Answer on Question #49187 – Physics – Mechanics | Kinematics | Dynamics

**1.** Air in a cylinder is compressed to one-tenth its original volume with no change in temperature. What is the change in its pressure?

| $\eta_1 = 0.1$ |
| --- |
| $\eta_2 - ?$ |

*Solution.*

Let write the ideal gas law for the initial and final state of the gas:

$$p_1V_1 = \frac{m}{M}RT, \quad p_2V_2 = \frac{m}{M}RT,$$

where $m$ and $M$ are the mass and molar mass, correspondingly. The gas temperature $T$ remains constant.

If we divide the first equation by the second one, the following equation will be obtained:

$$\frac{p_1V_1}{p_2V_2} = 1, \quad \text{or} \quad \frac{p_2}{p_1} = \frac{V_1}{V_2}.$$

According to the text, $\frac{V_2}{V_1} = 1 - \eta_1$. So, change in gas pressure is:

$$\eta_2 = \frac{p_2 - p_1}{p_1} = \frac{p_2}{p_1} - 1 = \frac{1}{\frac{V_2}{V_1}} - 1 = \frac{1}{1-\eta_1} - 1 = \frac{\eta_1}{1-\eta_1}.$$

$$\eta_2 = \frac{0.1}{1-0.1} = \frac{1}{9}.$$

**Answer**: the pressure increases to $\frac{1}{9}$-th towards its original quantity

(the pressure increases at $\frac{10}{9}$ times).