CHAPTER 3
Concept Explorations

3.17. Moles and Molar Mass

Part 1: The mole provides a convenient package where we can make a connection between the mass of a substance and the number (count) of that substance. This is a familiar concept if you have ever bought pieces of bulk hard candy, where you purchase candy by mass rather than count. Typically, there is a scale provided for weighing the candy. For example, a notice placed above the candy bin might read, “For the candy in the bin below, there are 500 pieces of candy per kg.” Using this conversion factor, perform the following calculations.

a. How many candies would you have if you had 0.2 kg?

b. If you had 10 dozen candies, what would be their mass?

c. What is the mass of one candy piece?

d. What is the mass of 2.0 moles of candies?
Part 2: The periodic table provides information about each element that serves somewhat the same purpose as the label on the nail bin described in Part 1, only in this case, the mass (molar mass) of each element is the number of grams of the element that contain $6.02 \times 10^{23}$ atoms or molecules of the element. As you are aware, the quantity $6.02 \times 10^{23}$ is called the mole.

a. If you had 0.2 kg of helium, how many helium atoms would you have?

b. If you had 10 dozen helium atoms, what would be their mass?

c. What is the mass of one helium atom?

d. What is the mass of 2.0 moles of helium atoms?

Part 3: Say there is a newly defined “package” called the binkle. One binkle is defined as being exactly $3 \times 10^{12}$.

a. If you had 1.0 kg of nails and 1.0 kg of helium atoms, would you expect them to have the same number of binkles? Using complete sentences, explain your answer.

b. If you had 3.5 binkles of nails and 3.5 binkles of helium atoms, which quantity would have more (count) and which would have more mass? Using complete sentences, explain your answers.
c. Which would contain more atoms, 3.5 g of helium or 3.5 g of lithium? Using complete sentences, explain your answer.

3.18. Moles Within Moles and Molar Mass

Part 1

a. How many hydrogen and oxygen atoms are present in 1 molecule of H₂O?

b. How many moles of hydrogen and oxygen atoms are present in 1 mol H₂O?

c. What are the masses of hydrogen and oxygen in 1.0 mol H₂O?

d. What is the mass of 1.0 mol H₂O?

Part 2: Two hypothetical ionic compounds are discovered with the chemical formulas XCl₂ and YCl₂, where X and Y represent symbols of the imaginary elements. Chemical analysis of the two compounds reveals that 0.25 mol XCl₂ has a mass of 100.0 g and 0.50 mol YCl₂ has a mass of 125.0 g.

a. What are the molar masses of XCl₂ and YCl₂?

b. If you had 1.0-mol samples of XCl₂ and YCl₂, how would the number of chloride ions compare?

c. If you had 1.0-mol samples of XCl₂ and YCl₂, how would the masses of elements X and Y compare?
d. What is the mass of chloride ions present in 1.0 mol XCl$_2$ and 1.0 mol YCl$_2$?

e. What are the molar masses of elements X and Y?

f. How many moles of X ions and chloride ions would be present in a 200.0-g sample of XCl$_2$?

g. How many grams of Y ions would be present in a 250.0-g sample of YCl$_2$?

h. What would be the molar mass of the compound YBr$_3$?

Part 3: A minute sample of AlCl$_3$ is analyzed for chlorine. The analysis reveals that there are 12 chloride ions present in the sample. How many aluminum ions must be present in the sample?

a. What is the total mass of AlCl$_3$ in this sample?

b. How many moles of AlCl$_3$ are in this sample?