ENSC 461

Assignment #5 (Exergy)

Assignment date:

Due date:

Problem 1:

A system undergoes a refrigeration cycle while receiving Q_c by heat transfer at temperature T_c and discharging energy Q_H by heat transfer at a higher temperature T_H. There are no other heat transfers.

a) Using an exergy balance, show that the network input to the cycle cannot be zero.

b) Show that the coefficient of performance of the cycle can be expressed as:

$$COP = \left(\frac{T_c}{T_H - T_c}\right)\left(1 - \frac{T_H X_{d\,estroyed}}{T_0(Q_H - Q_c)}\right)$$

where $X_{destroyed}$ is the exergy destruction and T_0 is the temperature of the surroundings.

c) Using the result of part (b), obtain an expression for the coefficient of performance.

Problem 2:

Helium gas enters an insulated nozzle operating at steady state at 1300 *K*, 4 bar, and 10 *m/s*. At the exit, the temperature and pressure of the helium are 900 *K* and 1.45 bar, respectively. Determine:

a) the exit velocity in m/s

b) the isentropic nozzle efficiency

c) the rate of exergy destruction, in *kJ/kg* of gas flowing through the nozzle.

Assume the ideal gas model for helium and ignore the effects of gravity. Let T_0 = 20°C and P_0 = 1atm.