An ordinary egg can be approximated as a 5.5 cm diameter sphere. The egg is initially at a uniform temperature of 8°C and is dropped into boiling water at 97°C. Taking the properties of the egg to be \( \rho = 1020 \text{ kg/m}^3 \) and \( \text{Cp} = 3.32 \text{ KJ/(Kg. °K)} \), determine how much heat is transferred to the egg by the time the average temperature of the egg rises to 70°C and the amount of entropy generation associated with this heat transfer process. (5 points)

\[
\begin{align*}
\text{Write 1st law for system} & \quad E_{in} - E_{at} = \Delta E_{sys} \\
Q_{in} &= \Delta U_{eggs} \\
&= m(c_2 - c_1) = m(c(T_2 - T_1)) \\
m &= 8V = \frac{8 \pi D^3}{6} = (1020) \frac{T_1 (0.055)^3}{6} = 0.0889 \text{ kg} (1 \text{ point}) \\
Q_{in} &= m(c(T_2 - T_1)) = 0.0889 (3.32 \text{ KJ/kg°C}) (70 - 8)\text{C} \\
&= 18.2 \text{ KJ} \quad 2 \text{ points}
\end{align*}
\]

\[
\begin{align*}
\text{Entropy Generation} & \quad S_{in} = S_{at} + S_{gen} = \Delta S_{sys} \\
\frac{Q_{in}}{T_{at}} + S_{gen} &= \Delta S_{sys} - \frac{Q}{T_b} \\
\Delta S_{sys} &= m(\ln T_2 - \ln T_1) = mc \frac{\ln T_2}{T_1} = 0.0889 (3.32) \ln \frac{70+273}{8+273} \quad 1 \text{ point} \\
S_{gen} &= -\frac{18.2 \text{ KJ}}{870 \cdot \text{K}} + 0.0588 \text{ KJ/K} \\
&= 0.00966 \text{ KJ/K} \quad (\text{per egg}) \quad 1 \text{ point}
\end{align*}
\]