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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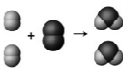
Reactions occur at the particulate level:

$$2H_2 + O_2 \rightarrow 2H_2O$$

**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

1 3
2
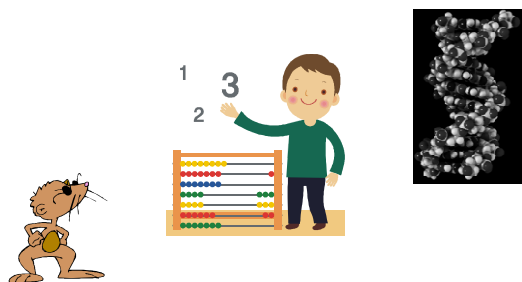
The Mole

Mole always contains the same number of formula units:
$$6.02 \times 10^{23} \quad (Avogadro's\ Number)$$

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

Each Element Has A Different Atomic Mass

Periodic Table

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

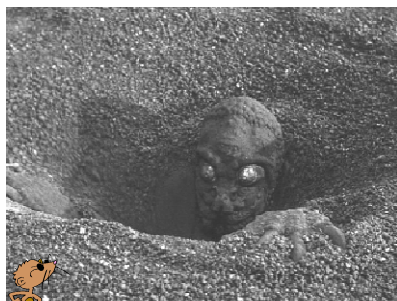**A Mole always contains same number of particulates (formula units)**

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

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)**
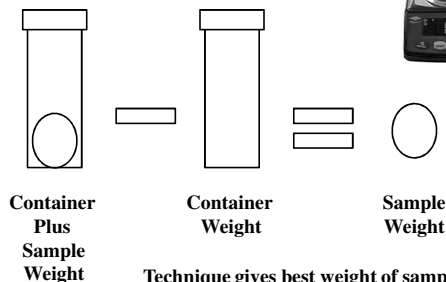
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Moles and Formula Units

Weigh each vial

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

Determine moles of the sample (grams / mole)

 mass (grams)   x $\dfrac{1\ mole}{formula\ mass\ (g)}$ = # Moles

Identify Number of Formula Units

 # moles   x $\dfrac{6.02 \times 10^{23}\ formula\ units}{mole}$ = # 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)

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

Identify Number of Formula Units (Molecules)

moles   x $\dfrac{6.02 \times 10^{23} \text{ molecules}}{\text{mole}}$ =   # 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

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