

Volume-Volume and Mass-Volume Problems

Volume-volume problems involve direct comparison of the coefficients in a balanced equation. The reason is that equal volumes of gases at the same temperature and pressure contain equal numbers of moles and molecules. Also involved is the fact that at STP the volume of a gas is equal to 22.4 L/mole. Calculation of numbers of molecules involves the use of Avogadro's number, 6.02×10^{23} molecules/mole.

Examples

How many liters of HCl gas can be produced from 10 L of Cl_2 gas by the reaction $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$?

$$1:2 = 10 \text{ L} : ? \text{ L} \quad ? = 20 \text{ L}$$

How many grams of hydrogen gas (H_2) are needed to produce 5.00 L of water vapor, measured at STP, according to the reaction $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$? ($\text{H} = 1.00 \text{ g/mole}$; $\text{O} = 16.0 \text{ g/mole}$)

$$\frac{5.00 \text{ L}}{22.4 \text{ L/mole}} = .223 \text{ moles of } \text{H}_2\text{O vapor}$$

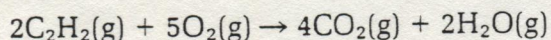
$$2:2 = ? \text{ moles } \text{H}_2 : .223 \text{ moles } \text{H}_2\text{O} \quad ? = .223 \text{ moles } \text{H}_2$$
$$.223 \text{ moles} \times 2.00 \text{ g/mole} = .446 \text{ g } \text{H}_2$$

How many H_2 molecules are there in .223 moles of H_2 at STP?

$$.223 \text{ moles} \times 6.02 \times 10^{23} \text{ molecules/mole} = 1.34 \times 10^{23} \text{ molecules } \text{H}_2$$

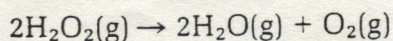
Solve the following problems. Show your work.

1. How many liters of CO_2 can be produced from 14.5 L of C_2H_2 by the reaction



1. _____

2. How many liters of oxygen are released from the decomposition of 3.6 L of hydrogen peroxide gas (H_2O_2) to produce water vapor and oxygen? (Write the balanced equation for the reaction as part of your work.)



2. _____

Volume-Volume and Mass-Volume Problems (Continued)

3. How many grams of zinc ($\text{Zn} = 65.4 \text{ g/mole}$) are required to produce 67.2 L of hydrogen gas at STP, according to the reaction



3. _____

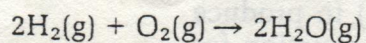
4. a. How many liters of Cl_2 gas at STP can be produced by decomposing 70.0 g of HCl gas? ($\text{H} = 1.00 \text{ g/mole}$; $\text{Cl} = 35.5 \text{ g/mole}$) (Include a balanced equation in your work.)

4a. _____

- b. How many Cl_2 molecules would be produced?

b. _____

5. How many liters of H_2O vapor could be produced by the reaction of 9.03×10^{23} molecules of O_2 , according to the reaction



5. _____