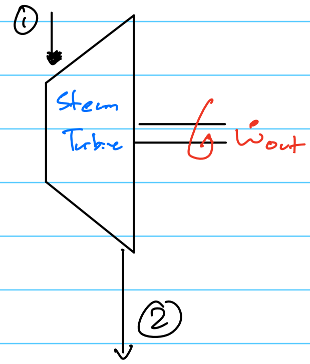
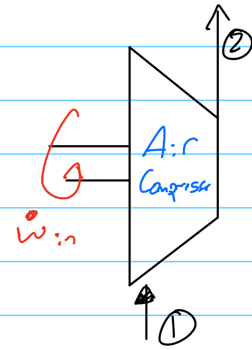
Trevor Swan **ECHE225: QUIZ #3 // 9.19.24**

3.




$P_1 = 12.5$ MPa
$T_1 = 500°C$
$\dot{m}_1 = 25$ kg/s

$P_2 = 10$ kPa
$x = 0.92$




$P_2 = 1$ MPa
$T_2 = 620K$
$C_p = 1.0303 \frac{kJ}{kg \cdot K}$
$P_1 = 98$ kPa
$T_1 = 295K$
$\dot{m}_1 = 10$ kg/s

a) Work done $\dot{W}_{out}$ Turbine to 1000th (MW)

1st Law: $\cancel{\dot{W}_{in}}^{0} - \dot{W}_{out} = \dot{m}(h_2 - h_1)$

$\dot{W}_{out} = \dot{m}(h_1 - h_2)$

$h_1 \} \xrightarrow[\text{Table}]{\text{SH}} h_1 = 3343.6 \frac{kJ}{kg}$

$h_2 \} \xrightarrow[\text{Table}]{\text{Sat. Mix}}$ $h_f = 191.81 \frac{kJ}{kg}$, $h_g = 2583.90 \frac{kJ}{kg}$

$h_2 = 191.81 + 0.92(2583.90 - 191.81)$
$= 2392.533$

$\dot{W}_{out} = 25 \frac{kg}{s}\left(3343.6 - 2392.533 \frac{kJ}{kg}\right) = 23776.675 \frac{kJ}{s}$

$23776.675$ kW $= \boxed{23.777 \text{ MW}}$

b) Work done $\dot{W}_{in}$ Compressor to 10ths (kW)

1st Law: $\dot{W}_{in} - \cancel{\dot{W}_{out}}^{0} = \dot{m}(h_2 - h_1)$ Assume air is ideal

$\dot{W}_{in} = \dot{m}(h_2 - h_1)$

$\Delta h = c_p \Delta T \Rightarrow h_2 - h_1 = c_p(T_2 - T_1)$
$= 1.0303 \frac{kJ}{kg \cdot K}(620K - 295K)$
$= 334.85 \frac{kJ}{kg}$

$\Rightarrow \dot{W}_{in} = 10 \frac{kg}{s}\left(334.85 \frac{kJ}{kg}\right) = \boxed{3348.5 \text{ kW}}$

(3.3485 MW in)

c) Turbine Produces 23.777 MW
− Compressor Consumes 3.3485 MW
20.4285 MW delivered to generator

↳ The us Turbine powers both!

net power to 100ths: $\boxed{20.43 \text{ MW}}$