Unit 4 Describing substances

When do we use molar mass and Avogadro's number?

As you learned with Dalton's atomic theory, when substances undergo a chemical change, the atoms rearrange in whole **number** ratios.

The problem for us is that we can't physically count these atoms and molecules.

We "count by weighing" instead, and use molar mass to do this.

How much carbon should I weigh out if I want one mole of carbon?

How much carbon should I weigh out if I want 2.5 moles?

1 mole C = 12.01 g

$$\frac{2.5 \text{ mole C}}{1 \text{ mole}} \left| \frac{12.01 \text{ g C}}{} \right. = 30. \text{ g C}$$

↑

use molar mass to convert.

What is the mass of 2.56 moles of H_2O?

$$2.56 \text{ mol } H_2O \left| \frac{18.02 \text{ g}}{1 \text{ mol } H_2O} \right. = 46.1 \text{ g } H_2O$$

1 mole H_2O = 18.02 g

How many moles is 17.4 g of H_2O?

$$17.4 \text{ g } H_2O \left| \frac{1 \text{ mol } H_2O}{18.02 \text{ g}} \right. = 0.966 \text{ mol } H_2O$$

If I wanted 6.02×10^{23} atoms of sulfur, how much should I weigh out?

one mole of sulfur weighs 32.07 g $\quad 1 \text{ mole} = 32.07 \text{ g S}$

6.02×10^{23} atoms is one mole, $\quad 1 \text{ mole} = 6.02 \times 10^{23} \text{ atoms}$

$$6.02 \times 10^{23} \text{ atoms S} \left| \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} \right. = 1.00 \text{ mol S}$$

$$1.00 \text{ mol S} \left| \frac{32.07 \text{ g}}{1 \text{ mole}} \right. = 32.07 \text{ g S}$$

2-step problem. $\quad \#\text{atoms} \leftrightarrow \text{mole} \leftrightarrow \text{mass}$

How much would 5.71×10^{24} molecules of water weigh?

$$\frac{5.71 \times 10^{24} \text{ molecules} \mid 1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}} = 9.49 \text{ moles } H_2O$$

$$\frac{9.49 \text{ moles } H_2O \mid 18.02 \text{ g } H_2O}{1 \text{ mole}} = 171 \text{ g } H_2O$$

$$\frac{5.71 \times 10^{24} \text{ molecules} \mid 1 \text{ mole} \mid 18.02 \text{ g } H_2O}{6.02 \times 10^{23} \text{ molecules} \mid 1 \text{ mole}} = 171 \text{ g } H_2O$$

1 mole = 18.02 g H_2O

1 mole = 6.02×10^{23} molecules