Section Wrap-up

In section 5.1, you learned about the average atomic mass of an element. Then, in section 5.2, you learned how chemists group particles using the mole. In the final section of this chapter, you will learn how to use the average atomic masses of the elements to determine the mass of a mole of any substance. You will learn about a relationship that will allow you to relate the mass of a sample to the number of particles it contains.

Section Review

1. K/U In your own words, define the mole. Use three examples.

2. I Imagine that $\$6.02 \times 10^{23}$ were evenly distributed among six billion people. How much money would each person receive?

(2.) $\frac{6.02\times10^{23}}{6\times10^{9}} = 1.003\times10^{14}$ \$

3. I A typical adult human heart beats an average of 60 times per minute. If you were allotted a mole of heartbeats, how long, in years, could you expect to live? You may assume each year has 365 days.

(3.) $\frac{6.02\times10^{23}}{60} = 1.003\times10^{22}$ min $\div 60 \div 24 \div 365 = 1.91\times10^{16}$ yrs

4. I Calculate the number of atoms in 3.45 mol of iron, Fe.

(4.) $N = n \times N_A = 3.45 \times 6.02\times10^{23} = 2.1\times10^{24}$ atoms

5. I A sample of carbon dioxide, CO_2, contains 2.56×10^{24} molecules.

(a) How many moles of carbon dioxide are present? $n = N/N_A = 4.25$ mol

(b) How many moles of atoms are present? $4.25 \text{ mol} \times \frac{3 \text{ atoms}}{\text{molecule}} = 12.76$

6. I A balloon is filled with 0.50 mol of helium. How many atoms of helium are in the balloon? $N = n \times N_A = 3.01\times10^{23}$

7. I A sample of benzene, C_6H_6, contains 5.69 mol.

(a) How many molecules are in the sample? $N = n \times N_A = 3.4254\times10^{24}$ molecules

(b) How many hydrogen atoms are in the sample? $3.4254\times10^{24} \text{ molecules} \times \frac{6 \text{ atoms H}}{\text{molecule}} = 2.1\times10^{25}$ atoms H

8. I Aluminum oxide, Al_2O_3, forms a thin coating on aluminum when aluminum is exposed to the oxygen in the air. Consider a sample made up of 1.17 mol of aluminum oxide.

(a) How many molecules are in the sample? $N = n \times N_A = 7.04\times10^{23}$ molecules

(b) How many atoms are in the sample? $N \times 5 = 3.5217\times10^{24}$

(c) How many oxygen atoms are in the sample? $N \times 3 = 2.11\times10^{24}$

9. C Why do you think chemists chose to define the mole the way they did?

10. I A sample of zinc oxide, ZnO, contains 3.28×10^{24} molecules of zinc oxide. A sample of zinc metal contains 2.78 mol of zinc atoms. Which sample contains more zinc: the compound or the element?

Unit Investigation Prep

In your Unit Investigation, you will need to determine the amount of several pure substances in a mixture. Do you think it will be more convenient for you to work with quantities expressed in moles or molecules?

$ZnO = 3.28\times10^{24} \text{ molecules} \times \frac{1 \text{ atom Zn}}{2 \text{ atoms (Zn+O)}}$

$= 1.64\times10^{24}$ Zn atoms

$Zn = 2.78 \times N_A$

$= 1.674\times10^{24}$ Zn atoms

∴ more zinc in the element sample