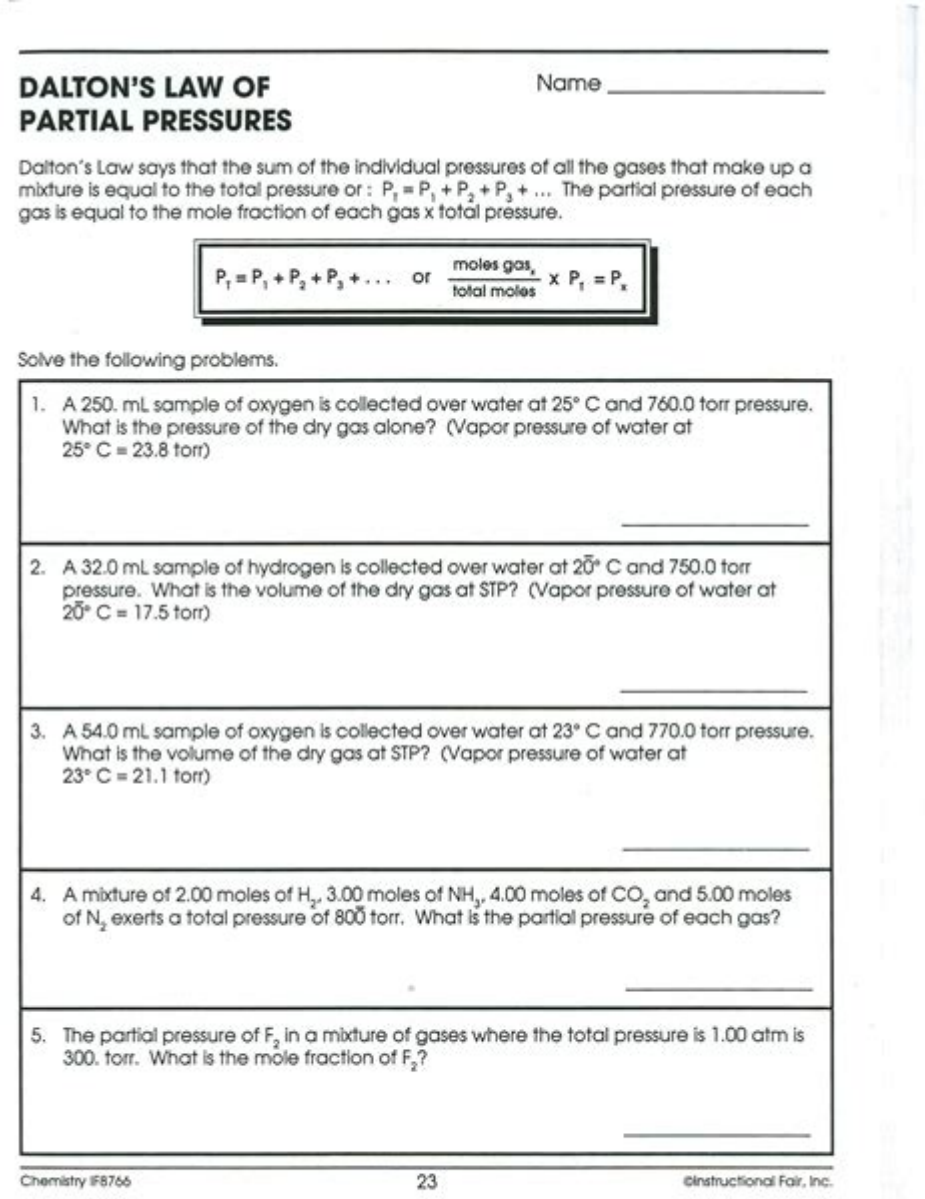
Daltons Law Of Partial Pressure Worksheet With Answers



DALTON'S LAW OF PARTIAL PRESSURES

Name _____

Dalton's Law says that the sum of the individual pressures of all the gases that make up a mixture is equal to the total pressure or : $P_T = P_1 + P_2 + P_3 + \ldots$ The partial pressure of each gas is equal to the mole fraction of each gas x total pressure.

$$P_T = P_1 + P_2 + P_3 + \ldots \quad \text{or} \quad \frac{\text{moles gas}_x}{\text{total moles}} \times P_T = P_x$$

Solve the following problems.

1. A 250. mL sample of oxygen is collected over water at 25° C and 760.0 torr pressure. What is the pressure of the dry gas alone? (Vapor pressure of water at 25° C = 23.8 torr)

2. A 32.0 mL sample of hydrogen is collected over water at 20° C and 750.0 torr pressure. What is the volume of the dry gas at STP? (Vapor pressure of water at 20° C = 17.5 torr)

3. A 54.0 mL sample of oxygen is collected over water at 23° C and 770.0 torr pressure. What is the volume of the dry gas at STP? (Vapor pressure of water at 23° C = 21.1 torr)

4. A mixture of 2.00 moles of H_2, 3.00 moles of NH_3, 4.00 moles of CO_2 and 5.00 moles of N_2 exerts a total pressure of 800 torr. What is the partial pressure of each gas?

5. The partial pressure of F_2 in a mixture of gases where the total pressure is 1.00 atm is 300. torr. What is the mole fraction of F_2?

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Dalton's Law of Partial Pressure Worksheet with Answers is a valuable educational tool for students learning about gases and their behaviors. This law, formulated by John Dalton in the early 19th century, states that in a mixture of non-reacting gases, the total pressure exerted is equal to the sum of the partial pressures of each gas in the mixture. This principle has significant applications in various fields, including chemistry, physics, and engineering. In this article, we will explore the fundamentals of Dalton's Law, provide a worksheet for practice, and present answers to enhance understanding.

Understanding Dalton's Law of Partial Pressure

Dalton’s Law can be mathematically represented as:

$$ P_{total} = P_1 + P_2 + P_3 + ... + P_n $$

where:
- P_{total} is the total pressure of the gas mixture.
- $P_1, P_2, P_3, ..., P_n$ are the partial pressures of the individual gases.

What is Partial Pressure?

Partial pressure refers to the pressure that a single gas in a mixture would exert if it occupied the entire volume alone at the same temperature. Understanding partial pressure is crucial for calculations involving gas mixtures, especially in reactions occurring in gaseous states.

Applications of Dalton's Law

Dalton's Law of Partial Pressure is essential for several applications, including:

1. Respiratory Physiology: Understanding how gases behave in the lungs and bloodstream.
2. Chemical Reactions: Predicting the behavior of gases in reactions based on their individual pressures.
3. Environmental Studies: Assessing the impact of various gases in the atmosphere.
4. Engineering: Designing equipment that involves gas mixtures, such as reactors and compressors.

Worksheet on Dalton's Law of Partial Pressure

To help reinforce the understanding of Dalton's Law, here is a worksheet that contains problems related to the calculation of partial pressures.

Worksheet Instructions: Solve the following problems using Dalton's Law of Partial Pressure. Show all calculations clearly.

Problem 1: A container holds a mixture of three gases: Nitrogen (N_2), Oxygen (O_2), and Carbon Dioxide (CO_2). The partial pressures of the gases are as follows:
- $P_{N2} = 400 \, \text{mmHg}$
- $P_{O2} = 200 \, \text{mmHg}$
- $P_{CO2} = 100 \, \text{mmHg}$

Calculate the total pressure in the container.

Problem 2: In a sealed container, there are 2 moles of Helium (He) and 3 moles of Argon (Ar). If the total pressure in the container is 600 mmHg, find the partial pressure of each gas.

Problem 3: A gas mixture consists of 1 mole of Methane (CH_4), 2 moles of Ethane (C_2H_6), and 3 moles of Propane (C_3H_8). If the total pressure of the mixture is 900 mmHg, calculate the partial pressure of each gas.

Problem 4: A balloon filled with a mixture of gases has a total pressure of 800 mmHg. The partial pressure of Helium is 300 mmHg, and the partial pressure of Neon is 200 mmHg. What is the partial pressure of the remaining gas?

Answers to the Worksheet

Below are the answers to the worksheet problems, along with explanations for each solution.

Answer to Problem 1

Given:
- $P_{N2} = 400 \, \text{mmHg}$
- $P_{O2} = 200 \, \text{mmHg}$
- $P_{CO2} = 100 \, \text{mmHg}$

Solution:
Using Dalton's Law:

$$P_{total} = P_{N2} + P_{O2} + P_{CO2}$$
$$P_{total} = 400 \, \text{mmHg} + 200 \, \text{mmHg} + 100 \, \text{mmHg}$$
$$P_{total} = 700 \, \text{mmHg}$$

Total Pressure: 700 mmHg.

Answer to Problem 2

Given:
- Moles of He = 2
- Moles of Ar = 3
- Total Pressure = 600 mmHg

Solution:
First, calculate the total number of moles:

$$n_{total} = n_{He} + n_{Ar} = 2 + 3 = 5$$

Next, calculate the mole fractions:

$$\text{Mole fraction of He} = \frac{n_{He}}{n_{total}} = \frac{2}{5}$$
$$\text{Mole fraction of Ar} = \frac{n_{Ar}}{n_{total}} = \frac{3}{5}$$

Now, calculate the partial pressures:

$$ P_{He} = \text{Mole fraction of He} \times P_{total} = \frac{2}{5} \times 600 \, \text{mmHg} = 240 \, \text{mmHg} $$
$$ P_{Ar} = \text{Mole fraction of Ar} \times P_{total} = \frac{3}{5} \times 600 \, \text{mmHg} = 360 \, \text{mmHg} $$

Partial Pressures:
- He = 240 mmHg
- Ar = 360 mmHg

Answer to Problem 3

Given:
- Moles of CH_4 = 1
- Moles of C_2H_6 = 2
- Moles of C_3H_8 = 3
- Total Pressure = 900 mmHg

Solution:
Total moles:

$$ n_{total} = 1 + 2 + 3 = 6 $$

Mole fractions:

$$ \text{Mole fraction of } CH_4 = \frac{1}{6} $$
$$ \text{Mole fraction of } C_2H_6 = \frac{2}{6} $$
$$ \text{Mole fraction of } C_3H_8 = \frac{3}{6} $$

Calculate the partial pressures:

$$ P_{CH_4} = \frac{1}{6} \times 900 = 150 \, \text{mmHg} $$
$$ P_{C_2H_6} = \frac{2}{6} \times 900 = 300 \, \text{mmHg} $$
$$ P_{C_3H_8} = \frac{3}{6} \times 900 = 450 \, \text{mmHg} $$

Partial Pressures:
- CH_4 = 150 mmHg
- C_2H_6 = 300 mmHg
- C_3H_8 = 450 mmHg

Answer to Problem 4

Given:
- Total Pressure = 800 mmHg
- $P_{He} = 300 \, \text{mmHg}$
- $P_{Ne} = 200 \, \text{mmHg}$

Solution:
Calculate the partial pressure of the remaining gas (let's call it Gas X):

$$ P_{total} = P_{He} + P_{Ne} + P_{X} $$
$$ 800 = 300 + 200 + P_{X} $$
$$ P_{X} = 800 - 300 - 200 = 300 \, \text{mmHg} $$

Partial Pressure of Remaining Gas (Gas X): 300 mmHg.

Conclusion

The Dalton's Law of Partial Pressure Worksheet with Answers provides a practical approach to understanding this fundamental principle of gas behavior. By working through the problems, students can gain insight into how gases interact in mixtures and the significance of partial pressures in various scientific applications. Mastery of these concepts is crucial for further studies in chemistry, physics, and engineering, making Dalton's Law an essential topic in the study of gases.

Frequently Asked Questions

What is Dalton's Law of Partial Pressures?

Dalton's 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 gas in the mixture.

How do you calculate the partial pressure of a gas in a mixture using Dalton's Law?

To calculate the partial pressure of a gas, you can use the formula: P_total = P1 + P2 + P3 + ... + Pn, where P_total is the total pressure and P1, P2, P3, ..., Pn are the partial pressures of each individual gas.

What units are used for pressure in Dalton's Law calculations?

Pressure can be measured in various units, including atmospheres (atm), millimeters of mercury (mmHg), or pascals (Pa). It's important to use consistent units when performing calculations.

How can Dalton's Law be applied in real-world situations?

Dalton's Law can be applied in various fields such as chemistry, medicine, and environmental science, for example, in calculating the composition of gases in the atmosphere or in determining the partial pressures of gases in respiratory physiology.

What is a common worksheet problem related to Dalton's Law?

A common problem might ask you to find the total pressure of a gas mixture containing 3 moles of gas A at 2 atm, 2 moles of gas B at 1.5 atm, and 1 mole of gas C at 1 atm, requiring you to apply Dalton's Law to find the total pressure.

Can Dalton's Law be applied to gaseous mixtures at varying temperatures?

Yes, but the gases must be at the same temperature for the law to apply accurately since temperature affects gas pressure. If the gases are at different temperatures, adjustments or separate calculations may be needed.

What is the significance of the partial pressure concept in gas laws?

The concept of partial pressure is significant because it allows for the analysis of gas mixtures as if they were individual gases, simplifying calculations and applications in both theoretical and practical scenarios.

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