Answer on Question 67516, Physics, Molecular Physics, Thermodynamics

Question:

A gas is compressed from $400\,cm^3$ to $200\,cm^3$ at a constant pressure of $100\,kPa$. At the same time, $100\,J$ of heat energy is transferred out of the gas. What is the change in internal energy of the gas during this process?

Solution:

We can find the change in internal energy of the gas during this process from the first law of thermodynamics:

$$\Delta U = Q + W,$$

here, ΔU is the change in internal energy of the gas during this process, $Q = -100\,J$ is the heat energy that transferred out of the gas, W is the work done by the gas.

By the definition of the work done by the gas, we get:

$$W = -p\Delta V = -p\left(V_{final} - V_{initial}\right) =$$
$$= -100 \cdot 10^3\ Pa \cdot (200 \cdot 10^{-6}\ m^3 - 400 \cdot 10^{-6}\ m^3) = 20\,J.$$

Finally, we can find the change in internal energy of the gas during this process:

$$\Delta U = Q + W = -100\,J + 20\,J = -80\,J.$$

Answer:

$\Delta U = -80\,J.$