

## 6.5: Mole Calculations

### Learning Objectives

- Perform conversions between mass and moles of a compound.

In the [previous section](#), several relationships were written, including:

- 1 mol Al = 26.98 g Al =  $6.022 \times 10^{23}$  atoms Al
- 1 mol  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  = 342.3 g  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  =  $6.022 \times 10^{23}$  molecules  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- 1 mol NaCl = 58.44 g NaCl =  $6.022 \times 10^{23}$  formula units NaCl

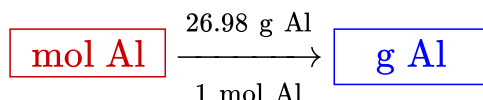
These relationships may be used to convert from grams to moles or vice versa; or from moles to atoms, molecules, or formula units or vice versa. In the [next section](#), we will show how these relationships may also be used to count atoms, molecules, or formula units by weighing.

### Conversion Factors

The above relationships allow for a number of possible conversions. Let's start with aluminum, since it provides the simplest conversion. Here are the possible conversions:

$\boxed{\text{mol Al}} \rightleftharpoons \boxed{\text{g Al}}$	$\boxed{\text{mol Al}} \rightleftharpoons \boxed{\text{atoms Al}}$	$\boxed{\text{g Al}} \rightleftharpoons \boxed{\text{atoms Al}}$
$\frac{26.98 \text{ g Al}}{1 \text{ mol Al}}$ or $\frac{1 \text{ mol Al}}{26.98 \text{ g Al}}$	$\frac{6.022 \times 10^{23} \text{ atoms Al}}{1 \text{ mol Al}}$ or $\frac{1 \text{ mol Al}}{6.022 \times 10^{23} \text{ atoms Al}}$	$\frac{6.022 \times 10^{23} \text{ atoms Al}}{26.98 \text{ g Al}}$ or $\frac{26.98 \text{ g Al}}{6.022 \times 10^{23} \text{ atoms Al}}$

If converting from moles of aluminum to grams of aluminum, a conversion that places grams of aluminum in the numerator and moles of aluminum in the denominator would be used to ensure the proper cancellation of units:



This means that the mass of aluminum in 8.36 mol Al may be calculated like this:

$$8.36 \cancel{\text{ mol Al}} \times \frac{26.98 \text{ g Al}}{1 \cancel{\text{ mol Al}}} = \boxed{226 \text{ g Al}}$$

### ✓ Example 6.5.1

Calculate the mass of 0.220 mol  $\text{Cu}(\text{NO}_3)_2$ .

#### Solution

Steps for Problem Solving	
Identify the "given" information and what the problem is asking you to "find."	<p>Given: 0.220 mol <math>\text{Cu}(\text{NO}_3)_2</math></p> <p>Find: g <math>\text{Cu}(\text{NO}_3)_2</math></p>
List known relationship(s).	1 mol $\text{Cu}(\text{NO}_3)_2$ = 187.57 g $\text{Cu}(\text{NO}_3)_2$ = $6.022 \times 10^{23}$ formula units $\text{Cu}(\text{NO}_3)_2$
Prepare a concept map and use the proper conversion factor.	$\boxed{\text{mol Cu}(\text{NO}_3)_2} \xrightarrow{\frac{187.57 \text{ g Cu}(\text{NO}_3)_2}{1 \text{ mol Cu}(\text{NO}_3)_2}} \boxed{\text{g Cu}(\text{NO}_3)_2}$
Calculate the answer.	$0.220 \cancel{\text{ mol Cu}(\text{NO}_3)_2} \times \frac{187.57 \text{ g Cu}(\text{NO}_3)_2}{1 \cancel{\text{ mol Cu}(\text{NO}_3)_2}} = \boxed{41.3 \text{ g Cu}(\text{NO}_3)_2}$

### Steps for Problem Solving

Think about your result.

0.220 mol is a little less than  $\frac{1}{4}$  of a mole. Since 1 mole has a mass of 187.57 g, the answer should be a little less than  $\frac{1}{4}$  of this amount. The answer is rounded to three significant figures since the fewest significant figures in the calculation is three.

### ✓ Example 6.5.2

How many moles are in 0.0114 g Hg?

#### Solution

### Steps for Problem Solving

Identify the "given" information and what the problem is asking you to "find."

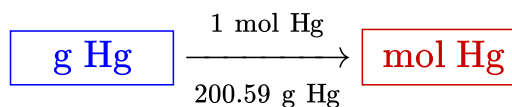
Given: 0.0114 g Hg

Find: mol Hg

List known relationship(s).

1 mol Hg = 200.59 g Hg =  $6.022 \times 10^{23}$  atoms Hg

Prepare a concept map and use the proper conversion factor.



Calculate the answer.

$$0.0114 \text{ g Hg} \times \frac{1 \text{ mol Hg}}{200.59 \text{ g Hg}} = \boxed{5.68 \times 10^{-5} \text{ mol Hg}}$$

Think about your result.

Since there are 200.59 g Hg in 1 mol Hg, 0.0114 g Hg must be a very small fraction of a mole. The answer is rounded to three significant figures since the fewest significant figures in the calculation is three.

### ✏ Exercise 6.5.1

- What is the mass of 0.27 mol Ne?
- How many grams are in 386 mol  $\text{Fe}_3(\text{PO}_4)_2$ ?
- How many moles are present in 7.0 g of  $\text{NH}_3$ ?
- Calculate the number of moles in 555 g  $\text{CaCO}_3$ .

#### Answer A

5.4 g Ne

#### Answer B

$1.38 \times 10^5$  g  $\text{Fe}_3(\text{PO}_4)_2$

#### Answer C

0.41 mol  $\text{NH}_3$

#### Answer D

5.55 mol  $\text{CaCO}_3$

### Summary

- Calculations involving conversions between moles of a material and the mass of that material are described.

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