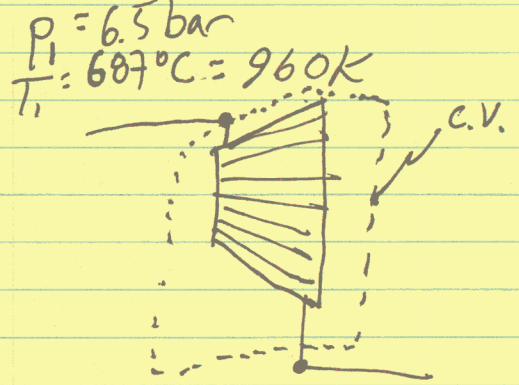
6.88 Given: Air, S.S., insulated turbine, ideal gas; $\Delta KE = \Delta PE = 0$

(a) $\frac{\dot{W}}{\dot{m}} = ?$



$$\frac{dE}{dt} = \dot{Q} - \dot{W} + \dot{m}_i\left(h_i + \frac{V_i^2}{2} + gz_i\right) - \dot{m}_e\left(h_e + \frac{V_e^2}{2} + gz_e\right)$$

insulated; $\Delta KE = 0$; $\Delta PE = 0$

S.S.

$$\frac{\dot{W}}{\dot{m}} = h_i - h_e$$

From table A-22

$h_i = 1000.55$ kJ/kg

$h_e = 607.02$ kJ/kg

$$\boxed{\frac{\dot{W}}{\dot{m}} = 393.53 \text{ kJ/kg}}$$

(b) Determine if this is reversible, irreversible or impossible

$$\frac{dS}{dt} = \sum_j \frac{\dot{Q}_j}{T_j} + \sum_i \dot{m}_i s_i - \sum_e \dot{m}_e s_e + \dot{\sigma}$$

S.S. ; $\dot{Q} = 0$

$$\frac{\dot{\sigma}}{\dot{m}} = s_e - s_i = \Delta s$$

For an ideal gas $\Delta s = s^\circ(T_2) - s^\circ(T_1) - R\ln\left(\frac{P_2}{P_1}\right)$

$= 2.409 - 2.913 - .287 \ln\left(\frac{1 \text{ bar}}{6.5 \text{ bar}}\right)$ kJ/kg·K

$$\frac{\dot{\sigma}}{\dot{m}} = s_e - s_i = 0.0249 \text{ kJ/kg·K} > 0$$

So $\Rightarrow$ IRREVERSIBLE