

CHEQ 1094**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:

$$1 \text{ mole} \equiv \text{gram formula weight (molar mass)} \equiv 6.02 \times 10^{23} \text{ units}$$

moles	mass (g)	no. of units
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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)