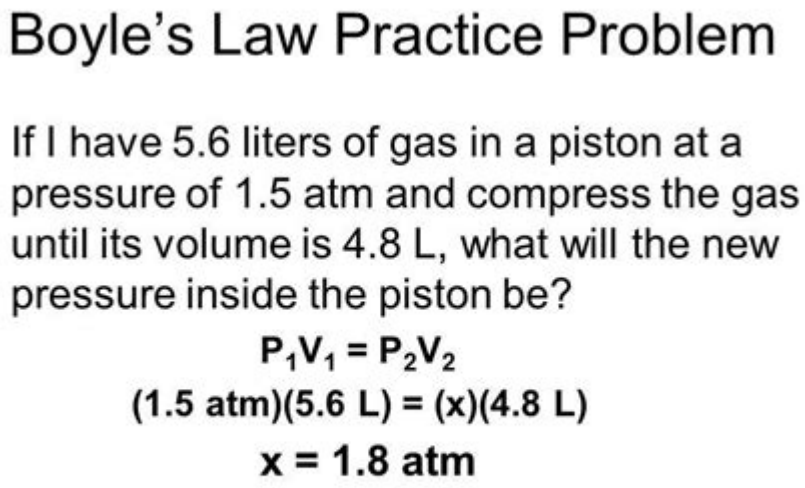
Boyles Law Problems Answer Key



Boyle's Law problems answer key is an essential resource for students and enthusiasts of physics and chemistry, especially those studying gas laws. Boyle's Law states that the pressure of a gas is inversely proportional to its volume when the temperature is held constant. This fundamental principle governs how gases behave under various conditions and is critical in various scientific and practical applications. In this article, we will delve into the intricacies of Boyle's Law, solve several problems, and provide an answer key to enhance understanding.

Understanding Boyle's Law

Boyle's Law is mathematically expressed as:

$$ P_1 \times V_1 = P_2 \times V_2 $$

Where:
- P_1 = initial pressure
- V_1 = initial volume
- P_2 = final pressure
- V_2 = final volume

This equation highlights the inverse relationship between pressure and volume: as the volume of a gas increases, the pressure decreases, provided the temperature remains constant.

The Importance of Boyle's Law

Boyle's Law is crucial for several reasons:
1. Practical Applications: It has applications in various fields such as meteorology, engineering, and respiratory physiology.
2. Foundation for Further Study: Understanding Boyle's Law lays the groundwork for learning about other gas laws, such as Charles's Law and Avogadro's Law.
3. Real-World Relevance: It helps explain everyday phenomena, such as how syringes work or how lungs inflate and deflate.

Common Problems Involving Boyle's Law

To understand Boyle's Law better, we will explore several common problems and provide solutions. Below are some typical scenarios where Boyle's Law applies:

Problem 1: Volume Change with Pressure

Problem Statement: A gas occupies a volume of 5.0 L at a pressure of 2.0 atm. What will be the volume of the gas if the pressure is increased to 4.0 atm?

- Given:
- $V_1 = 5.0 \, L$
- $P_1 = 2.0 \, atm$
- $P_2 = 4.0 \, atm$

- Find: V_2

Solution:

Using Boyle's Law:

$$P_1 \times V_1 = P_2 \times V_2$$

Substituting the known values:

$$2.0 \times 5.0 = 4.0 \times V_2$$

$$10 = 4.0 \times V_2$$

Now, solve for V_2:

$$V_2 = \frac{10}{4.0} = 2.5 \, L$$

Answer: The volume of the gas will be 2.5 L.

Problem 2: Pressure Change with Volume

Problem Statement: A balloon has a volume of 2.0 L at a pressure of 1.0 atm. If the volume decreases to 1.0 L, what is the new pressure?

- Given:
- $V_1 = 2.0 \, L$
- $P_1 = 1.0 \, atm$
- $V_2 = 1.0 \, L$

- Find: P_2

Solution:

Using Boyle's Law:

$$P_1 \times V_1 = P_2 \times V_2$$

Substituting the known values:

$$1.0 \times 2.0 = P_2 \times 1.0$$

$$2.0 = P_2$$

Answer: The new pressure will be 2.0 atm.

Problem 3: Calculating Unknown Pressure and Volume

Problem Statement: A gas is compressed from a volume of 10.0 L at a pressure of 1.5 atm to a volume of 5.0 L. What is the final pressure of the gas?

- Given:
- $V_1 = 10.0 \, L$
- $P_1 = 1.5 \, atm$
- $V_2 = 5.0 \, L$

- Find: P_2

Solution:

Using Boyle's Law:

$$P_1 \times V_1 = P_2 \times V_2$$

Substituting the known values:

$$1.5 \times 10.0 = P_2 \times 5.0$$

$$ 15.0 = P_2 \times 5.0 $$

Now, solve for P_2:

$$ P_2 = \frac{15.0}{5.0} = 3.0 \, atm $$

Answer: The final pressure will be 3.0 atm.

Problem 4: Rearranging Boyle's Law

Problem Statement: If a gas has a pressure of 0.5 atm and occupies 20.0 L, what volume will it occupy at a pressure of 1.0 atm?

- Given:
- $P_1 = 0.5 \, atm$
- $V_1 = 20.0 \, L$
- $P_2 = 1.0 \, atm$

- Find: V_2

Solution:

Using Boyle's Law:

$$ P_1 \times V_1 = P_2 \times V_2 $$

Substituting the known values:

$$ 0.5 \times 20.0 = 1.0 \times V_2 $$

$$ 10.0 = 1.0 \times V_2 $$

Now, solve for V_2:

$$ V_2 = 10.0 \, L $$

Answer: The volume will be 10.0 L.

Answer Key Summary

To summarize, here’s the answer key for the problems discussed:

1. Problem 1: Volume when pressure increases to 4.0 atm - 2.5 L
2. Problem 2: New pressure when volume decreases to 1.0 L - 2.0 atm
3. Problem 3: Final pressure when volume is compressed to 5.0 L - 3.0 atm
4. Problem 4: Volume at a pressure of 1.0 atm - 10.0 L

Conclusion

Understanding Boyle's Law problems answer key is crucial for mastering the behavior of gases. The law's application in various scientific and real-world scenarios makes it an essential topic in physics and chemistry education. By practicing problems and using the answer key, students can solidify their grasp of this important principle and develop the analytical skills needed to solve more complex gas law problems. Whether in a classroom setting or for personal enrichment, mastering Boyle's Law is a stepping stone to a deeper understanding of the physical world.

Frequently Asked Questions

What is Boyle's Law and how is it applied in gas problems?

Boyle's Law states that the pressure of a gas is inversely proportional to its volume when temperature and the number of moles are held constant. It is applied in gas problems by using the formula P1V1 = P2V2, where P is pressure and V is volume.

How do you solve a Boyle's Law problem involving an initial volume and pressure?

To solve a Boyle's Law problem, rearrange the formula P1V1 = P2V2 to find the unknown variable. For example, if you know P1, V1, and P2, you can find V2 by rearranging the equation to V2 = P1V1 / P2.

What units are typically used in Boyle's Law problems?

In Boyle's Law problems, pressure is typically measured in atmospheres (atm) or pascals (Pa), and volume is measured in liters (L) or cubic meters (m^3). It's important to use consistent units when solving the equations.

Can Boyle's Law be applied to real-world scenarios, and can you provide an example?

Yes, Boyle's Law can be applied to real-world scenarios, such as in a syringe. When the plunger is pulled back, the volume of gas increases, which decreases the pressure inside the syringe, allowing the gas to enter.

What are common mistakes students make when solving Boyle's Law problems?

Common mistakes include not converting units properly, misapplying the

formula, or failing to keep temperature constant. Additionally, students may confuse the relationship between pressure and volume, forgetting that they are inversely related.

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