

Name \_\_\_\_\_ Section \_\_\_\_\_ Date \_\_\_\_\_

Worksheet 8B

Chemical Quantities

Extra Practice Problems

**Gram Formula Mass** (Zumdahl page 230)

Atomic, molecular, and formula masses are all relative numbers. That is, they contain no units. Saying that the atomic mass of magnesium is 24 means that its atoms are twice as heavy as those of some other element (carbon) with an atomic mass of 12. It is possible, however, to assign units to atomic, molecular, and formula masses. When the unit grams is used with an atomic mass, we define the gram atomic mass of an element. The gram atomic mass is the mass of one mole of an element. Similarly the gram molecular mass is the mass of one mole of a molecular compound, and the gram formula mass is the mass of one mole of an ionic compound. The term molar mass is a general expression that refers to the gram atomic, molecular, or formula mass of any substance. The exercises below will help you improve your ability to use these concepts.

**Example A**

What is the gram molecular mass of phosphoric acid,  $\text{H}_3\text{PO}_4$ ?

**Solution** The formula for phosphoric acid,  $\text{H}_3\text{PO}_4$  tells you that one mole of this compound consists of three moles of hydrogen atoms, one mole of phosphorus atoms, and four moles of oxygen atoms. The gram molecular mass of  $\text{H}_3\text{PO}_4$  then, can be found by first determining the molar mass of the three elements that make up the compound.

$$\frac{3 \text{ mol H}}{1} \times \frac{1.0 \text{ g H}}{1 \text{ mol H}} = 3.0 \text{ g H}$$

$$\frac{1 \text{ mol P}}{1} \times \frac{31.0 \text{ g P}}{1 \text{ mol}} = 31.0 \text{ g P}$$

$$\frac{4 \text{ mol O}}{1} \times \frac{16.0 \text{ g O}}{1 \text{ mol O}} = 64.0 \text{ g O}$$

Molar Mass of  $\text{H}_3\text{PO}_4$  is  $3.0 \text{ g H} + 31.0 \text{ g P} + 64.0 \text{ g O} = 98.0 \text{ g}$

Therefore, the gram molecular mass of  $\text{H}_3\text{PO}_4$  is 98.0 g.

**You Try It**

1. What is the gram molecular mass of aluminum hydroxide,  $\text{Al}(\text{OH})_3$  ?

Your Solution

### Example B

Find the molar mass of iron (III) sulfate  $\text{Fe}_2(\text{SO}_4)_3$

Solution Each mole of  $\text{Fe}_2(\text{SO}_4)_3$  contains two moles of iron atoms, three moles of sulfur atoms, and 12 moles of oxygen atoms. You can find the molar mass of  $\text{Fe}_2(\text{SO}_4)_3$  by adding the molar mass of each of the three atoms that make up the compound.

$$\frac{2 \text{ mol Fe}}{1} \times \frac{55.8 \text{ g Fe}}{1 \text{ mol Fe}} = 111.6 \text{ g Fe}$$

$$\frac{3 \text{ mol S}}{1} \times \frac{32.1 \text{ g S}}{1 \text{ mol S}} = 96.3 \text{ g S}$$

$$\frac{12 \text{ mol O}}{1} \times \frac{16.0 \text{ g O}}{1 \text{ mol O}} = 192.0 \text{ g O}$$

The molar mass of  $\text{Fe}_2(\text{SO}_4)_3 = 111.6 \text{ g Fe} + 96.3 \text{ g S} + 192.0 \text{ g O} = 399.9 \text{ g}$

### You Try It

2. What is the molar mass of sucrose  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ?

### Problems For You To Try

3. Find the gram molecular mass of *p*-dichlorobenzene,  $\text{C}_6\text{H}_4\text{Cl}_2$ .

4. What is the molar mass of calcium bisulfate  $\text{Ca}(\text{HSO}_4)_2$ ?