

**Science and the Environment**  
**Mole and Molar mass**

1. Determine the **molar mass** of the following substances:

- 1) copper, Cu
- 2) oxygen, O<sub>2</sub>
- 3) water, H<sub>2</sub>O
- 4) methane, CH<sub>4</sub>
- 5) calcium carbonate, CaCO<sub>3</sub>
- 6) calcium hydroxide, Ca(OH)<sub>2</sub>
- 7) magnesium nitrate, Mg(NO<sub>3</sub>)<sub>2</sub>
- 8) aluminum oxide, Al<sub>2</sub>O<sub>3</sub>

2. Convert the following quantities into grams.

- 1) 1.5 mol Na
- 2) 0.15 mol Cl<sub>2</sub>
- 3) 0.50 mol C<sub>2</sub>H<sub>5</sub>OH
- 4)  $1.2 \times 10^{-4}$  mol C<sub>3</sub>H<sub>8</sub>
- 5)  $2.55 \times 10^{-2}$  mol O<sub>2</sub>

3. Convert the following quantities into moles.  
Recall that 1 kg = 1000 g and 1g = 1000 mg

- 1) 16.0 kg CH<sub>4</sub>
- 2) 10.0 g Pb(NO<sub>3</sub>)<sub>2</sub>
- 3)  $5.00 \times 10^4$  g MgCl<sub>2</sub>
- 4) 750 mg H<sub>2</sub>
- 5) 3.50 kg O<sub>2</sub>

## Science and the Environment

### The mole and Avogadro's number

Reference: *Chemistry* by Zumdhal, 6<sup>th</sup> edition

The mole is an amount. It is the amount of carbon atoms contained in exactly 12.0 grams of  $^{12}\text{C}$ . Techniques have been used to determine this number as  $6.02 \times 10^{23}$ . This number is called **Avogadro's number**. One mole of something consists of  $6.02 \times 10^{23}$  units of that substance.

#### Sample problem 1

A silicon chip used in an integrated circuit of a microcomputer has a mass of 5.68 mg. How many silicon, Si, atoms are present in this chip?  $1\text{g} = 1000\text{mg}$

#### Solution

The strategy for solving this problem is to convert from milligrams to grams, then to moles, and finally to atoms.

#### Sample problem 2

Penicillin, an antibiotic, has the formula is  $\text{C}_{14}\text{H}_{20}\text{N}_2\text{SO}_4$ . How many molecules are contained in 312.4 g of penicillin?

#### Solution

The strategy is to convert grams into moles, and then to molecules of penicillin.

#### Sample problem 3

Caffeine, a stimulant found in tea, coffee, and chocolate, has the formula  $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$ . How many molecules are contained in 19.42 g of pure caffeine?

#### Solution

The strategy is to convert from grams into moles, and then to molecules.

**Worksheet**  
**Avogadro's number =  $6.02 \times 10^{23}$**

- 1) Determine the number of atoms contained in 12.0 g aluminum, Al.
- 2) Determine the number of atoms contained in 5.00 g sodium, Na.
- 3) In an experiment,  $1.20 \times 10^{21}$  atoms of silver, Ag, are produced. Determine the mass, in grams, of silver produced.
- 4) Determine the number of molecules contained in 4.00 g methane, CH<sub>4</sub>.
- 5) Determine the number of molecules contained in 9.00 g water, H<sub>2</sub>O.
- 6) How many C atoms are contained in one molecule of methane, CH<sub>4</sub>?
- 7) How many H atoms are contained in one molecule of propane, C<sub>3</sub>H<sub>8</sub>?