Name Key Section _____ Date _____

7C Chemical Quantities
Extra Practice Problems

Converting with Moles

Chemists often need to know about the quantitative relationships among the elements and compounds involved in a chemical reaction. These relationships may involve masses and/or volumes. For example, a chemist might want to know what volume of gas is produced when a certain mass of a compound is heated. The concept of moles is the key idea that makes it possible for chemists to deal easily and efficiently with all mass and volume relationships in chemical reactions. The following exercise illustrates methods of converting among moles, mass, and volume.

Example A

What is the mass in grams of 4.52 mol of barium chloride, $BaCl_2$?

Solution The problem involves the relationship between the number of grams and the number of moles of a compound. Begin by expressing the conversion factor between these two quantities.

$$1 \text{ mol } BaCl_2 = 208.3 \text{ g } BaCl_2$$

Then write this relationship in such a way as to convert the amount of $BaCl_2$ in moles to its equivalent in grams.

$$4.52 \text{ mol } BaCl_2 \times \frac{208.3 \text{ g } BaCl_2}{1 \text{ mol } BaCl_2} = 941.52 \text{ g } BaCl_2$$

The correct answer, expressed to three significant figures, is 942 g $BaCl_2$.

You Try It

1. In a chemical reaction, 0.397 mole of ethyl chloride (C_2H_5Cl) is produced. What is the mass in grams of this amount of C_2H_5Cl?

Your Solution

$$\frac{0.397 \text{ mol} \mid 64.52 \text{ g}}{1 \text{ mol}} = 25.61 \text{ g } C_2H_5Cl$$

Example B

A chemist plans to use 435 g of ammonium nitrate (NH_4NO_3) in a reaction. How many moles of NH_4NO_3 is this?

Solution

1 gram molecular mass of NH_4NO_3 = 80.0 g NH_4NO_3

Use this conversion factor to convert a mass to moles. The problem is as follows.

$$435 \text{ g } NH_4NO_3 \times \frac{1 \text{ mol } NH_4NO_3}{80.0 \text{ g } NH_4NO_3} = 5.44 \text{ mol } NH_4NO_3$$

You Try It

2. A small bottle in the chemistry stockroom contains 43.25 g of nickel(II) carbonate, $NiCO_3$. How many moles of $NiCO_3$ is this?

Your Solution

$$\frac{43.25\ g \mid 1\ mol}{118.7\ g} = 0.364\ mol$$

Example C

What is the volume at STP of 2.66 mol of methane (CH_4) gas?

Solution Remember that for any gas at STP the following is true.

$$1\ mol = 22.4\ L$$

To convert the volume of the gas in moles to its equivalent in liters, multiply as shown below.

$$2.66\ \cancel{mol\ CH_4} \times \frac{22.4\ L\ CH_4}{1\ \cancel{mol\ CH_4}} = 59.5 L\ CH_4$$

Notice that you would obtain the same answer to this problem no matter what gas the problem mentioned.

You Try It

3. What is the equivalent in moles of 135 L of ammonia (NH_3) gas?

Your Solution

Problems For You To Try

4. A nurse has been asked to get 0.0465 mole of quinine ($C_{20}H_{24}N_2O_2$). What mass of quinine should the nurse obtain?

$$\frac{0.0465\ mol \mid 324.44\ g}{1\ mol} = 15.09\ g$$

5. During an electroplating process, 5.8625 g of silver is deposited on a steel bar. How many moles of silver is this?

$$\frac{5.8625\ g \mid 1\ mol}{107.87} = 0.054\ mol$$

6. A helium-filled balloon has a total volume of 136,500 L at STP. How many moles of helium are in the balloon?

$$\frac{136{,}500\ L \mid 1\ mol}{22.4\ L} = 6{,}093.75\ mol$$

7. A chemist is studying one of the five oxides of nitrogen: N_2O, NO, N_2O_3, NO_2, or N_2O_5. He learns that 250 mL of the gas has a mass of 0.335 g. Which oxide is he working with?

$$\frac{250\ mL \mid 1.0\ L \mid 1.0\ mol}{1000\ mL \mid 22.4\ L} = \frac{0.335\ g}{0.0112\ mol} = 30.06\ g/mol$$

$NO = 30.02\ g/mol$