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Chemistry - Ideal Gas Law

Calculating Pressure Using Ideal Gas Law

> **Given:**
> - Volume (\(V\)) = 17.3 L
> - Amount of substance (\(n\)) = 0.500 mol
> - Temperature (\(T\)) = 20°C

Introduction:

The problem involves calculating the pressure of a gas contained within a specified volume, at a certain temperature, given the amount of gas (in moles). Use the Ideal Gas Law, which states:

\(PV = nRT \)

where \(P\) is the pressure of the gas, \(V\) is the volume, \(n\) is the number of moles, \(R\) is the ideal gas constant, and \(T\) is the temperature in Kelvin.

Step 1: Convert Temperature to Kelvin

> \(T(K) = T(°C) + 273.15\)
>
> \(T(K) = 20 + 273.15 = 293.15 \text{ K}\)

Explanation and Supporting Statement: The temperature conversion from Celsius to Kelvin is necessary because the Ideal Gas Law requires temperature in Kelvin.

Step 2: Identify and Use the Ideal Gas Constant (\(R\))

> - The ideal gas constant \(R\) = 0.0821 L·atm/(K·mol)

Explanation and Supporting Statement: The ideal gas constant is a necessary constant for solving the Ideal Gas Law equation when pressure is needed in atmospheres and volume in liters.

Step 3: Substitute All Known Values into the Ideal Gas Law Equation

> \(P = \frac{nRT}{V}\)
>
> \(P = \frac{(0.500 \text{ mol}) \times (0.0821 \text{ L·atm/K·mol}) \times (293.15 \text{ K})}{17.3 \text{ L}}\)

Explanation and Supporting Statement: By substituting the known values of \(n\), \(R\), \(T\), and \(V\) into the Ideal Gas Law equation, calculate the pressure \(P\).

Step 4: Perform the Calculation

> \(P = \frac{(0.500 \times 0.0821 \times 293.15)}{17.3}\)
>
> \(P = \frac{12.027}{17.3}\)
>
> \(P \approx 0.695 \text{ atm}\)

Explanation and Supporting Statement: The arithmetic calculations have been carried out to solve for the pressure \(P\), ensuring precision at each step.

Final Solution:

The pressure of the gas in the container is approximately **0.695 atm**