Answer on question #62673, Chemistry / General chemistry

A student collected a 40.0 mL sample of H_2 gas at a temperature of 20.0°C and pressure of 720.0 mmHg. The next day the temperature was still 20.0°C but the sample's volume had decreased to 38.4 mL. What is the new pressure, in mm Hg?

Solution:

To solve this problem we need to use the Ideal gas law:

$$pV = nRT$$

We have 2 conditions of our system that is why we need mark parameters in this law. Index 1 and 2 correspond to first and second day of student's work:

$$p_1V_1 = n_1RT_1$$

$$p_2V_2 = n_2RT_2$$

Now, we can divide first equation on second equation:

$$\frac{p_1V_1}{p_2V_2} = \frac{n_1RT_1}{n_2RT_2} = \frac{n_1T_1}{n_2T_2}$$

From the initial conditions we know that T_1=T_2 and we rewrite this equation:

$$\frac{p_1V_1}{p_2V_2} = \frac{n_1RT_1}{n_2RT_2} = \frac{n_1}{n_2}$$

The next step is n determination:

$$n_1 = \frac{V_1}{V_m} = \frac{40 \cdot 10^{-3} L}{22.4\ L/mol} = 1.79 \cdot 10^{-3} mol$$

$$n_2 = \frac{V_2}{V_m} = \frac{38.4 \cdot 10^{-3} L}{22.4\ L/mol} = 1.71 \cdot 10^{-3} mol$$

The new pressure equal to:

$$p_2 = \frac{n_2p_1V_1}{n_1V_2} = \frac{1.71 \cdot 10^{-3} mol \cdot 720\ mmHg\ \cdot\ 40 \cdot 10^{-3} L}{1.79 \cdot 10^{-3} mol\ \cdot\ 38.4 \cdot 10^{-3} L} = 714\ mmHg$$

Answer: the new pressure in the system is 714 mmHg.