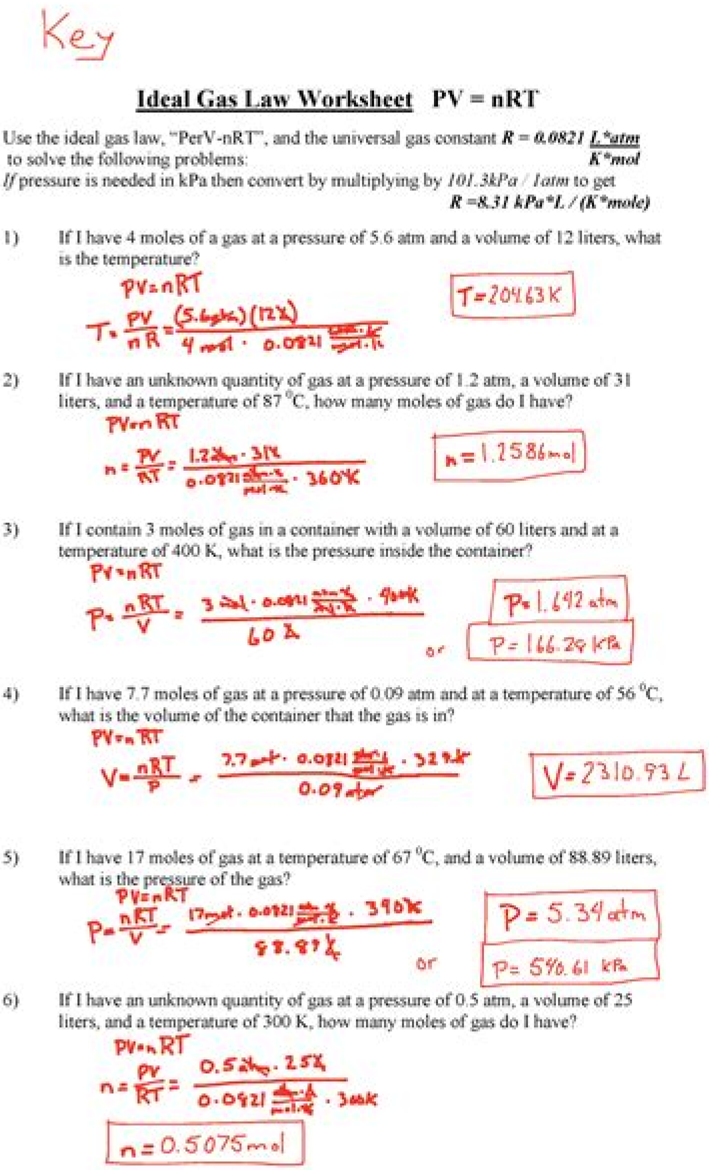
Ideal Gas Law Worksheet Answers



Key

Ideal Gas Law Worksheet PV = nRT

Use the ideal gas law, "PerV-nRT", and the universal gas constant *R = 0.0821 L*atm / K*mol* to solve the following problems:

If pressure is needed in kPa then convert by multiplying by *101.3kPa / 1atm* to get *R =8.31 kPa*L / (K*mole)*

1) If I have 4 moles of a gas at a pressure of 5.6 atm and a volume of 12 liters, what is the temperature?

$PV=nRT$

$T=\frac{PV}{nR}=\frac{(5.6\,\cancel{atm})(12\,\cancel{L})}{4\,\cancel{mol}\cdot 0.0821\,\frac{\cancel{L}\cdot\cancel{atm}}{\cancel{mol}\cdot K}}$

$\boxed{T=204.63\,K}$

2) If I have an unknown quantity of gas at a pressure of 1.2 atm, a volume of 31 liters, and a temperature of 87 °C, how many moles of gas do I have?

$PV=nRT$

$n=\frac{PV}{RT}=\frac{1.2\,\cancel{atm}\cdot 31\,\cancel{L}}{0.0821\,\frac{\cancel{atm}\cdot\cancel{L}}{mol\cdot\cancel{K}}\cdot 360\,\cancel{K}}$

$\boxed{n=1.2586\,mol}$

3) If I contain 3 moles of gas in a container with a volume of 60 liters and at a temperature of 400 K, what is the pressure inside the container?

$PV=nRT$

$P=\frac{nRT}{V}=\frac{3\,\cancel{mol}\cdot 0.0821\,\frac{atm\cdot\cancel{L}}{\cancel{mol}\cdot\cancel{K}}\cdot 400\,\cancel{K}}{60\,\cancel{L}}$

$\boxed{P=1.642\,atm}$ or $\boxed{P=166.29\,kPa}$

4) If I have 7.7 moles of gas at a pressure of 0.09 atm and at a temperature of 56 °C, what is the volume of the container that the gas is in?

$PV=nRT$

$V=\frac{nRT}{P}=\frac{7.7\,\cancel{mol}\cdot 0.0821\,\frac{\cancel{atm}\cdot L}{\cancel{mol}\cdot\cancel{K}}\cdot 329\,\cancel{K}}{0.09\,\cancel{atm}}$

$\boxed{V=2310.93\,L}$

5) If I have 17 moles of gas at a temperature of 67 °C, and a volume of 88.89 liters, what is the pressure of the gas?

$PV=nRT$

$P=\frac{nRT}{V}=\frac{17\,\cancel{mol}\cdot 0.0821\,\frac{atm\cdot\cancel{L}}{\cancel{mol}\cdot\cancel{K}}\cdot 390\,\cancel{K}}{88.89\,\cancel{L}}$

$\boxed{P=5.34\,atm}$ or $\boxed{P=540.61\,kPa}$

6) If I have an unknown quantity of gas at a pressure of 0.5 atm, a volume of 25 liters, and a temperature of 300 K, how many moles of gas do I have?

$PV=nRT$

$n=\frac{PV}{RT}=\frac{0.5\,\cancel{atm}\cdot 25\,\cancel{L}}{0.0821\,\frac{\cancel{atm}\cdot\cancel{L}}{mol\cdot\cancel{K}}\cdot 300\,\cancel{K}}$

$\boxed{n=0.5075\,mol}$

Ideal gas law worksheet answers are essential for students studying chemistry and physics as they help solidify the understanding of the relationships between pressure, volume, temperature, and the number of moles of a gas. The ideal gas law is a fundamental equation that describes the behavior of ideal gases, and mastering it is crucial for success in various scientific applications. This article will delve into the ideal gas law, its components, applications, and how to approach typical worksheets involving the law.

Understanding the Ideal Gas Law

The ideal gas law combines several other gas laws into a single equation. It is expressed as:

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PV = nRT

Where:
- P is the pressure of the gas (in atmospheres, pascals, etc.)
- V is the volume of the gas (in liters or cubic meters)
- n is the number of moles of the gas
- R is the ideal gas constant (0.0821 L·atm/(K·mol) or 8.314 J/(K·mol))
- T is the temperature of the gas (in Kelvin)
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Components of the Ideal Gas Law

To effectively work with the ideal gas law, it is essential to understand each component:

- **Pressure (P):** The force exerted by gas particles colliding with the walls of their container. It can be measured in various units, including atmospheres (atm), pascals (Pa), or torr.
- **Volume (V):** The amount of space the gas occupies, typically measured in liters (L) or cubic meters (m^3).
- **Number of moles (n):** A measure of how many molecules of gas are present, expressed in moles (mol).
- **Temperature (T):** The measure of the average kinetic energy of gas particles, always expressed in Kelvin (K) for gas law calculations.
- **Ideal gas constant (R):** A proportionality constant that relates the units used for pressure, volume, temperature, and the number of moles.

Applications of the Ideal Gas Law

The ideal gas law is widely used in chemistry, physics, and engineering. Here are some common applications:

1. **Calculating gas properties:** The ideal gas law allows for the calculation of any one of the four variables (P, V, n, T) if the others are known.
2. **Understanding gas behavior:** It helps explain how gases behave under different conditions of temperature and pressure.
3. **Real-world applications:** The ideal gas law is utilized in various fields, such as meteorology, automotive engineering, and the study of

respiration in biology.

4. **Stoichiometry of gas reactions:** It aids in determining the amounts of gases involved in chemical reactions.

How to Solve Ideal Gas Law Problems

When working with ideal gas law problems, follow these steps:

1. **Identify known variables:** Determine which variables (P, V, n, T) you have and which you need to find.
2. **Convert units:** Ensure all units are consistent. Convert temperature to Kelvin and, if necessary, convert pressure and volume to the appropriate units.
3. **Rearrange the equation:** If necessary, rearrange the ideal gas law equation to solve for the unknown variable.
4. **Plug in values:** Substitute the known values into the rearranged equation.
5. **Calculate:** Perform the calculation to find the unknown variable.

Sample Ideal Gas Law Worksheet Problems and Answers

To help you understand how to apply the ideal gas law, here are some sample worksheet problems along with their answers:

Problem 1

A gas occupies a volume of 10.0 L at a pressure of 2.00 atm and a temperature of 300 K. How many moles of gas are present?

Solution:

1. Identify known variables: $V = 10.0$ L, $P = 2.00$ atm, $T = 300$ K, $R = 0.0821$ L·atm/(K·mol).
2. Rearrange the ideal gas law: $n = PV / RT$.
3. Plug in values: $n = (2.00 \text{ atm}) (10.0 \text{ L}) / (0.0821 \text{ L·atm/(K·mol)} 300 \text{ K})$.
4. Calculate: $n \approx 0.81$ moles.

Problem 2

How much volume will 2.5 moles of an ideal gas occupy at a pressure of 1.5 atm and a temperature of 250 K?

Solution:

1. Identify known variables: $n = 2.5$ moles, $P = 1.5$ atm, $T = 250$ K, $R = 0.0821$ L·atm/(K·mol).
2. Rearrange the ideal gas law: $V = nRT / P$.
3. Plug in values: $V = (2.5 \text{ moles}) (0.0821 \text{ L·atm/(K·mol)}) (250 \text{ K}) / (1.5 \text{ atm})$.
4. Calculate: $V \approx 41.7$ L.

Common Mistakes to Avoid

When working with the ideal gas law, students often make some common errors:

- **Incorrect unit conversions:** Always double-check that pressure, volume, and temperature are in the correct units before using them in calculations.
- **Forgetting to use Kelvin:** Temperature must always be in Kelvin when using the ideal gas law; failing to convert can lead to incorrect results.
- **Neglecting significant figures:** Pay attention to significant figures based on the precision of the measurements given in the problem.

Conclusion

In summary, **ideal gas law worksheet answers** provide invaluable insights into the behavior of gases and reinforce essential concepts in chemistry and physics. By understanding the components of the ideal gas law, applying it to various problems, and avoiding common pitfalls, students can enhance their grasp of gas behavior and excel in their scientific studies. Mastering the ideal gas law opens up a world of possibilities in both theoretical and practical applications, making it a crucial topic in the sciences.

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 calculate the number of moles using the ideal gas law?

You can calculate the number of moles (n) by rearranging the ideal gas law to $n = PV / RT$.

What units should pressure, volume, and temperature be in for the ideal gas law?

Pressure should be in atmospheres (atm) or Pascals (Pa), volume in liters (L) or cubic meters (m^3), and temperature in Kelvin (K).

What is the ideal gas constant (R) value in different units?

The ideal gas constant R is approximately 0.0821 L·atm/(K·mol) when using liters and atmospheres, and 8.314 J/(K·mol) when using Joules.

How does the ideal gas law apply to real gases?

The ideal gas law is an approximation that assumes no intermolecular forces and that gas particles occupy no volume. Real gases deviate from this behavior under high pressure and low temperature.

What are common mistakes when solving ideal gas law problems?

Common mistakes include using incorrect units, not converting temperature to Kelvin, and misunderstanding the relationships between pressure, volume, and temperature.

Can the ideal gas law be used for mixtures of gases?

Yes, the ideal gas law can be used for mixtures of gases by applying Dalton's Law of Partial Pressures, where the total pressure is the sum of the partial pressures of each gas.

What is the significance of the ideal gas law in chemistry?

The ideal gas law is significant in chemistry because it relates the macroscopic properties of gases and helps predict how gases will behave under varying conditions.

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