

CHEM 0094**MOLES**

The mass of 1 mole of any chemical species (atom, molecule or ion) is the number of grams equal to its formula weight (FW) and is known as its molar mass with units of g/mole (or g/mol).

Examples of masses of 1 mole (molar mass):

C atoms: 12.01 g	O ₂ molecules: 32.0 g	H ₂ O molecules: 18.0 g
CO ₂ molecules: 44.0 g	C ₆ H ₁₂ O ₆ molecules: 180 g	
MgCl ₂ formula units: 95.2 g	Fe ₂ (CO ₃) ₃ formula units: 291.7 g	
CaSO ₄ ·2H ₂ O formula units: 172.2 g	CO ₃ ²⁻ ions: 60.0 g	

It was determined experimentally that 1 mole of anything contains approximately 6.02×10^{23} (Avogadro's number, N) units of that substance.

We can summarize the relationship between mass, moles and number of units as follows:

1 mole	≡	gram formula weight (molar mass)	≡	6.02×10^{23} units
moles		mass (g)		no. of units

As we saw in unit conversion, any equality leads to two conversion factors. Thus we can easily interconvert mass, moles and number of units.

Convert:

- 1.65 g of Al to moles. (*Ans.* 0.0612 mole).
- 3.75×10^2 moles of Si to mass (in grams). (*Ans.* 1.05×10^4 g)
- 5.85×10^{-3} g CO₂ to molecules of CO₂. (*Ans.* 8.00×10^{19} molecules)
- 1.0×10^{25} N₂ molecules to moles of N₂. (*Ans.* 17 moles)
- 5.74×10^{-3} moles of Ni to atoms of Ni. (*Ans.* 3.46×10^{21})
- 8.00×10^{21} molecules of O₂ to grams of oxygen. (*Ans.* 0.425 g)
- 4.66 g of bromine to moles of bromine molecules. (*Ans.* 2.92×10^{-2} moles)

Calculate:

- the mass of C₄H₈O₂ that contains 2.50 moles of oxygen atoms. (*Ans.* 110. g)
- the number of moles of hydrogen atoms in 25.5 g of C₃H₈. (*Ans.* 4.63 moles)
- the number of carbon atoms in 15.8 mg of sucrose (C₁₂H₂₂O₁₁). (*Ans.* 3.33×10^{20})
- the mass of NH₂CONH₂ that contains 4.00×10^{27} N atoms. (*Ans.* 2.00×10^5 g)