The Mole

Chapter 3

Section 2

Convenient Units

- A dozen
  - 12 of something
  - You often count eggs by the dozen
  - If you buy 4 dozen eggs how many eggs do you buy?
    - 4 dozen x 12eggs per dozen = 48 eggs

The Mole is a Convenient Unit for Chemists

- A dozen is 12 of something
- A mole is 6.02×10^{23} of something

- Thus if you have 4 moles of eggs you have $4 \times 6.02 \times 10^{23} = 2.408 \times 10^{24}$ eggs

- Because the mole is such a big number it is usually used for counting small things like molecules or atoms

And that’s a lot…

- Because the mole is such a big number it is usually used for counting small things like molecules or atoms

The Mole

- A quantity equal to the number of atoms in the atomic mass of any element expressed in grams
- Look at your periodic table and find the atomic mass of calcium (40.08)
  - 40.08g of calcium is one mole of calcium
- How many grams does one mole of hydrogen weigh? Tungsten?

How is that possible if they all are 6.02×10^{23} atoms???

- If you have a dozen eggs it will be much less in weight than a dozen basketballs!!
- Relative masses oxygen is 16 times the mass of hydrogen thus will be much more massive

Workbook

- Please take out your workbook
- Do questions on page 116
  - Should take less than 3!

The Origin of the Mole

- John Dalton believed that molecules are made up of “atoms”
- Atoms combine in proportion to their atomic masses
  - 2.0 g of hydrogen gas combines with 159.8 g of bromine gas. The bromine gas atom is 159.8 g/2.0 g = 79.9 times heavier than hydrogen

The Origin of the Mole Cont.

- Avogadro's Hypothesis: Equal volumes of different gases, at the same temperature and pressure, all contain the same number of particles.

- Example:
- If 500 mL of nitrogen gas combines with 1000 mL of oxygen gas, how many nitrogen molecules are present for every oxygen molecule? Suggest a formula for the compound formed

Answer

- 1 N : 2 O
- NO_2

Conversions with the Mole

- 1 mol = 6.02×10^{23}

- The conversion factor is

Conversion Factors	
$\frac{6.02 \times 10^{23} \text{ items}}{1 \text{ mol}}$	$\frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ items}}$

Note

- The unit for a mole is mol (**NOT M or m or anything else)**

Sample Problem—Converting Moles to Number of Items

How many oxygen atoms are in 3.2 mol of oxygen atoms?

What to Think about

1. Convert: mol O → atoms O
2. Setup:
   $3.2 \text{ mol O} \times \frac{? \text{ atoms O}}{1 \text{ mol O}}$
3. Conversion factor:
   6.02×10^{23} atoms O per 1 mol O
4. Count the number of significant figures of each value in the operation and then round the answer to the least of these.

How to Do It

$$3.2 \text{ mol O} \times \frac{6.02 \times 10^{23} \text{ atoms O}}{1 \text{ mol O}} = 1.9 \times 10^{24} \text{ atoms O}$$

Note: There is no uncertainty in the 1 mol O. The uncertainty of the conversion factor is expressed in the 6.02×10^{23} atoms O.

Workbook

- Please complete page 117 -118 (practice problems)

Molar Mass

- The mass of one mole of an elements atoms
- 1 mol of Carbon = 12g
- 1 mol of Oxygen = 16g

- This is also the atomic mass (on periodic table)

Molecular Mass

- Also called formula mass
  - The sum of the atomic masses of the compounds parts
  - The formula expressed in grams

- CO_2 is 1C (12u) + 2O (32u) = 44u
- One mol of CO_2 has 1 mol of C and 2 moles of O and its molar mass is 44g

Workbook

- Please do page 119 and 120 practice problems

- Homework
  - Chapter 3.2 all practice problems
  - Chapter 3.2 review p122-123 (2-12,14)

Molar Mass as a conversion factor

Name	Equivalence Statement	Conversion Factors	
Molar mass	1 mol = ? g	$\frac{?\ g}{1\ mol}$	$\frac{1\ mol}{?\ g}$
Example: H_2O	1 mol = 18.0 g	$\frac{18.0\ g}{1\ mol}$	$\frac{1\ mol}{18.0\ g}$