

Homework 20

Thermodynamics problems

Please think over the following problems:

1. 1kg of nitrogen expanded adiabatically and performed work of 300J. Find the change of the internal energy of the gas and the change of the gas temperature. c_v of nitrogen is 745J/kg $^{\circ}$ K. (Just to remind: “adiabatically” means that the gas was thermally isolated from the environment and $\Delta Q=0$).
2. Gas with $m=1\text{kg}$, $p=2 \times 10^5\text{N/m}^2$ and $c_v=700\text{ J/kg}^{\circ}\text{K}$ was heated and expanded due to the heating. What is the specific heat of the gas in this process if its temperature increased by 2K and increase of its volume was 0.001m^3 (We assume that the gas has high volume and temperature so its pressure can be considered as constant).

Hint: To find heat capacitance c you should remember what it is. It was introduced as: $\Delta Q = cm\Delta T$. So if you find ΔQ and ΔT you can find c .

3. Each of two cylinders contain 1 mole of gas. Pressure in one cylinder is 4,000Pa, pressure in the other 6,000Pa. Find the pressure which will be established if we connect the cylinders with a narrow tube (neglect the volume of the tube). The temperature is maintained constant.
4. What is the density of nitrogen at $T=0^{\circ}\text{C}$ and pressure of 105Pa.
5. After we let a certain amount of gas out of the cylinder, the pressure in the cylinder dropped by 40% and the temperature – by 20%. Find the fraction of the initial gas mass which was lost.