GENERAL CHEMISTRY STANDARD 9.6

9.6: Use Dalton's Law of Partial Pressures to describe different mixed-gas situations

DEFINITIONS

- **Dalton's Law of Partial Pressures:** In a mixture of non-reacting gases, the total pressure exerted is equal to the sum of the partial pressures of each of the individual gases

$P_T = P_1 + P_2 + P_3 + \ldots + P_n$

P_T = Total Pressure

P_n = Individual Partial Pressures (consistent units)

EXAMPLE

- A sample of gas A evaporates over water in a closed system. What is the pressure of gas A if the total pressure is 1.3 atm and the water vapor pressure is 1.0 atm?

To find the pressure of gas A, use Dalton's Law of Partial Pressures

No need to convert units as they are already in the same units

Step 1

$P_T = 1.5$ atm
$P_1 = 1.0$ atm
$P_2 = ?$

Step 2

$P_T = P_1 + P_2$

Step 3

$P_T - P_1 = P_2$

Step 4

$1.5 \text{ atm} - 1 \text{ atm} = P_2$

Step 5

$P_2 = 0.5$ atm

ANOTHER EXAMPLE

- Find the total pressure if 500. mm Hg of nitrogen, 250. kPa of neon, and 250. torr of oxygen are combined together in one vessel and do not react.

  First, need to convert the units to one consistent unit for all measurements of pressure:

$$\frac{500.\ \text{mm Hg}}{1} \times \frac{101.3\ \text{kPa}}{760.\ \text{mm Hg}} = 66.6\ \text{kPa}$$

$$\frac{250.\ \text{torr}}{1} \times \frac{101.3\ \text{kPa}}{760.\ \text{torr}} = 33.3\ \text{kPa}$$

Step 1

$P_T = ?$
$P_1 = 66.6$ kPa
$P_2 = 33.3$ kPa
$P_3 = 250.$ kPa

Step 2

$P_T = P_1 + P_2 + P_3$

Step 3

$P_T = P_1 + P_2 + P_3$

Step 4

66.6 kPa + 33.3 kPa + 250. kPa = P_T

Step 5

$P_T = 349.9$ kPa

TRY IT YOURSELF

- The pressure of a mixture of nitrogen, carbon dioxide, and oxygen is 150. kPa. What is the partial pressure of oxygen if the partial pressures of nitrogen and carbon dioxide are 100. kPa and 0.25 atm, respectively?

TRY IT YOURSELF SOLUTION

- The pressure of a mixture of nitrogen, carbon dioxide, and oxygen is 150. kPa. What is the partial pressure of oxygen if the partial pressures of nitrogen and carbon dioxide are 100. kPa and 0.25 atm, respectively?

$$\frac{0.25\ \text{atm}}{} \left| \frac{101.3\ \text{kPa}}{1.0\ \text{atm}} \right. = 25.3\ \text{kPa}$$

Step 1

$P_T = 150.\ \text{kPa}$
$P_1 = 100.\ \text{kPa}$
$P_2 = 25.3\ \text{kPa}$
$P_3 = ?$

Step 2

$P_T = P_1 + P_2 + P_3$

Step 3

$P_3 = P_T - P_2 - P_3$

Step 4

$P_3 – 150.\ \text{kPa} – 100.\ \text{kPa} – 25.3\ \text{kPa}$

Step 5

$P_T = 24.7\ \text{kPa}$