Answer on Question #57121, Physics / Molecular Physics | Thermodynamics

A 2.0 mol sample of an ideal monatomic gas undergoes a reversible process at constant volume, increasing its temperature from 400 K to 600K. What is the entropy change of the gas?

Solution:

For heating or cooling of any system (gas, liquid or solid) at constant volume from an initial temperature T_0 to a final temperature T, the entropy change is

$$\Delta S = nC_V \ln\left(\frac{T}{T_0}\right)$$

where the constant-volume heat capacity C_v is constant and there is no phase change.

Here n is the number of moles of gas.

In the case of a monatomic gas

$$C_V = \frac{3}{2}R$$

where R is the ideal gas constant

Thus,

$$\Delta S = \frac{3}{2}nR \ln\left(\frac{T}{T_0}\right) = \frac{3}{2} \cdot 2.0 \cdot 8.31 \cdot \ln\left(\frac{600}{400}\right) = 10.1 \ \frac{\text{J}}{\text{K}}$$

Answer: $\Delta S = 10.1 \ \frac{\text{J}}{\text{K}}$