ME 24-221
THERMODYNAMICS I

Solution to Quiz # 6
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Given: Closed system with water; State 1: Saturated Liquid at 100 kPa
State 2: Saturated Vapor at 100 kPa
Heat transfer from a reservoir at 120 ^{o}C (393.15 K).
$_1S_{2,\,gen}$ is zero for the system and reservoir.

Solution: Saturated water tables; pressure entry, Table B.1.2 is used.

Entropy change of the system: $\Delta S_{system} = S_2 - S_1 = m(s_2 - s_1) = m(s_{g(100kPa)} - s_{f(100kPa)})$

$$\mathbf{\Delta S_{system}} = m(s_{fg(100kPa)}) = 2(6.0568) = \mathbf{12.1136\ kJ/K} \text{ ----(a)}$$

Heat transfer to the system: $_1Q_2 = T\Delta S$ ($_1S_{2,\,gen} = 0$)

Since the system undergoes the process from sat. liquid to sat. vapor, it is in saturated state throughout and the temperature is constant. $T = T_{sat(100kPa)} = 99.62\ ^{o}C = 372.77$ K

Hence $\mathbf{_1Q_{2,system}} = T\Delta S = 372.77(12.1136) = \mathbf{4515.58\ kJ}$ ----------(b)

Entropy change of reservoir: $\Delta S_{reservoir} = {}_1Q_{2,\,reservoir}/T_{reservoir}$ ($_1S_{2,\,gen} = 0$)

And, $_1Q_{2,\,reservoir} = -{}_1Q_{2,system}$

Therefore, $\mathbf{\Delta S_{reservoir}} = -4515.58/393.15 = \mathbf{-11.4856\ kJ/K}$ ----------©

Net entropy change of the universe: $\Delta S_{net} = \Delta S_{system} + \Delta S_{reservoir}$
$= 12.1136 - 11.4856$
$\mathbf{\Delta S_{net}} = \mathbf{0.628\ kJ/K}$ ----------(d)