Physics 102-Rec
Quiz # 4
Chapter 21

Date: 2 April 2002

Name: Key Id: Sect:

1. 100 g of water at 100 °C is cooled to 7 °C by putting it in a refrigerator. Calculate the change in entropy of the water. (c_{water} = 4186 J/kg °C)

$$\Delta S = \int \frac{dQ}{T} \Rightarrow \Delta S = mc \ln\left(\frac{T_f}{T_i}\right) = (0.1)(4186)\ln\left(\frac{280}{373}\right)$$

$$\boxed{\Delta S = -120 \text{ J/K}}$$

2. One mole of an ideal gas expand isothermally to three times its original volume. Calculate the change in entropy of the gas.

$$\Delta S = \int \frac{dQ}{T} \Rightarrow \Delta S = \frac{Q}{T} = \frac{nRT\ln(V_f/V_i)}{T} = nR\ln\left(\frac{V_f}{V_i}\right)$$

$$\Delta S = (1)(8.31)\ln(3) = \boxed{9.1 \text{ J/K}}$$

3. One kilogram of water at 80 °C is mixed with the same amount of water at 40 °C. Calculate the change in entropy of the system after thermal equilibrium is reached.

$$Q_1 + Q_2 = 0 \Rightarrow mc(T_f - T_1) + mc(T_f - T_2) = 0$$

$$2T_f = T_1 + T_2 \Rightarrow T_f = \frac{T_1 + T_2}{2} = \frac{80+40}{2} = 60°C$$

$$\Delta S = mc\ln\left(\frac{T_f}{T_1}\right) + mc\ln\left(\frac{T_f}{T_2}\right)$$

$$= (1)(4186)\ln\left(\frac{333}{353}\right) + (1)(4186)\ln\left(\frac{333}{313}\right)$$

$$= -244 + 259 = \boxed{15 \text{ J/K}}$$