Homework #7

MEMS 0051 - Introduction to Thermodynamics

Assigned March 2nd, 2019
Due: March 8th, 2019

Problem #1

A high-temperature reservoir at 800 [K] dissipates 1 [MJ] of heat into a heat engine. The heat engine then dissipates 6.5 [kJ] into a cold-temperature reservoir. For the following cases of the cold-temperature reservoir, determine the change in specific entropy. Be sure to comment on the reversibility or irreversibility of the processes.

a) T_L=300 [K]
b) T_L=450 [K]
c) T_L=100 [K]
d) T_L=500 [K]

Problem #2

A rigid tank contains 3 [kg] of R-134a at 293.15 [K] and 175 [kPa]. The refrigerant is then cooled until the pressure within the tank reaches 105 [kPa]. Determine the change of entropy during the process.

Problem #3

A piston cylinder containing ammonia at 100 [kPa] and -10 [°C] is cooled in an isothermal reaction until the height of the piston is a fifth of what it was before cooling. What is the work per unit mass done by the piston cylinder?

Problem #4

An experiment is being performed where a 13.5 [L] balloon containing 300 [g] of super-heated CO_2 at 1 [MPa] is cooled in an isothermal process by removing 170 [kJ]. Determine the volume change of the balloon. Do not treat as an ideal gas.

Problem #5

The compressor in a refrigeration process takes in R-410a refrigerant at 300 [kPa] and 35 [°C]. The condenser then cools the refrigerant until the pressure within the tank reaches 138.8[kPa]. The heat rejected from the condenser is emitted into the ambient environment at a constant temperature of 20 [°C]. Assuming the compressor acts like a rigid container, determine the following:

1. Heat per unit mass rejected (**q**)
2. Work per unit mass done by the condenser to perform this process (**w**)
3. Coefficient of performance (β)