

Answer on the question #64095, Chemistry / General Chemistry

Question:

A weather balloon has a volume of 46.9 L when released under conditions of 739 mmHg and 27.0 °C. What is the volume of the balloon at an altitude of 10,000 m where the pressure is 153 mmHg and the temperature is 215 K?

Solution:

According to the combined gas law, you have the following relation between the temperature, gas and pressure:

$$\frac{pV}{T} = \text{const}$$

That means, that under the first set of conditions and under the final conditions the ratio written above is constant :

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$V_2 = T_2 \frac{p_1 V_1}{T_1 p_2}$$

$$T_2 = 215 \text{ K}, p_1 = 739 \text{ mmHg}, V_1 = 46.9 \text{ L}, T_1 = 27.0 + 273.15 = 300.15 \text{ K}, \\ p_2 = 153 \text{ mmHg}$$

$$V_2 = (215\text{K}) \frac{739(\text{mmHg}) \cdot 46.9(\text{L})}{300.15(\text{K}) \cdot 153(\text{mmHg})} = 162.3 \text{ L}$$

Answer : 162.3 L