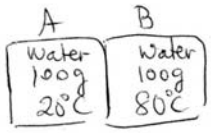
KING FAHD UNIVERSITY OF PERTOLEUM & MINERALS
PHYSICS DEPARTMENT
QUIZ #5- CHAPTER 20

NAME: Key ID# SECTION#

You mix two samples of water, A and B. Sample A is 100 g at 20 ^{0}C and sample B is also 100 g but at 80 ^{0}C. Calculate the change in the entropy of the system.
C_{water} = 4190 J/kgC^0.



$$\Rightarrow T_f = \frac{80+20}{2} = 50^\circ C$$

$$\Delta S_A = m C \ln\left(\frac{T_f}{T_i}\right) = 0.1 \times 4190 \ln\left(\frac{323}{293}\right) = 40.8 \frac{J}{K}$$

$$\Delta S_B = m C \ln\left(\frac{T_f}{T_i}\right) = 0.1 \times 4190 \ln\left(\frac{323}{353}\right) = -37.2 \frac{J}{K}$$

$$\Delta S_{system} = \Delta S_A + \Delta S_B = \boxed{3.6\ J/K}$$

notice that $\Delta S_{system} > 0$!

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A heat engine absorbs 8.71×10^3 J per cycle from a hot reservoir with an efficiency of 20% and executes 5 cycles per second.

(a) What is the work delivered by the engine?

$Q_H = 8.71 \times 10^3 \text{ J} \qquad e = 0.2 \qquad t = 0.2 \text{ s}$

$$e = \frac{W}{Q_H} \Rightarrow W = Q_H \times e = 8.71 \times 10^3 \times 0.2$$

$$\boxed{W = 1742 \text{ J}}$$

(b) What is the heat expelled to the cold reservoir?

$$Q_H = W + Q_L \Rightarrow Q_L = Q_H - W = \boxed{6968 \text{ J}}$$

(c) What is the power output of the heat engine?

$$P = \frac{W}{t} = \frac{1742}{0.2} = \boxed{8710 \text{ W}}$$

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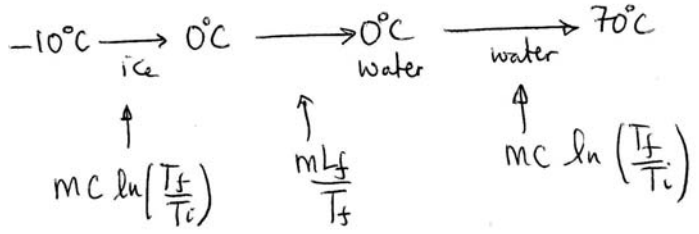
A 1.0 kg piece of ice at –10 ^{0}C is changed slowly and reversibly to water at 70 ^{0}C. What is the change in entropy of the ice? C_{ice} = 2220 J/kgC^0, C_{water} = 4190 J/kgC^0, L_f = 333 x 103 J/kg.



$$\Delta S = 1 \times 2220 \times \ln\left(\frac{273}{263}\right) + \frac{1 \times 333 \times 10^3}{273} + 1 \times 4190 \times \ln\left(\frac{343}{273}\right)$$

$$= 82.8 + 1220 + 956 = \boxed{2259 \text{ J/k}}$$