

KEY

Molar Conversions

Background: The mole (abbreviated mol) is a unit of measurement that is used in chemistry to express the counting amount of particles (like atoms and compounds). It is an especially important unit because it makes a connection between the counting amount of particles, the gram amount of particles and sometimes even the liter amount of particles.

Scientists have found that if they measured out exactly 12.0 grams of carbon (carbon's molar mass), that in that 12.0 grams of carbon would be 602 000 000 000 000 000 000 atoms of carbon (or 6.02×10^{23} atoms - good thing for scientific notation). This very large number is known as Avogadro's number. They further discovered that this held true for all of the other elements; where the molar mass (mass of 1 mole) of an element contains 6.02×10^{23} atoms. The mole is one of the base units in the International System of Units (SI).

Review: Use the "grid" to solve for the number of seconds in 10 years.

$$\begin{array}{c|c|c|c|c} 10 \text{ YRS} & 365 \text{ days} & 24 \text{ hrs} & 60 \text{ min} & 60 \text{ s} \\ \hline & 1 \text{ YR} & 1 \text{ day} & 1 \text{ hr} & 1 \text{ min} \end{array} = 315360000 \text{ s} = \boxed{3.1536 \times 10^8 \text{ s}}$$

Just as we used the "grid" to convert from years to seconds, we can use the "grid" to convert between moles, atoms, and grams. The unit equality between mole, gram, and Avogadro's number is given below.

$$\boxed{1.0 \text{ mole of an element} = 6.02 \times 10^{23} \text{ atoms of that element} = \text{molar mass of that element}}$$

Mole-Atom Practice

ROUND FOR SIG FIGS

1. How many atoms of sodium are in 5 moles of sodium?

$$\begin{array}{c|c} 5 \text{ mol Na} & 6.02 \times 10^{23} \text{ atoms Na} \\ \hline & 1 \text{ mol Na} \end{array} = \boxed{3 \times 10^{24} \text{ atoms Na}}$$

2. How many atoms of potassium are in 0.42 moles of potassium?

$$\begin{array}{c|c} 0.42 \text{ mol K} & 6.02 \times 10^{23} \text{ atoms K} \\ \hline & 1 \text{ mol K} \end{array} = 2.5284 \times 10^{23} = \boxed{2.5 \times 10^{23} \text{ atoms K}}$$

3. How many moles of magnesium are in 1.25×10^{23} atoms of magnesium?

$$\begin{array}{c|c} 1.25 \times 10^{23} \text{ atoms Mg} & 1 \text{ mol Mg} \\ \hline & 6.02 \times 10^{23} \text{ atoms Mg} \end{array} = 0.20764116 = \boxed{0.208 \text{ mol Mg}}$$

4. How many moles of boron are in 3.14×10^{25} atoms of boron?

$$\begin{array}{c|c} 3.14 \times 10^{25} \text{ atoms B} & 1 \text{ mol B} \\ \hline & 6.02 \times 10^{23} \text{ atoms B} \end{array} = 52.1594 = \boxed{52.2 \text{ mol B}}$$

Mole-Gram Practice

In order to convert between moles and grams of an element, you must determine the molar mass of the element. Use the periodic table to find the molar mass.

$$\boxed{\text{molar mass of an element} = \text{mass from periodic table (round to two decimal places)}}$$

Determine the molar mass of each element below:

5. Iron, Fe 55.85 g/mol

6. Phosphorus, P 30.97 g/mol

7. Calcium, Ca 40.08 g/mol

8. Barium, Ba 137.33 g/mol

Now let's convert between moles and grams.

9. How many grams of iron are in 2.9 moles of iron?

$$\frac{2.9 \text{ mol Fe} | 55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 161.965$$

$= \boxed{160 \text{ g Fe}}$

11. How many moles of calcium are in 62.45 grams of calcium?

$$\frac{62.45 \text{ g Ca} | 1 \text{ mol Ca}}{40.08 \text{ g Ca}} = 1.55813$$

$= \boxed{1.558 \text{ mol Ca}}$

10. How many grams of phosphorus are in 5.23 moles of phosphorus?

$$\frac{5.23 \text{ mol P} | 30.97 \text{ g P}}{1 \text{ mol P}} = 161.9731$$

$= \boxed{162 \text{ g P}}$

12. How many moles of barium are in 196.84 grams of barium?

$$\frac{196.84 \text{ g Ba} | 1 \text{ mol Ba}}{137.33 \text{ g Ba}} = 1.4333$$

$= \boxed{1.4333 \text{ mol Ba}}$

Mixed Practice

SHOW YOUR WORK

13. How many grams of copper (Cu) are in 7.3 moles of copper?

$\boxed{460 \text{ g Cu}}$

14. How many atoms of lead (Pb) are in 6.755 moles of lead?

$\boxed{4.067 \times 10^{24} \text{ atoms Pb}}$

15. How many moles of sulfur (S) are in 152.1 grams of sulfur?

$\boxed{4.743 \text{ mol S}}$

16. How many moles of mercury (Hg) are in 4.50×10^{12} atoms of mercury?

$\boxed{7.48 \times 10^{-12} \text{ moles Hg}}$

17. What is the mass in grams of silver (Ag) in 1.00 moles of silver?

$\boxed{108 \text{ g Ag}}$