Question: How many moles of ideal gas are in a 325 mL container that has a pressure of 695 torr at 19 °C?

A. $1.24 \times 10{-}2$ mol
B. $1.48 \times 10{-}2$ mol
C. 9.42 mol
D. 12.4 mol
E. 80.6 mol

HINT: What do you wan to determine? What equation can be used to calculate this?

Concepts: To answer this question we need to recognize that the ideal gas equation of state can be used to determine the quantity (moles) of a gas when we are given experimental information about the gas.

Connections:

What is given? We are told that we have an ideal gas. We are also given experimental information that describes the state of the gas: the volume, pressure and temperature.

What do I want to know? We want to know how much of the gas is present, that is how many moles of the gas are present.

The Ideal Gas Law is what we call an "equation of state." This means that when taken together, the variables in the ideal gas law define the state of a sample completely, i.e., it tells us essentially everything we need to know except for the identity of the sample.

$PV = nRT$ *Ideal Gas Law*

The variables in this equation are P (pressure), V (volume), T (temperature) and n (moles). R is a constant. For a prpoblem where the data given is in terms of pressure and volume, we use the gas constant: 0.0821 L-atm/(K-mol). (If teh experimental data given is realted to energy (or speeds) we use 8.314 J/(mol-K))

In this problem, after gathering all of the infomation given, we realize that we know P, V and T and we want to find n. Therefore we can rearrange the ideal gas law to solve for the number of moles.

$n = PV/(RT)$

Finally: it is important when solving this equation to make sure that all of the experimental information is in units that will cancel with the gas constant R. We are not always given information in those units, so the first step when uisng the ideal gas equation will be to convert all measurements into the same units as the unit of the gas constant.

Be sure you understand everything above before moving on to the solution below.

Solution:

Summarize the information that we are given.

P = 695 torr V = 325 mL T = 19°C

We know P, V and T and we want to find the number of moles: n. Therefore we can rearrange the ideal gas law to solve for the number of moles.

n = PV/(RT)

Since we are dealing with pressure and volume (not energy) units, we will want to use R= 0.0821 L-atm/mol-K

As we can see from the R value we need to convert our given information into different units. Pressure must be in atmospheres, volume in liters and temperature in Kelvin:

P = 695 torr/760 torr/atm = 0.9145 atm

V = 325 mL/1000 mL/L = 0.325 L

T = 19°C + 273.15 = 292.15 K

Now we can substitue these values into the ideal gas equation of state:

PV=nRT

n = PV/RT

(0.9145 atm)(0.325 L)/[(0.0821 L-atm/mol-K)(292.15 K)] = 1.24×10^{-2} mol

Answer :A