7-3 Using Chemical Formulas

Formula mass – sum of atomic masses for all atoms in a compound, molecule, or ion (amu).

Molar Mass – Same number as formula mass but in **g / mol** (Mass is often called weight, molar mass usually reported)

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7-3 Using Chemical Formulas

Find Formula mass and Molar mass of H_2O

$H \rightarrow 1.0$ amu or g/mol

$O \rightarrow 16.0$ amu or g/mol

Formula mass

$H_2O \rightarrow 2H + 1O \rightarrow 2 \times (1.0 \text{ amu}) + 16.0 \text{ amu} = 18 \text{ amu}$

Molar mass

18 g / mol

This means 18 grams of water is 1 mole

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7-3 Using Chemical Formulas

Find molar mass (molecular weight) of CO_2

	C	O_2
Look up masses →	12.0 g/mol	+ 2 x (16.0 g/mol)
	12.0 g/mol	+ 32.0 g/mol

44.0 g/mol

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7-3 Using Chemical Formulas

Find molar mass of H_2SO_4

	H_2	S	O_4
	2 x (1.0 g/mol)	+ 32.1 g/mol	+ 4 x (16.0 g/mol)
	2 g/mol	+ 32.1 g/mol	+ 64.0 g/mol

98.1 g/mol

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7-3 Using Chemical Formulas

Using Molar Mass to convert grams to moles

How many moles of CO_2 are in a 100.0 g sample?

I need to use…

Molar mass of $CO_2 \rightarrow 44.0$ g/mol

$$100.0 \text{ g } CO_2 \left[\frac{1 \text{ mole } CO_2}{44.0 \text{ g } CO_2} \right] = 2.27 \text{ moles } CO_2$$

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7-3 Using Chemical Formulas

Find number of molecules, formula units, ions, and atoms

How many molecules of CO_2 are in a 0.500 mole sample?

$$0.500 \text{ mol } CO_2 \left[\frac{6.02 \times 10^{23}}{1 \text{ mol}} \right] = 3.01 \times 10^{23} \text{ molecules } CO_2$$

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7-3 Using Chemical Formulas

Find number of molecules, formula units, ions, and atoms

How many atoms are in a 0.500 mole sample of CO_2?

$$3.01 \times 10^{23} \text{ molecules} \left(\frac{3 \text{ atoms}}{1 \text{ molecule}} \right) = 9.03 \times 10^{23} \text{ atoms}$$

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7-3 Using Chemical Formulas

Percentage Composition

Find percentage of an element in a compound…

$$\frac{\text{Mass of element}}{\text{Mass of compound}} \times 100 = \% \text{ element}$$

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7-3 Using Chemical Formulas

Percentage Composition

To create a 100 g sample of CO_2, 72.7 g of oxygen is needed. What is the percentage of oxygen in CO_2?

$$\frac{72.7 \text{ g O}}{100.0 \text{ g } CO_2} \times 100 = 72.7\%$$

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7-3 Using Chemical Formulas

Percentage Composition

Find percentage of an element in a compound…

$$\frac{\text{Molar mass of element}}{\text{molar mass of compound}} \times 100 = \% \text{ element}$$

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7-3 Using Chemical Formulas

Percentage Composition

What is the weight percentage of oxygen in CO_2?

$$\frac{2 \times 16.0 \text{ g O}}{44.0 \text{ g } CO_2} \times 100 = 72.7\%$$

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7-3 Using Chemical Formulas

What is the percentage of water in $CaCl_2 \cdot 2H_2O$?

First we need the molar masses…

H_2 O

$2 \times 1.0 \text{ g/mol} + 16.0 \text{ g/mol} = \boxed{18.0 \text{ g / mol}}$

Ca $Cl_2 \cdot$ $2H_2O$

$40.1 \text{ g/mol} + 2 \times 35.5 \text{ g/mol} + 2 \times 18.0 \text{ g/mol} = \boxed{147.1 \text{ g/mol}}$

Percentage of H_2O

$$\frac{2 \times 18.0 \text{ g } H_2O}{147.1 \text{ g } CaCl_2 \cdot H_2O} \times 100 = \boxed{24.5\%}$$

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