Problem Session #5

1) Suppose the coldest reservoir we have at hand is at 10°C. If we want a heat engine that is at least 90% efficient, what is the minimum temperature of the required hot reservoir?

2) A Carnot-cycle heat engine does 2.50 kJ of work per cycle and has an efficiency of 45.0%. Find W, Q_1 and Q_2 for one cycle.

3) Assuming that CO_2 is an ideal, calculate ΔH° and ΔS° for the following process:
1 CO_2 (g, 298.15 K, 1 bar) → 1 CO_2 (g, 1000 K, 1bar)
Given: $\bar{C}_p{}^0 = 26.648 + 42.262 \text{ x } 10^{-3} \text{ T} - 142.40 \text{ x } 10^{-7} \text{ T}^2 (\text{J.K}^{-1}.\text{mol}^{-1})$

4) The temperature of an ideal monatomic gas is increased from 300K to 500K. What is the change in molar entropy of the gas
a) if the volume is held canstant
b) if the pressure is held constant

5) Calculate the entropy change when 1 mol of ice is heated from 250K to300K. Take the heat capacities ($C_{p,m}$) of water and ice to be constant at 75.3 and 37.7 JK^{-1} mol $^{-1}$, respectively, and the latent heat of fusion of ice as 6.02 $kJmol^{-1}$.

6) Two moles of water at 50°C are placed in a refrigerator which is mantained at 5°C. Taking the heat capacity of water as 75.3 $J.K^{-1}$ mol^{-1} and independent of temperature, calculate the entropy change for cooling of the water to 5°C. Also calculate the entropy change in the refrigerator, and the net entropy change.

7) Determine the overall change in entropy for the following process using 1.00 mole of He:
He (298.0 K, 1.50 atm) → He (100.0K, 15.0 atm)
The heat capacity of He is 20.78 J/mol.K . Assume the helium acts as ideally.