The Mole

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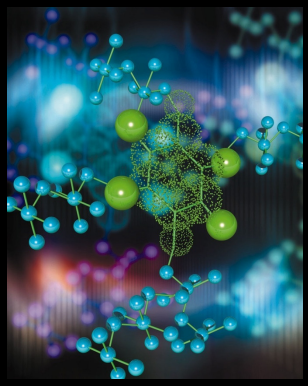
Molecules Are Too Small To See

We must "deduce" number of molecules involved in reactions



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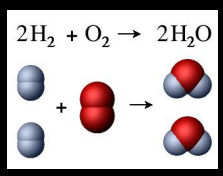
Reactions occur at the particulate level:



Molecules "collide" to form new products
(Collision Theory)

Need way to determine number of reacting atoms

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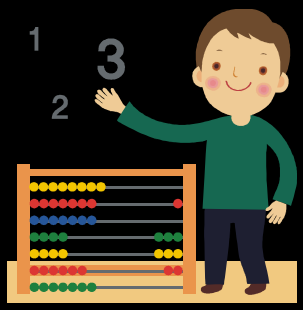
The Mole is a Chemist's Way of Counting Atoms & Molecules



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The Mole

Mole always contains the same number of formula units:
6.02×10^{23} (*Avogadro's Number*)

1 mol element = 6.02×10^{23} atoms
1 mol diatomic element = 6.02×10^{23} molecules
1 mol molecular compound = 6.02×10^{23} molecules
1 mol ionic compound = 6.02×10^{23} formula units

So, the "per" expressions:

1 mol = 6.02×10^{23} atoms
1 mol = 6.02×10^{23} molecules
1 mol = 6.02×10^{23} formula units

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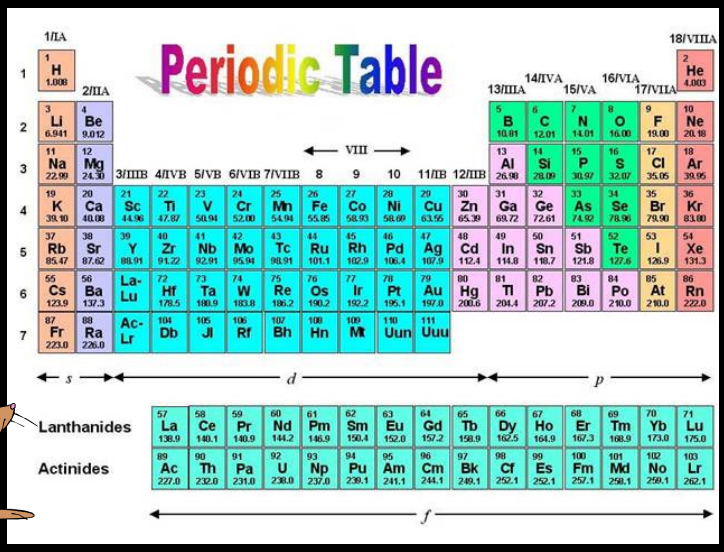
Each Element Has A Different Atomic Mass



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Each Element or Compound Mole Has Different Mass

12.01 g C
1.008 g H = Avogadro's number of atoms or molecules
2.016 g H_2
32.00 g O_2
18.02 g H_2O
58.44 g NaCl
159.7 g Fe_2O_3
108.0 g N_2O_5
~68,000 g Hemoglobin

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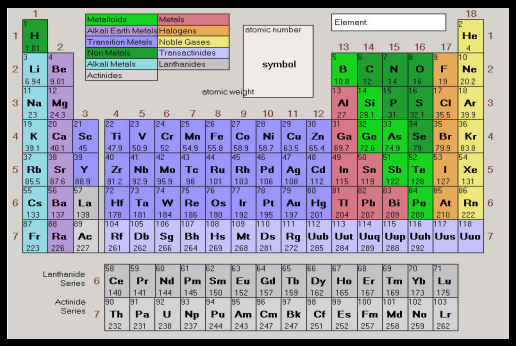
The Mole

A Mole always contains same number of particulates (formula units)

But

Since each element /compound has a different mass,

Equal # atoms (a mole) of different elements have a different mass



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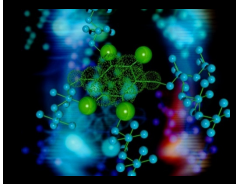
Mole Map



Avagadro's

$\frac{6.02 \times 10^{23}\ \text{fu}}{\text{mole}}$

Molar Mass

g / mole

Atomic Units | Moles | Grams

Avogadro's Number: From Memory
Molar Mass: Calculated from Periodic Table

Let the Units Drive the Solution!

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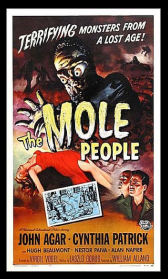
Let's Study the Mole, People



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The Mole Lab

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Today's Lab

Work In Pairs

See Video on The Mole

Identify Unknown Elements

Determine Moles and Formula Units for Ionic Compounds

Determine Moles and Molecules for Molecular Compound

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Element Identification

Select 3 Element Vials (with different colored dots)

Each vial marked with:

Label (Letter of the Unknown)

Weight of empty vial and cap

Weigh each vial

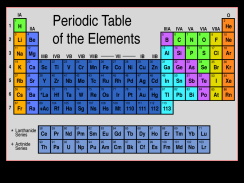
Mass of unknown vial – mass written on vial = mass unknown

Determine Atomic Mass of the unknown (grams / mole)

mass (grams) unknown / 0.100 mole = unknown atomic mass

Identify Unknown Element

Find element on the periodic table with unknown's atomic mass



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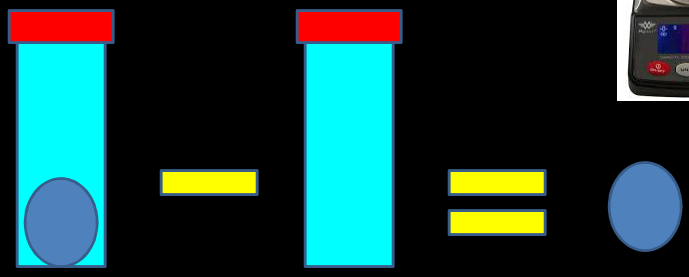
Weighing By Difference



Container Plus Sample Weight

Container Weight

Sample Weight

Technique gives best weight of sample
(no mechanical loss while weighing)

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Moles and Formula Units

Weigh each vial

Mass of sample vial – mass written on vial = mass sample

Determine moles of the sample (grams / mole)

$$\text{mass (grams)} \times \frac{1 \text{ mole}}{\text{formula mass (g)}} = \text{\# Moles}$$

Identify Number of Formula Units

$$\text{\# moles} \times \frac{6.02 \times 10^{23} \text{ formula units}}{\text{mole}} = \text{\# Formula Units}$$

Each group determines both NaCl and KNO_3

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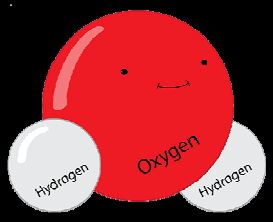
Moles and Number of molecules



Measure mass of 40.0 mL of deionized water

Tare balance with 50 mL grad cylinder; fill to 40.0 mL

Measure mass

Determine moles of the sample (grams / mole)

$$\text{mass (grams)} \times \frac{1 \text{ mole}}{\text{molecular mass (g)}} = \text{\# Moles sample}$$

Identify Number of Formula Units (Molecules)

$$\text{\# moles} \times \frac{6.02 \times 10^{23} \text{ molecules}}{\text{mole}} = \text{\# Molecules in sample}$$

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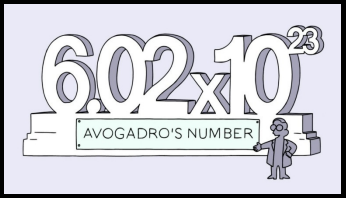

Results

Fill in tables with calculated values

Conclusion

Questions

Proper units and sig figs

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Let's Boldly Go Explore Today's Lab

SHUTTLES MESH: LARRY L. KEATHLEY
RENDER AND POSTWORK: CHRIS S. DIXTON 2006

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