{ kJ/kg}$ $s_1 = 7.2901 \text{ kJ/kg} \cdot \text{K}$

Because isentropic $s_1 = s_2 = 7.2901$ $P_2 = 300 \text{ kPa}$ $h_2 = 2769.3$
 $0h + \frac{0V^2}{2} \rightarrow V_2 = \sqrt{V_1^2 - 2(h_2 - h_1)}$
 $V_2 = 459.54 \text{ m/s}$

8-23



At 4 MPa $350^\circ \text{C} \rightarrow h_1 = 3093.3 \text{ kJ/kg}$
 At 120 kPa $s_1 = s_2 \rightarrow s_1 = 7.5466 \text{ kJ/kg} \cdot \text{K}$
 $h_{2s} = 2654.5 \text{ kJ/kg}$ $h_2 = 2657.5$
 $\eta_t = \frac{h_1 - h_2}{h_1 - h_{2s}} = \frac{3093.3 - 2657.5}{3093.3 - 2654.5} = 0.77$

8-30E $P_1 = 14.7 \text{ psia}$ $V_1 = 60 \text{ ft/s}$ $P_2 = 200 \text{ psia}$ $V_2 = 240 \text{ ft/s}$ $T_1 = 750 \text{ R}$ $\eta_c = 0.87$

$\frac{T_{2s}}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}}$ $T_{2s} = 535 \text{ R}$ $\left(\frac{200}{14}\right)^{\frac{1.667-1}{1.667}}$
 $T_{2s} = 1019.6$

$\eta_c = \frac{T_{2s} - T_1}{T_2 - T_1} \rightarrow T_2 = T_1 + \frac{T_{2s} - T_1}{\eta_c}$
 $T_2 = 535 + \frac{1019.6 - 535}{0.87} = 1092 \text{ R}$

$T_2 = 632 \text{ F}$

$W_{in} = cp(T_2 - T_1) + \frac{V_2^2 - V_1^2}{2}$ $cp = 0.1245$

$W_{in} = 0.1245 \cdot 552 \text{ R} + \frac{240^2 - 60^2}{2}$

$W_{in} = 270.42 \text{ Btu/lbm}$