

1. Relative Atomic Mass
2. The Mole
3. Molar Mass

Relative Atomic Mass

Mass: The amount of _____ in an object.

Atomic Mass:

- The mass of a particular atom.
- The atomic mass is found by comparing the mass of an element to the mass of an atom of carbon-12. Carbon-12 is assigned an atomic mass of exactly _____.
- The mass of one individual atom is extremely small. A large number of atoms is needed to provide enough mass to measure.
- A mole is...

The Mole



THE MOLE

Avogadro's Number

1 mole = $6.02214179 \times 10^{23}$ items

**items = atoms/molecules/particles etc

The abbreviation for the unit mole is _____.

Think about the term "dozen".

We can say ...

... a **dozen** eggs = 12 eggs

... a **dozen** books = 12 books

Similarly, a **mole** of particles = 6.02×10^{23} particles

... a mole of eggs = 6.02×10^{23} eggs

HOW BIG IS THE MOLE?

If you were able to count atoms at the rate of 10 million per second, it would take about 2 billion years to count the atoms in one mole.

If you had Avogadro's number of unpopped popcorn kernels, and spread them across the US, the country would be covered in popcorn to a depth of 9 miles.

One mole of seconds is about 19 quadrillion years, or 4 240 666 times the age of the Earth, or 954 150 times the age of the universe.

One mole of paper would make a stack that would reach to the moon more than 80 billion times.

One mole of donuts divided equally among Earth's people, each person would have 90 trillion donuts.

Practice Problems:

1. How many lithium atoms are in 3.2 mol of lithium?
2. Find the number of chromium ions in 3.5 mol of chromium ions.
3. How many **atoms** are in 0.23 mol of NaCl?
4. 7.3×10^{24} carbon monoxide molecules represent how many moles of carbon monoxide?
5. How many moles of argon do 1.81×10^{22} atoms of argon represent?
6. How many hydrogen atoms are there in 1.0 mole of water? How many oxygen atoms are there in 1.0 mole of water? What is the ratio of hydrogen atoms to oxygen atoms?

Movie: How Big Is a Mole (<https://www.youtube.com/watch?v=TEl4jeETVmg>)

Molar Mass

*Each element has a unique atomic mass.
Each compound has a unique molecular mass.*

WHAT IS MOLECULAR MASS?

-
- Unit =
- Example:
 - H₂O

WHAT IS MOLAR MASS?

-
- It is a _____.

Example:

What is the molar mass of MgCl_2 ?

- # of Mg atoms =
- Atomic mass of Mg =
- # of Cl atoms =
- Atomic mass of Cl =

- Molar mass =

What is the molar mass of $\text{Al}_2(\text{SO}_4)_3$?

- # of Al atoms =
- Atomic mass of Al =
- # of S atoms =
- Atomic mass of S =
- # of O atoms =
- Atomic mass of O =

- Molar mass =

Practice Problem I: (Find the Molar Mass)

7. What is the molar mass of $\text{Na}_2\text{Cr}_2\text{O}_7$?

8. What is the molar mass of iron (III) sulphide?

9. What is the molar mass of ammonium nitrate?

10. What is the molar mass of propane, C_3H_8 ?

Compound	Formula	Molar Mass (g/mol)
a) Na_2O	---	
b) $\text{Cu}(\text{NO}_3)_2$	---	
c) Calcium chloride		
d) Iron (II) oxide		
e) Iron (III) oxide		
f) Copper (I) nitride		
g) Potassium permanganate		
h) KBr	---	
i) Nitrogen gas		
j) Argon gas		
k) H_2SO_4	---	

- a) 61.98 g/mol b) 187.57 g/mol c) 110.98 g/mol d) 71.85 g/mol e) 159.70 g/mol f) 204.66 g/mol
g) 158.04 g/mol h) 119.00 g/mol i) 28.02 g/mol j) 39.95 g/mol k) 98.09 g/mol

Practice Problem II: (Conversions + Molar Mass)

11. Find the mass of 4.60 moles of $\text{Ca}(\text{OH})_2$.

12. Calculate the number of moles present in a 358.0 gram sample of sodium carbonate.

13. How much would a sample of 7.4 mol of MgO weigh in kilograms?

14. A sample of CoCl_2 weighs 4524 grams. How many mol of CoCl_2 are in this sample?

15. How many moles of water are in 1.8 g of water?

16. Very large quantities of chemicals are produced in the chemical industry. Worldwide production of sulphuric acid (H_2SO_4) is estimated at two trillion (2.0×10^{12}) moles annually. How many tonnes of H_2SO_4 is this? (1 tonne = 1000 kg)

17. A mass of a 0.0150 mol sample of a gas that is known to have sulfur and oxygen has a mass of 0.9615g.
a) Find the molar mass of this gas.

b) Determine the molecular formula for this gas.

Write the formulae for several possible compounds of sulfur and oxygen, starting with the simplest.

Calculate the molar mass for each one and find which one matches with the calculated molar mass in (a).

Possible Formula for S & O	Molar Mass	Correct?

The molecular formula for the compound is _____.

18. How many molecules are in 200.0g of NaCl?

19. How many atoms are in 2 molecules of $\text{Hg}(\text{IO}_3)_2$?

20. How many molecules are in 64.0g of FeS?

21. How many moles are in 2.75×10^{23} atoms of Fe?

22. What is the mass of 3.00×10^{22} atoms of Pt?

23. What is the density of acetic acid, CH_3COOH , if 0.250 mol has a volume of 14.3 mL?

24. How many moles are in 85.0 mg of CuSCN ?

- 1) 1.9×10^{24} atoms
- 2) 2.1×10^{24} ions
- 3) 2.8×10^{23} atoms
- 4) 12 mol
- 5) 0.0301 mol
- 6) 1.2×10^{24} atoms, 6.0×10^{23} atoms, ratio is 2:1
- 7) 261.98 g/mol
- 8) 207.91 g/mol
- 9) 80.06 g/mol
- 10) 44.11 g/mol
- 11) 341g
- 12) 3.378 mol
- 13) 0.30 kg
- 14) 34.85 mol
- 15) 0.10 mol
- 16) 2.0×10^8 tonnes
- 17) 64.1 g/mol, SO_2
- 18) 2.061×10^{24} molecules
- 19) 18 atoms
- 20) 4.38×10^{23} molecules
- 21) 0.457 moles
- 22) 9.72g
- 23) 1.05g/mL
- 24) 6.99×10^{-4} mol

