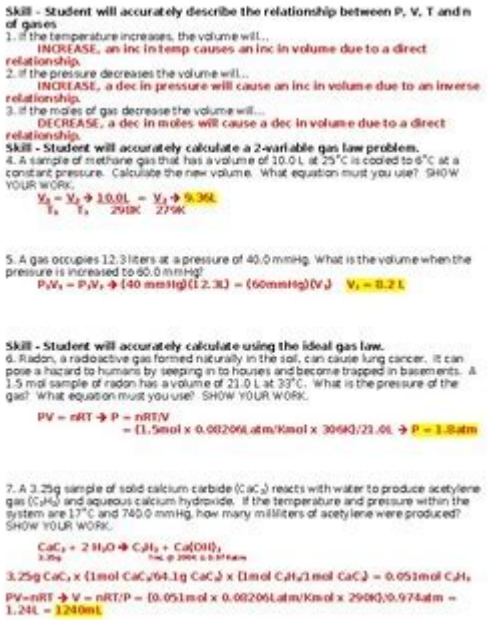
Gas Law Review Answer Key



Skill - Student will accurately describe the relationship between P, V, T and n of gases.

1. If the temperature increases, the volume will...
INCREASE, an inc in temp causes an inc in volume due to a direct relationship.

2. If the pressure decreases the volume will...
INCREASE, a dec in pressure will cause an inc in volume due to an inverse relationship.

3. If the moles of gas decrease the volume will...
DECREASE, a dec in moles will cause a dec in volume due to a direct relationship.

Skill - Student will accurately calculate a 2-variable gas law problem.

4. A sample of methane gas that has a volume of 10.0 L at 25°C is cooled to 6°C at a constant pressure. Calculate the new volume. What equation must you use? SHOW YOUR WORK.

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \rightarrow \frac{10.0L}{298K} = \frac{V_2}{279K} \rightarrow 9.36L$

5. A gas occupies 12.3 liters at a pressure of 40.0 mmHg. What is the volume when the pressure is increased to 60.0 mmHg?

$P_1V_1 = P_2V_2 \rightarrow (40\ mmHg)(12.3L) = (60mmHg)(V_2) \quad V_2 = 8.2L$

Skill - Student will accurately calculate using the ideal gas law.

6. Radon, a radioactive gas formed naturally in the soil, can cause lung cancer. It can pose a hazard to humans by seeping in to houses and become trapped in basements. A 1.5 mol sample of radon has a volume of 21.0 L at 33°C. What is the pressure of the gas? What equation must you use? SHOW YOUR WORK.

$PV = nRT \rightarrow P = nRT/V$

$= (1.5mol \times 0.08206L\,atm/Kmol \times 306K)/21.0L \rightarrow P = 1.8atm$

7. A 3.25g sample of solid calcium carbide (CaC_2) reacts with water to produce acetylene gas (C_2H_2) and aqueous calcium hydroxide. If the temperature and pressure within the system are 17°C and 740.0 mmHg, how many milliliters of acetylene were produced? SHOW YOUR WORK.

$CaC_2 + 2\,H_2O \rightarrow C_2H_2 + Ca(OH)_2$

$3.25g\,CaC_2 \times (1mol\,CaC_2/64.1g\,CaC_2) \times (1mol\,C_2H_2/1mol\,CaC_2) = 0.051mol\,C_2H_2$

$PV=nRT \rightarrow V = nRT/P = (0.051mol \times 0.08206L\,atm/Kmol \times 290K)/0.974atm = 1.24L = 1240mL$

Gas law review answer key is an essential resource for students and educators alike, especially in the fields of chemistry and physics. Understanding the behavior of gases and the principles governing them is crucial for grasping various scientific concepts. This article aims to provide a comprehensive overview of gas laws, their applications, and a detailed answer key for common problems related to these laws.

What Are Gas Laws?

Gas laws are a set of physical laws that describe how gases behave under various conditions of pressure, volume, and temperature. These laws are essential for understanding the properties of gases in scientific applications, from laboratory experiments to real-world phenomena.

Key Gas Laws

1. Boyle's Law: This law states that the pressure of a gas is inversely proportional to its volume when temperature remains constant. Mathematically, it can be expressed as:
$$
P_1 V_1 = P_2 V_2
$$
where P is pressure and V is volume.

2. Charles's Law: This law demonstrates that the volume of a gas is directly proportional

to its absolute temperature when pressure is constant. The equation is:
$$
\frac{V_1}{T_1} = \frac{V_2}{T_2}
$$
where T is the absolute temperature.

3. Avogadro's Law: This law states that equal volumes of gases, at the same temperature and pressure, contain an equal number of molecules. The mathematical representation is:
$$
V_1/n_1 = V_2/n_2
$$
where n is the number of moles.

4. Ideal Gas Law: This law combines the previous laws into a single equation that describes the behavior of an ideal gas. It is given by:
$$
PV = nRT
$$
where R is the ideal gas constant.

5. Dalton's Law of Partial Pressures: This law states that in a mixture of non-reacting gases, the total pressure exerted is equal to the sum of the partial pressures of each individual gas:
$$
P_{total} = P_1 + P_2 + P_3 + ...
$$

Applications of Gas Laws

Gas laws are employed in various fields, which include but are not limited to:

- Meteorology: Understanding atmospheric pressure and weather patterns.
- Engineering: Designing systems such as engines and HVAC units.
- Medicine: Analyzing respiratory systems and the behavior of anesthetic gases.
- Chemistry: Conducting experiments involving gas reactions.

Gas Law Review Problems

To fully grasp gas laws, practice problems are essential. Below are some example problems along with their solutions, which can serve as a gas law review answer key.

Example Problems

1. Boyle's Law Problem: A gas occupies a volume of 2.0 L at a pressure of 1.0 atm. What will be the volume when the pressure is increased to 2.0 atm, assuming the temperature

remains constant?

Solution: Using Boyle's Law:
$$
P_1 V_1 = P_2 V_2
$$
$$
(1.0 \, \text{atm})(2.0 \, \text{L}) = (2.0 \, \text{atm})(V_2)
$$
$$
V_2 = \frac{(1.0 \, \text{atm})(2.0 \, \text{L})}{2.0 \, \text{atm}} = 1.0 \, \text{L}
$$

2. Charles's Law Problem: A balloon has a volume of 3.0 L at a temperature of 300 K. What will be the volume at 600 K if the pressure remains constant?

Solution: Using Charles's Law:
$$
\frac{V_1}{T_1} = \frac{V_2}{T_2}
$$
$$
\frac{3.0 \, \text{L}}{300 \, \text{K}} = \frac{V_2}{600 \, \text{K}}
$$
$$
V_2 = \frac{3.0 \, \text{L} \times 600 \, \text{K}}{300 \, \text{K}} = 6.0 \, \text{L}
$$

3. Ideal Gas Law Problem: Calculate the pressure exerted by 2 moles of an ideal gas in a 10 L container at a temperature of 300 K.

Solution: Using the Ideal Gas Law:
$$
PV = nRT
$$
Rearranging for P:
$$
P = \frac{nRT}{V}
$$
$$
P = \frac{(2 \, \text{mol})(0.0821 \, \text{L atm/(K mol)})(300 \, \text{K})}{10 \, \text{L}} = 49.26 \, \text{atm}
$$

4. Dalton's Law Problem: A container holds three gases: Gas A has a pressure of 2.0 atm, Gas B has a pressure of 3.0 atm, and Gas C has a pressure of 1.0 atm. What is the total pressure in the container?

Solution: Using Dalton's Law:
$$
P_{total} = P_A + P_B + P_C = 2.0 \, \text{atm} + 3.0 \, \text{atm} + 1.0 \, \text{atm} = 6.0 \, \text{atm}
$$

\]

Conclusion

Understanding the principles of gas laws is fundamental in both academic and practical applications. The gas law review answer key provided above serves not only as a means for students to check their work but also as a reference for educators preparing lesson plans. Mastery of these concepts will pave the way for advanced studies in chemistry, physics, and engineering, allowing students to tackle more complex scientific challenges in the future. By continually practicing these gas law problems and their solutions, learners can solidify their understanding and application of these essential scientific principles.

Frequently Asked Questions

What is the ideal gas law formula?

The ideal gas law formula is PV = nRT, where P is pressure, V is volume, n is the number of moles of gas, R is the ideal gas constant, and T is temperature in Kelvin.

How do you convert Celsius to Kelvin for gas law calculations?

To convert Celsius to Kelvin, add 273.15 to the Celsius temperature. For example, 25°C is 25 + 273.15 = 298.15 K.

What conditions are ideal for gases to follow the ideal gas law?

Gases behave ideally under high temperature and low pressure conditions, where intermolecular forces are negligible.

What is the significance of the gas constant (R) in the ideal gas law?

The gas constant (R) relates the pressure, volume, temperature, and amount of gas in the ideal gas law. Its value is 0.0821 L·atm/(K·mol) or 8.314 J/(K·mol) depending on the units used.

What happens to gas pressure if the volume is decreased at constant temperature?

According to Boyle's Law, if the volume of a gas is decreased while keeping the temperature constant, the pressure will increase.

How does temperature affect gas volume at constant pressure?

According to Charles's Law, if the temperature of a gas increases at constant pressure, its volume will also increase.

What is Dalton's Law of Partial Pressures?

Dalton's Law states that the total pressure of a mixture of gases is equal to the sum of the partial pressures of each individual gas in the mixture.

How do you calculate the molar mass of a gas using the ideal gas law?

To calculate the molar mass (M) of a gas, you can rearrange the ideal gas law to $M = (mRT)/(PV)$, where m is the mass of the gas, R is the gas constant, T is temperature, P is pressure, and V is volume.

What is the relationship between gas temperature and kinetic energy?

The average kinetic energy of gas particles is directly proportional to the absolute temperature of the gas. As temperature increases, the kinetic energy of the particles also increases.

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