Physics 102Rec
Quiz # 5
Chapter 20

Name: Key Id#: Sect#:

1. What is the coefficient of performance of an ideal heat pump that brings heat from the outdoor at – 3 °C into a 22 °C house?

$$K = \frac{T_H}{\Delta T} = \frac{295}{25} = \boxed{11.8}$$

2. The surface of the sun is approximately 6000 K and the temperature of the earth's surface is approximately 23 °C. What is the net entropy change when 1000 J of heat energy is transferred from the sun to the earth?

$$\Delta S_{sun} = -\frac{|Q|}{T_s} = -\frac{1000}{6000} = -0.17 \text{ J/K}$$

$$\Delta S_{earth} = \frac{Q}{T_E} = \frac{1000}{296} = 3.38 \text{ J/K}$$

$$\Delta S_{net} = 3.38 - 0.17 = \boxed{3.2 \text{ J/K}}$$

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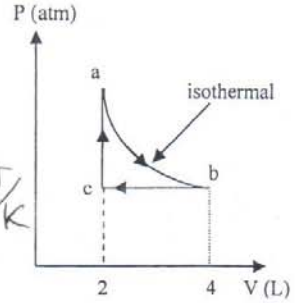
One mole of a diatomic ideal gas is taken trough the cycle shown in the figure. If $T_a = 400$ K and $T_c = 200$ K, calculate the change in entropy for each process.



$$\Delta S_{ab} = n R \ln\left(\frac{V_b}{V_a}\right)$$

$$= 1 \times 8.31 \times \ln\left(\frac{4}{2}\right) = 5.76 \text{ J/K}$$

$$\Delta S_{bc} = n C_p \ln\left(\frac{T_c}{T_b}\right) = n C_p \ln\left(\frac{V_c}{V_b}\right)$$

$$= 1 \times \frac{7}{2} \times 8.31 \times \ln\left(\frac{2}{4}\right) = -20.16 \text{ J/K}$$

$$\Delta S_{ca} = n C_v \ln\left(\frac{T_a}{T_c}\right) = 1 \times \frac{5}{2} \times 8.31 \times \ln\left(\frac{400}{200}\right)$$

$$= 14.4 \text{ J/K}$$

Notes: $\Delta S_{cycle} = 5.76 - 20.16 + 14.4 = 0$

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1. Five moles of a monatomic ideal gas expand isobarically at 1 atm. from a volume of 2 L to a volume of 10 L. calculate the entropy change during the process.

$$\Delta S = n C_p \ln\left(\frac{T_f}{T_i}\right)$$

$$= n C_p \ln\left(\frac{V_f}{V_i}\right)$$

$$= 5 \times \frac{5}{2} \times 8.31 \ln\left(\frac{10}{2}\right)$$

$$= \boxed{167.1 \text{ J/K}}$$

$$\frac{P_i V_i}{P_f V_f} = \frac{nRT_i}{nRT_f}$$

$$\frac{T_f}{T_i} = \frac{V_f}{V_i}$$

2. A 100 g of ice at 0 °C is heated to 80 °C. Calculate the change in entropy of ice. The specific heat of water is = 4190 J/Kg K, and the heat of fusion of ice = 333 kJ/K)

$$\Delta S = \frac{mL}{T} + mc \ln\left(\frac{T_f}{T_i}\right)$$

$$= \frac{0.1 \times 333 \times 10^3}{273} + 0.1 \times 4190 \times \ln\left(\frac{353}{273}\right)$$

$$= 122.1 + 107.7 = \boxed{229.8 \text{ J/K}}$$