

Science and the Environment
Mole and Molar mass

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

- 1) copper, Cu
- 2) oxygen, O₂
- 3) water, H₂O
- 4) methane, CH₄
- 5) calcium carbonate, CaCO₃
- 6) calcium hydroxide, Ca(OH)₂
- 7) magnesium nitrate, Mg(NO₃)₂
- 8) aluminum oxide, Al₂O₃

2. Convert the following quantities into grams.

- 1) 1.5 mol Na
- 2) 0.15 mol Cl₂
- 3) 0.50 mol C₂H₅OH
- 4) 1.2×10^{-4} mol C₃H₈
- 5) 2.55×10^{-2} mol O₂

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

- 1) 16.0 kg CH₄
- 2) 10.0 g Pb(NO₃)₂
- 3) 5.00×10^4 g MgCl₂
- 4) 750 mg H₂
- 5) 3.50 kg O₂

Science and the Environment

The mole and Avogadro's number

Reference: *Chemistry* by Zumdhal, 6th edition

The mole is an amount. It is the amount of carbon atoms contained in exactly 12.0 grams of ^{12}C . Techniques have been used to determine this number as 6.02×10^{23} . This number is called **Avogadro's number**. One mole of something consists of 6.02×10^{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 = 6.02×10^{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, 1.20×10^{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, CH₄.
- 5) Determine the number of molecules contained in 9.00 g water, H₂O.
- 6) How many C atoms are contained in one molecule of methane, CH₄?
- 7) How many H atoms are contained in one molecule of propane, C₃H₈?