Chemistry Lecture #51: The Mole

Oftentimes we use a word to describe a numerical quantity. For example, we'll say "a dozen eggs" instead of saying "twelve eggs." And it is easier to say "a ream of paper" than it is to say "500 sheets of paper."

Likewise, in chemistry we use the word "mole" to represent a specific number. In the same way that dozen = 12 and ream = 500, the word mole (sometimes shortened to "mol") represents the number 6.02×10^{23}.

1 mole = 6.02×10^{23} representative particles.

A representative particle is either an atom, molecule, or formula unit of an ionic compound.

He = atom H_2O = molecule
NaCl = formula unit (ionic compound)

Where did the number 6.02×10^{23} come from? It was defined as the number atoms in 12 g of carbon-12. If you have 12 g of carbon-12, you have 1 mole or 6.02×10^{23} atoms of carbon-12.

6.02×10^{23} is also called Avogadro's number.

CONVERTING PARTICLES TO MOLES (AND VICE-VERSA)

Calculate the number of moles that contain 1.204×10^{24} atoms of Na.

atoms ⟹ moles

1 mole Na = 6.02×20^{23} atoms Na

$$\frac{1.204 \times 10^{24} \text{ atoms Na}}{1} \times \frac{\text{moles Na}}{6.02 \times 10^{23} \text{ atoms Na}} = 2.00 \text{ mol Na}$$

Calculate the number of moles that contain 4.50×10^{24} atoms of zinc (Zn).

atoms ⟹ moles

1 mole Zn = 6.02×10^{23} atoms Zn

$$\frac{4.50 \times 10^{24} \text{ atoms Zn}}{1} \times \frac{\text{moles Zn}}{6.02 \times 10^{23} \text{ atoms Zn}} = 7.48 \text{ mol Zn}$$

How many sucrose molecules are in 3.50 moles of $C_{12}H_{22}O_{11}$?

moles ⟹ molecules

1 mole $C_{12}H_{22}O_{11}$ = 6.02×10^{23} molecules $C_{12}H_{22}O_{11}$

$$\frac{3.50 \text{ mole } C_{12}H_{22}O_{11}}{1} \times \frac{6.02 \times 10^{23} \text{ molecules } C_{12}H_{22}O_{11}}{1 \text{ mole } C_{12}H_{22}O_{11}}$$

$$= 2.11 \times 10^{24} \text{ molecules } C_{12}H_{22}O_{11}$$

How many formula units of $AgNO_3$ are in 3.25 mol of silver nitrate?

moles ⟹ formula units

1 mole $AgNO_3$ = 6.02×10^{23} formula units $AgNO_3$

$$\frac{3.25 \text{ mole } AgNO_3}{1} \times \frac{6.02 \times 10^{23} \text{ formula units } AgNO_3}{1 \text{ mole } AgNO_3}$$

$$= 1.96 \times 10^{24} \text{ formula units } AgNO_3$$