More Moles

Terms

Atomic Mass (in amu's):
average mass of 1 atom
weighted average of all isotopes shown on the Periodic Table
used for atoms

Formula Mass (in amu's):
sum of all atomic masses in 1 formula unit (simplest form)
used for Ionic Compounds

Molecular Mass (in amu's):
formula mass of 1 molecule
used for Molecular Compounds

Molar Mass (in grams):
formula mass in grams
mass in grams that contains one mole

Mole (in grams)
contains same number of units as exactly 12 g of carbon-12
average molecular weight expressed in grams
contains Avogadro's Number (6.02×10^{23} molecules or atoms)

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

Formula Mass (amu's) = molar mass (in grams)
"per" expressions:
1 mol = formula mass (in grams)
1 mol = gram-molecular-weight

Complete This Table

	formula Mass (amu)	mass (g)	# moles	# formula units
K_2SO_4			3.28	
SF_4		235		
$AgNO_3$				8.42×10^{24}
$MgBr_2$			0.662	
$CaCO_3$				7.30×10^{22}
NaCl		15.3		

Hint:
Formula units, Atoms, Molecules è Avogadro's number
Mass è requires MW (given or from periodic table)

Calculations for Silver Nitrate

For 8.42×10^{24} formula units

Number of Moles:

8.42×10^{24} formula units x $\frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ formula units}}$ = 13.9867 moles ➔ 14.0 moles

Formula Weight: (Using Periodic Table to get atomic masses)

Count Atoms, multiply by average weight, sum & round

1 Ag = 1 x 107.87 = 107.87 amu
1 N = 1 x 14.01 = 14.01 amu
3 O = 3 x 16.00 = 48.00 amu
Average MW = 169.88 amu

So, gram-molecular-weight (molar mass) = 169.88 g

The mass in grams for For 8.42 x 10^{24} formula units

14.0 moles x $\frac{169.88\ g}{1\ mol}$ = 2,378.32 g ➔ 2,380 g

Table Now Reads

	formula Mass (amu)	mass (g)	# moles	# formula units
K_2SO_4			3.28	
SF_4		235		
$AgNO_3$	169.88	2,380	14.0	8.42×10^{24}
$MgBr_2$			0.662	
$CaCO_3$				7.30×10^{22}
NaCl		15.3		

Calculations for Magnesium Bromide

Formula Weight (Using Periodic Table for atomic masses):

Count Atoms, multiply by average weight, sum & round

1 Mg = 1 x 24.31 = 24.31 amu
2 Br = 2 x 79.90 = 159.8 amu
Average MW = 184.1 amu

So, gram-molecular-weight (molar mass) = 184.1 g

Mass for 0.662 Moles:

0.662 moles x $\frac{184.1\ g}{1\ mol}$ = 121.874 g ➔ 122 g

 # formula units

$$0.662 \text{ moles} \times \frac{6.02\times10^{23} \text{ formula units}}{1 \text{ mole}} = 3.99 \times 10^{23} \text{ formula units}$$

Completed Table

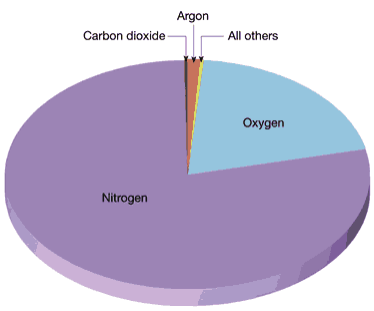
	formula mass	mass (g)	# moles	# formula units
K_2SO_4	174.27	572	3.28	1.97×10^{24}
SF_4	108.06	235	2.16	1.30×10^{24}
$AgNO_3$	169.88	2,380	14.0	8.42×10^{24}
$MgBr_2$	184.1	122	0.662	3.99×10^{23}
$CaCO_3$	100.01	12.1	0.121	7.30×10^{22}
NaCl	58.44	15.3	0.262	1.57×10^{23}

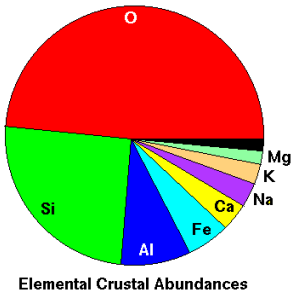
More % Composition Calculations

Percent (%) = parts per hundred

$$\% \text{ A} = \frac{\text{amount A}}{\text{total A}} \times 100 \qquad \frac{\text{Some Component}}{\text{All Components}}$$

Chemists ASSUME molar % unless otherwise specific





Elemental Crustal Abundances

Weight or Mass Percent

Calculations based on mass (grams), not moles

What is weight % of each element for 6.32 g Mg reacting with 8.31 g S?

Total Weight = 6.32 g + 8.31 g = 14.63 g

$$\% \text{ Mg} = \frac{6.32 \text{ g}}{14.63 \text{ g}} \times 100 = 43.2$$

$$\% \text{ S} = \frac{8.31 \text{ g}}{14.63 \text{ g}} \times 100 = 56.8$$

Think Moles, Not Grams!

Percent Component Calculation

% by mass of each element in magnesium sulfide

Write the formula: MgS

Determine molar mass

Mg 1 x 24.31 = 24.31 amu
S 1 x 32.06 = 32.06 amu
Formula weight = 56.37amu

Do the math

For % Mg

$$\frac{24.31 \text{ amu}}{56.37 \text{ amu}} \times 100 = 43.13$$

For % S

$$\frac{32.06 \text{ amu}}{56.37 \text{ amu}} \times 100 = 56.87$$

What is the mass in grams of BaI_2 that contains 42.0 g Iodine?

Determine molar mass

Ba: 1 x 137.3 = 137.3 amu
I: 2 x 126.9 = 253.8 amu
Formula Mass = 391.1 amu (Molar Mass = 391.1 g / mole)

All samples of BaI_2 will contain the following % Iodine

253.8 amu / 391.1 amu x 100 = 64.9 % Iodine

% composition ➔ Component / Whole

Since All samples of BaI_2 contain 0.649 (% as fraction) Iodine:

42.0 g / X = 0.649 ➔ X = 42.0 g / 0.649
X = 64.7 g

A barium iodide sample contains 15.7 g barium. How much iodine in the sample?

The formula mass for BaI_2:

Ba = 1 x 137.3 = 137.3
I = 2 x 126.9 = 253.8
Formula mass = 391.1 amu

% Ba = 137.3 / 391.1 x 100 = 35.11 %

Using the percent as a fraction:

0.3511 = 15.7 g Barium / mass barium iodide
mass barium iodide = 15.7 g / 0.3511 ==> 44.7 g

This gives you mass Barium Iodide, but problem asks for mass iodine

mass iodine = mass barium iodide - mass barium
mass iodine = 44.7 g - 15.7 g = 29 .0 g

Find the mass of CaF_2 that contains 15.6 g Ca

Moles of Ca?

$$15.6\ g \times \frac{1\ mole}{40.08\ g} = 0.387\ mole$$

Formula weight of calcium fluoride
Ca 1 x 40.08 = 40.08 amu
F 2 x 19.00 = 38.00 amu
Formula weight = 78.08 amu

Now, we have # moles Ca and molar mass of CaF_2 ➔ need grams

$$0.387\ mole \times \frac{78.08\ g}{1\ mole} = 30.217 \rightarrow 30.2\ g$$

 # grams of chlorine in sodium chloride that contains 2.95 g sodium

Determine number of moles of sodium

$$2.95\ g \times \frac{1\ mole}{22.99\ g} = 0.1283\ mol \rightarrow 0.128\ mol$$

Since we KNOW formula for sodium chloride is NaCl,
# of moles Na = # moles Cl

$$0.128\ mol \times \frac{35.45\ g}{1\ mol} = 4.5376\ g \rightarrow 4.54\ g$$

Lithium fluoride is used as a flux when welding or soldering aluminum. How many grams of fluorine are in 688 grams of the compound?

Write formula = LiF

Determine Molar Mass

1 Li = 1 x 6.941
1 F = 1 x 18.9984
Molar Mass = 25.9394 ➔ 25.939

Determine Moles LiF

$$688 \text{ grams} \times \frac{1 \text{ mole}}{25.939 \text{ g}} = 26.5238 \rightarrow 26.5 \text{ mol}$$

Determine grams F

$$26.5 \text{ mol} \times \frac{18.9984 \text{ g}}{1 \text{ mol}} = 503.458 \rightarrow 503 \text{ g}$$

Methanol, CH_3OH, is used in the fuel for internal combustion engines. How many grams of carbon are in 70.6 grams of methanol?

Write formula = CH_4O

Determine Molar Mass

1 C = 1 x 12.011 = 12.011
4 H = 4 x 1.008 = 4.032
1 O = 1 x 16.00 = 16.00
Molar Mass = 32.043 ➔ 32.04

Determine Moles Methanol

$$70.6 \text{ grams} \times \frac{1 \text{ mole}}{32.04 \text{ g}} = 2.2035 \rightarrow 2.20 \text{ mol}$$

Determine grams C

$$2.20 \text{ mol} \times \frac{12.011 \text{ g}}{1 \text{ mol}} = 26.4 \text{ g}$$

Find the percent water present in the hydrate $CuSO_4 \cdot 5\ H_2O$

Cu = 63.54	
S = 32.06	10 H = 10.08
4 O = 64.00	5 O = 80.00
Total = 159.60	Total = 90.08

$$\% \text{ Water} = \frac{90.08}{(159.60 + 90.08)} \times 100 = 36.08$$

Think Moles
Not
Grams

Assignment

Start Taking Unit 6 Practice Test
Blackboard only records highest score
Take until multiple 100's have been scored (questions are variable)
(Gives sense of test exam format and content)

The Practice Quiz is very similar to the Unit Exam
Success on Unit exam is directly related to practice exam experiences

At this point:
Elements & polyatomic ions should be memorized