Answer on Question #41555, Physics, Molecular Physics | Thermodynamics

Question.

A 0.5kg piece of metal (c = 600/kgK) at 300 degree celcius is dumped into a large pool of water at 20 degrees celcius. Assuming the change in temperature of water to be negligible, calculate the overall change in entropy for the system:

85.5J/K
67.4J/K
122.3J/K
202.3J/K

$m = 0.5 \ kg$

$c = 600 \ \dfrac{J}{kg \cdot K}$

$T_1 = 300°C = 573 \ K$

$T_2 = 20°C = 293 \ K$

$dS = ?$

Solution.

By definition entropy is:

$$\Delta S = \int \frac{\delta Q}{T}$$

In our case,

$$\delta Q = cmdT$$

Therefore,

$$\Delta S = \int_{T_2}^{T_1} \frac{\delta Q}{T} = \int_{T_2}^{T_1} cm \frac{dT}{T} = cm \ln \frac{T_1}{T_2}$$

So,

$$\Delta S = cm \ln \frac{T_1}{T_2} = 0.5 \cdot 600 \cdot \ln \frac{573}{293} = 300 \cdot \ln 1.956 = 300 \cdot 0.671 \approx 202 \ \frac{J}{K}$$

Answer.

$$\Delta S = cm \ln \frac{T_1}{T_2} = 202.3 \ \frac{J}{K}$$