1) A simple refrigerator:
Consider a refrigeration cycle operating in steady-state with performance coefficient $\beta = 4.5$ and work input at the rate $\dot{W} = 0.8$ kW. Energy is rejected from the refrigerator to the surroundings, which are at $T = 293$°K. Determine:

a) the rate energy is rejected, in kW.

b) the lowest theoretical temperature inside the refrigerator.

2) Composite engines:
The figure below shows a system consisting of a power cycle driving a heat pump. At steady-state, the power cycle receives $\dot{Q}_s$ by heat transfer at $T_s$ from the high-temperature source and delivers $\dot{Q}_1$ to a dwelling at $T_d$. The heat pump receives $\dot{Q}_0$ from the outdoors at $T_0$, and delivers $\dot{Q}_2$ to the dwelling.

a) Obtain an expression for the maximum theoretical value of the performance parameter $(\dot{Q}_1 + \dot{Q}_2)/\dot{Q}_s$ in terms of the temperature ratios $T_s/T_d$ and $T_0/T_d$.

b) Plot the result of part (a) versus $T_s/T_d$ ranging from 2 to 4 for $T_0/T_d = 0.85, 0.9$, and 0.95.