8. An inventor claims to have a heat engine that receives heat from a geothermal source at 500°C and has a thermal efficiency of 30%. Do you believe the claim?

\[ T_H = 500 + 273 = 773 \text{ K} \]
\[ T_L = 300 \text{ K} \]
\[ \eta_{\text{rev}} = 1 - \frac{T_L}{T_H} = 1 - \frac{300}{773} \leq 0.70 \]

8. A 1 m³ tank contains ammonia at 1700 kPa and 27°C. The tank is connected to an ammonia supply line at 1500 kPa and filled until the tank is half full (by volume) of liquid at 25°C. Calculate the heat transfer during the process. (250 MJ from the system).

9. Interstate 285 is a hot engine that receives heat from a steel slab of concrete (C = 0.43 kJ/(kg K)) that is initially at a temperature of 25°C. The engine injects heat to the environment, which is at a steady temperature of 25°C. As the engine operates, the concrete slab cools by the transfer of heat.

\[ h_{11} = h_1 \quad \text{and} \quad P_2 < P_1 \]
\[ \rightarrow \text{SSSF} \quad \text{and} \quad T_2 = T_1 \]
\[ \rightarrow \text{SSSF} \quad \text{and} \quad R_{11} = R_{12} \rightarrow \text{RSH} \text{ at } 500 \text{ kPa}, \text{ throttled to } 100 \text{ kPa} \]
\[ \text{RSH} \]
\[ \text{set liquid} \quad \text{RSH} \quad \text{at } 500 \text{ kPa}, \text{ throttled to } 100 \text{ kPa} \]
\[ h_{20} \rightarrow h_{21} \quad \text{at } 500 \text{ kPa} \]
\[ h_{21} = h_{22} \]
\[ 75 \% \rightarrow h_{23} = h_4 + X_2 h_{43} \quad \text{at } 100 \text{ kPa} \]

13. A heat engine receives heat from a 200 kg slab of concrete (C = 0.43 kJ/(kg K)) that is initially at a temperature of 200°C. The engine injects heat to the environment, which is at a steady temperature of 25°C. As the engine operates, the concrete slab cools by the transfer of heat.

\[ T_L = 25 \text{°C} \]
\[ T_1 = 200 \text{°C} \]
\[ h_3 \rightarrow h_4 \rightarrow h_5 \rightarrow h_6 \rightarrow h_7 \rightarrow h_8 \]
\[ \text{1st Law:} \quad Q_{\text{in}} = -nCv(T_2 - T_1) \]
\[ \dot{Q}_{\text{out}} = -nCv(T_2 - T_1) \]
\[ W = \int_{T_1}^{T_2} (1 - \frac{T_1}{T_2}) nCv dT \]
\[ W = \frac{nCv(T_2 - T_1) + nCT_L \ln \frac{T_L}{T_1}}{1 - \frac{T_1}{T_2}} \]

2nd Law quantities:
- SSSF adiabatic & reversible process
- Closed system
- Entropy quotient, involving H₂O or air
- Process possible?
- \[ S_{\text{gen}} = S_{\text{sys}} + S_{\text{env}} \]
- \[ M(\Delta S_{\text{sys}}) - \frac{Q_{\text{in}}}{T_{\text{env}}} \geq 0 \]

USUF
1st law open system: multiple inlet/outputs
Heat, mixing chamber
\[ P_0 = RT \]
\[ u_0 - u_1 \approx C_p(T_2 - T_1) \]
\[ h_2 - h_3 = C_p(T_2 - T_1) \]