SAMPLE PROBLEM I

What is the pressure in atmospheres exerted by a 0.500 mol sample of nitrogen gas in a 10.0 L container at 298 K?

SOLUTION

1 ANALYZE

Given: V of $N_2 = 10.0$ L
n of $N_2 = 0.500$ mol
T of $N_2 = 298$ K

Unknown: P of N_2 in atm

2 PLAN

$$n, V, T \longrightarrow P$$

The gas sample undergoes no change in conditions. Therefore, the ideal gas law can be rearranged and used to find the pressure as follows.

$$P = \frac{nRT}{V}$$

3 COMPUTE

$$P = \frac{(0.500\ \text{mol})\left(\frac{0.0821\ \text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}\right)(298\ \text{K})}{10.0\ \text{L}} = 1.22\ \text{atm}$$

4 EVALUATE

All units cancel correctly to give the result in atmospheres. The answer is properly limited to three significant figures. It is also close to an estimated value of 1.5, computed as $(0.5 \times 0.1 \times 300)/10$.

PRACTICE

Answers in Appendix E

1. What pressure, in atmospheres, is exerted by 0.325 mol of hydrogen gas in a 4.08 L container at 35°C?
2. A gas sample occupies 8.77 L at 20°C. What is the pressure, in atmospheres, given that there are 1.45 mol of gas in the sample?

extension
Go to **go.hrw.com** for more practice problems that ask you to use the ideal gas law.
Keyword: HC6GASX

SECTION REVIEW

1. State Avogadro's law, and explain its significance.
2. What volume (in milliliters) at STP will be occupied by 0.0035 mol of methane, CH_4?
3. State the ideal gas law equation, and tell what each term means.
4. What would be the units for R if P is in pascals, T is in kelvins, V is in liters, and n is in moles?
5. A 4.44 L container holds 15.4 g of oxygen at 22.55°C. What is the pressure?
6. A tank of hydrogen gas has a volume of 22.9 L and holds 14.0 mol of the gas at 12°C. What is the pressure of the gas in atmospheres?

Critical Thinking

7. **ANALYZING DATA** Nitrous oxide is sometimes used as a source of oxygen gas:

$$2N_2O(g) \longrightarrow 2N_2(g) + O_2(g)$$

What volume of each product will be formed from 2.22 L N_2O? At STP, what is the density of the product gases when they are mixed?