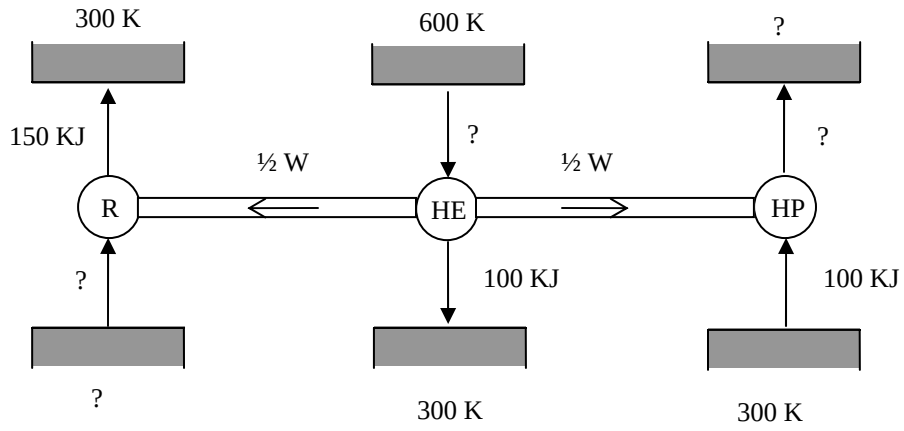
Unified Engineering Fall 2007
Thermodynamics & Propulsion Z. S. Spakovszky

(Add a short summary of the concepts you are using to solve the problem)

Problem T11

Consider a Carnot heat engine (HE) that absorbs heat from a large heat reservoir at a temperature of 600 K and rejects 100 KJ of heat to the atmosphere at 300 K. The Carnot heat engine supplies one half of the cycle work to a Carnot refrigerator (R) and one half of the cycle work to a Carnot heat pump (HP). The refrigerator rejects 150 KJ of heat to the atmosphere whereas the heat pump absorbs 100 KJ of heat from the atmosphere.



a) What is the cycle work W of the heat engine?

b) How much heat is absorbed by the heat engine?

c) Determine the COP of the refrigerator.

d) How much heat is absorbed by the refrigerator and what is the temperature of the cooling space?

e) Determine the COP of the heat pump.

f) How much heat is rejected by the heat pump and what is the temperature of the heating space?

(Add a short summary of the concepts you are using to solve the problem)

Problem T12 (Look ahead problem)

A truck engine is to be modeled as a diesel cycle. The compression ratio is 15 and the cutoff ratio is 2 (the cutoff ratio is defined as V_3/V_2). The air at the beginning of compression has a temperature of 15 C and a pressure of 1 atm. Assume that the air can be modeled as an ideal gas with $\gamma = 1.4$ and $R = 287$ J/kgK.

a) Draw a p-V diagram for the Diesel cycle, label all states, and discuss the modeled thermodynamic processes and actual events in the diesel engine.

b) Calculate the thermal efficiency of this engine.

c) What is the temperature of the air at the end of the compression stroke (just prior to the injection of the fuel in the actual engine)?

d) What is the number of engine diagrams (cycles in the p-V diagram) per minute for a four-cylinder engine running at 2000 rpm?

e) If the engine must deliver 186.4 kW (250 HP) at 2000 rpm, what is the required piston displacement for this four-cylinder engine?