

The Mole Concept

★ Mole = number of particles in a molecular or atomic mass expressed in grams

☆ Gram atomic mass or gram-atom - the mass of 1 mole of atoms

★ numerically equal to the atomic mass of the atom on the periodic table expressed in grams

★ examples

Element	Atomic Mass	Gram Atomic Mass
carbon	12 amu	12 g
sodium	23 amu	23 g
bromine	80 amu	80 g

☆ Gram molecular mass (GMM) or mole mass - mass of 1 mole of molecules

★ found by adding the atomic masses of all the atoms in a molecule

★ example

Sample Problem

Find the mass of one mole of table sugar ($C_{12}H_{22}O_{11}$)

Element	Gram Atomic Mass		Subscript	Product
C	12 g	×	12	144 g
H	1 g	×	22	22 g
O	16 g	×	11	176 g
TOTAL				342 g

☆ Gram formula mass (GFM) - formula mass expressed in grams or the mass of 1 mole of an ionic substance

★ formula mass - sum of the masses of the ions in the empirical formula of an ionic substance

★ example

Sample Problem

Find the gram formula mass of silver nitrate ($AgNO_3$)

Element	Gram Atomic Mass		Subscript	Product
Ag	108 g	×	1	108 g
N	14 g	×	1	14 g
O	16 g	×	3	48 g
TOTAL				170 g

★ Calculations involving the mole definition

$$\star \text{GFM} = \frac{\text{g}}{\text{mole}} \quad \therefore$$

$$\star \text{g} = \text{GFM} \times \text{mole} \quad \text{and}$$

$$\star \text{mole} = \frac{\text{g}}{\text{GFM}}$$

Examples

1. What is the mass of 2 mole of sodium sulfate?

$$\begin{array}{l} \underline{\text{Na}_2\text{SO}_4} \\ \text{Na} = 23 \times 2 = 46 \quad \text{g} = \frac{\text{GFM}}{142} \times \frac{\text{moles}}{2} \\ \text{S} = 32 \times 1 = 32 \\ \text{O} = 16 \times 4 = 64 \\ \quad \quad \quad 142 \quad \quad \quad \text{g} = \quad \quad \quad 284 \text{ g} \end{array}$$

2. How many moles are in 145g of sodium chloride?

$$\begin{array}{l} \underline{\text{NaCl}} \\ \text{Na} = 23 \times 1 = 23 \\ \text{Cl} = 35 \times 1 = 35 \\ \quad \quad \quad 58 \\ \text{moles} = \text{g} / \text{GFM} \\ \quad \quad \quad 145 / 58 \\ \text{moles} = \quad \quad \quad 2.5 \text{ moles} \end{array}$$

Answer the questions below by circling the number of the correct response

- The gram molecular mass of CO_2 is the same as the gram molecular mass of (1) CO (2) SO_2 (3) C_2H_6 (4) C_3H_8
- The number of molecules in 1.0 mole of SO_2 is the same as the number of molecules in
(1) 1.0 mole of N_2 (3) 0.25 mole of NO_2
(2) 2.0 moles of Ne (4) 0.50 mole of NH_3
- What is the gram formula mass of $\text{Ca}(\text{HCO}_3)_2$?
(1) 101 (3) 202
(2) 162 (4) 324
- What is the total mass of iron in 1.0 mole of Fe_2O_3 ?
(1) 160 g (3) 72 g
(2) 112 g (4) 56 g
- What is the mass, in grams, of 1.0 mole of $(\text{NH}_4)_2\text{S}$?
(1) 50 (3) 64
(2) 54 (4) 68
- The mass of two moles of sulfuric acid, expressed in grams, is equal to
(1) $\frac{98}{2}$ (3) $\frac{6.02 \times 10^{23}}{2}$
(2) 2×98 (4) $2 \times (6.02 \times 10^{23})$
- Which quantity is equivalent to 39 grams of LiF ?
(1) 1.0 mole (3) 0.30 mole
(2) 2.0 moles (4) 1.5 moles
- What is the total number of moles contained in 115 grams of $\text{C}_2\text{H}_5\text{OH}$?
(1) 1.00 (3) 3.00
(2) 1.50 (4) 2.50
- How many moles of water are contained in 0.250 mole of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?
(1) 1.25 (3) 40.0
(2) 4.50 (4) 62.5
- Which represents the greatest mass of chlorine
(1) 1 mole of chlorine (2) 1 atom of chlorine
(3) 1 gram of chlorine (4) 1 molecule of chlorine
- What is the total mass of iron in 1.0 mole of Fe_2O_3 ?
(1) 160 g (3) 72 g
(2) 112 g (4) 56 g
- What is the mass, in grams, of 1.0 mole of $(\text{NH}_4)_2\text{S}$?
(1) 50. (3) 64
(2) 54 (4) 68
- What is the gram atomic mass of the element chlorine?
(1) 17 g (3) 52 g
(2) 35 g (4) 70. g
- The mass in grams of 1.00 mole of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ is
(1) 172 g (3) 136 g
(2) 154 g (4) 118 g