9.2 Mass and the Mole

1. Molar Mass

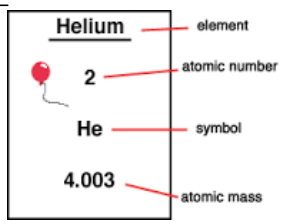
Periodic table shows the mass of one mole of each element.

A. What's the molar mass of aluminum?

26.98 grams/mol (round to hundredths place)

B. What's the molar mass of atomic iodine?

126.90 grams/mol



Conversions Process

Chemists use molar mass in conversions a lot.

A. Determine what information you're given, and what you are seeking.

B. Determine the molar mass of your element or compound.

C. i. If given an amount of moles, convert to mass:

$$x.xx\ mol \bullet \frac{x.xx\ g\ element}{1\ mol\ element} = grams\ element$$

(Moles of Sample) (Molar Mass (g/mol)) (Mass of Sample)

C. ii. If given a mass, convert to moles:

$$x.xx\ g \bullet \frac{1\ mol\ element}{x.xx\ g\ element} = moles\ element$$

(Mass of Sample) (Molar Mass (mol/g)) (Moles of Sample)

2. Mn Conversions

How many grams is in 3.00 moles of manganese?

Mn molar mass = 54.94 g/mol Mn

$$3.00\ \cancel{mol\ Mn} \bullet \frac{54.94\ g}{1\ \cancel{mol\ Mn}} = 165\ g\ Mn$$

3 sig. figs.

3. Ca Conversions

How many moles are there in 70.50 g of calcium?

Ca molar mass = 40.08 g/mol Ca

We are looking for moles, so we must use:

$$\frac{1\ mole\ Ca}{40.08\ g\ Ca}$$

$$70.50\ \cancel{g\ Ca} \bullet \frac{1\ mole\ Ca}{40.08\ \cancel{g\ Ca}} = 1.76\ mol\ Ca$$

Multiphasic Conversions

Mass converts to particles (and vice versa): use moles as an intermediate step.

You still need to determine your given information.

Then: mass to particles:

$$x.xx\ g \bullet \frac{1\ mole\ element}{x.xx\ g\ element} \bullet \frac{6.02\ E\ 23\ particles}{1\ mole} = particles$$

(Mass of Sample) (Molar Mass (mol/g)) (Particles Per mole) (Particles in Sample)

Or: particles to mass:

$$x.xx\ particles \bullet \frac{1\ mol}{6.02\ E\ 23\ particles} \bullet \frac{x.xx\ g\ element}{1\ mol\ element} = grams$$

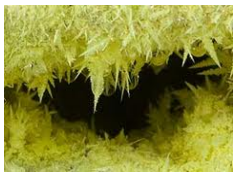
(Particles in Sample) (Moles per Particle) (Molar Mass (g/mol)) (Mass of Sample)

4. Sulfur Example

How many atoms in 15.0 grams of sulfur?
Known: mass = 15.0 g S;
molar mass S = 32.07 g/mol S

Mass to particles:

$$15.0\ g\ S \bullet \frac{1\ mole\ S}{32.07\ g\ S} \bullet \frac{6.02\ E\ 23\ atoms\ S}{1\ mole\ S} = 2.82\ E\ 23\ atoms\ S$$



5. Gold Example

How many grams in 2.12 E 24 atoms of gold?
Known: quantity Au = 2.12 E 24 atoms;
molar mass of Au = 196.97 g/mol
Setup: particles to mass.

$$2.12\ E\ 24\ atoms\ Au \bullet \frac{1\ mol\ Au}{6.02\ E\ 23\ atoms} \bullet \frac{196.97\ g\ Au}{1\ mol\ Au} = 694\ g\ Au$$

3 sig. figs

Wow!
That IS what I'm talking about

Homework

9.2 Booklet Problems.
Due: Next class.