Answer on Question #42208, Physics, Molecular Physics | Thermodynamics

A piston traps a certain mass of gas inside a cylinder. Initially the piston is halfway along the length of the cylinder. The piston is now moved towards the open end of the cylinder. The temperature of the gas remains constant. How are the density and the pressure of the gas affected by moving the piston?

Solution:

Given:

$V_2 = 2V_1$

We have isothermal process

For the special case of a gas to which Boyle's law applies, the product pV is a constant if the gas is kept at isothermal conditions.

The equation states that product of pressure and volume is a constant for a given mass of confined gas as long as the temperature is constant. For comparing the same substance under two different sets of condition, the law can be usefully expressed as

$$P_1V_1 = P_2V_2$$

The equation shows that, as volume increases, the ***pressure*** *of the gas* ***decreases*** in proportion.

$$P_2 = \frac{P_1V_1}{V_2} = \frac{P_1}{2}$$

The density is

$$\rho = \frac{m}{V}$$

Thus, for a given mass of gas, we obtain that, as volume increases, the ***density*** *of the gas* ***decreases*** in proportion.

$$\rho_2 = \frac{m}{V_2} = \frac{\rho_1V_1}{V_2} = \frac{\rho_1}{2}$$

Answer. the pressure of the gas decreases two times;

the density of the gas decreases two times.