Counting Atoms

How many iron atoms are present in 3.00 moles of iron metal?

1 mol Fe = 55.85 g Fe = 6.02×10^{23} atoms Fe

x atoms Fe = 3.00 mol Fe 1 mol Fe = 6.02×10^{23} atoms Fe

$$x \text{ mol Fe} = 3.00 \text{ mol Fe} \times \frac{6.02 \times 10^{23} \text{ atoms Fe}}{1 \text{ mol Fe}} = 1.81 \times 10^{24} \text{ atoms Fe}$$

Work out the following problems (show math set-ups)

x atoms S = 0.174 mol S

How many sulfur atoms are present in 0.174 moles of S nonmetal?

$$0.174 \text{ mol S} \times \frac{6.02 \times 10^{23} \text{ atoms S}}{1 \text{ mol S}} =$$

ANS: 1.05×10^{23} mol S

x mol K = 5.92×10^{24} atoms K

How many moles of K are present in 5.92×10^{24} atoms of K metal?

$$5.92 \times 10^{24} \text{ atoms} \times \frac{1 \text{ mol K}}{6.02 \times 10^{23} \text{ atoms K}} =$$

ANS: 9.83 atoms K

Let's go over this example together

x atoms C = 27.4 g C

How many atoms of C are present in 27.4 grams of

12.01 g C = 6.02×10^{23} atoms C

Combined we have a grams to particles equivalent statement

$$27.4 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} \times \frac{6.02 \times 10^{23} \text{ atoms C}}{1 \text{ mol C}} = 1.37 \times 10^{24} \text{ atoms C}$$

(grams) x (mol per grams) Avogradro's number

moles x $\frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mole}}$

Chemical Compounds

How many atoms are present in a formula unit of sodium sulfate Na_2SO_4?

Just as a mole of atoms is based on the atomic mass or atomic weight, a mole of a compound is based upon the formula mass or formula weight.

sodium sulfate, Na_2SO_4

First:	How many atoms are there present per formula unit of Na_2SO_4?	7 atoms
Second:	What is the mass in amu of one molecule of sodium sulfate?	142.06 amu
Third:	What is the mass—in grams—of one mole of sodium sulfate?	142.06 g
Fourth:	How many moles of Na_2SO_4 are in 16.0 g Na_2SO_4?	1.13×10^{-1} mol

Na_2SO_4

2 Na
1 S
4 O
7 atoms

2 Na x 22.99 = 45.98
1 S x 32.07 = 32.07
4 O x 16.00 = 64.00
142.06 g Na_2SO_4

x mol Na_2SO_4 = 16.0 g Na_2SO_4 x $\frac{1 \text{ mol } Na_2SO_4}{142.06 \text{ g } Na_2SO_4}$ = 1.13×10^{-1} mol Na_2SO_4

Molar Mass Calculations; one mole amount of a substance in grams

CH_4

1 C x 12.0 = 12.0
4 H x 1.0 = 4.0

ANS: 16.0

$CuSO_4 \cdot 5H_2O$ This is called a pentahydrate

1 Cu x 63.6 = 63.6
1 S x 32.0 = 32.0
4 O x 16.0 = 64.0
5 H_2O x 18.0 = 90.0

ANS: 249.6

$C_3H_5Br_2$

3 C x 12.0 = 36.0
5 H x 1.0 = 5.0
2 Br x 78.9 = 157.8

ANS: 198.8

aluminum nitrate $Al(NO_3)_3$

1Al x 27.0 = 27.0
3 N x 15.0 = 45.0
9 0 x 16.0 = 144.0

Note you must be able to derive correct formulas from names

ANS: 216.0

C_3H_7OH

3 C x 12.0 = 36.0
8 H x 1.0 = 8.0
1 O x 16.0 = 16.0

ANS: 60.0

calcium dihydrogen phosphate
$Ca(H_2PO_4)_2$

1 Ca x 40.1 = 40.1
4 H x 1.0 = 4.0
2 P x 31.0 = 62.0
8 O x 16.0 = 128.0

ANS: 234.1

Grams to Moles and Moles to Grams

How many moles are there in 41.7 g of $NaNO_3$?

1 mol $NaNO_3$ = 85.0 g $NaNO_3$

1 Na x 23.0 = 23.0
1 N x 14.0 = 14.0
3 O x 16.0 = 48.0
molar mass: 85.0 g/mol

In every calculuation problem ALWAYS
Calculate molar mass; MAKE a Table and Do it

The grams to moles conversion set-up

41.7 g $NaNO_3$ x $\frac{1 \text{ mol } NaNO_3}{85.0 \text{ g } NaNO_3}$ = 0.491 mol $NaNO_3$

(grams)
(molar mass; g/mol)
moles

Quickly convert to moles by dividing grams by molar mass
Memorize this!!!!

Calculate the number of moles in :

12.6 grams calcium sulfate

1 Ca x 40.1 = 40.1
1 S x 32.1 = 32.1
4 O x 16.0 = 64.0
136.2

How many moles of calcium sulfate are present in 12.6 g of calcium sulfate?

ANS: 9.25×10^{-2} mol $CaSO_4$

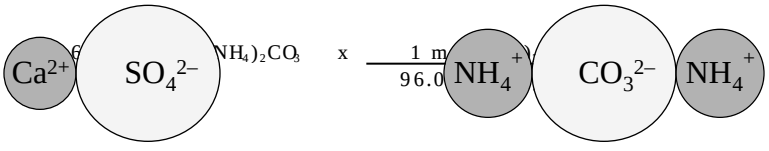
6.18×10^3 grams ammonium carbonate

2 N x 14.0 = 28.0
8 H x 1.0 = 8.0
3 O x 16.0 = 48.0
96.0

How many moles of ammonium carbonate are present in 6.18×10^3 grams of ammonium carbonate salt?

ANS: 64.4mol $(NH_4)_2CO_3$

$CaSO_4$ $(NH_4)_2CO_3$ x $\frac{1 \text{ m}}{96.0}$



$CaSO_4$ $(NH_4)_2CO_3$

How many moles of calcium sulfate atoms are present in 12.6 grams of calcium sulfate ionic salt?

How many moles of ammonium carbonate are present in 6.18 x 10^3 grams of ammonium carbonate ionic salt?

Converting Mole Amounts to Grams

Calculate the number of grams in (show math set-ups):

4.22 moles of KCl

KCl
1 K x 39.1 = 39.1
1 Cl x 35.5 = 35.5
74.6 g/mol

4.22 mol KCl x $\frac{74.6\text{ g KCl}}{1\text{ mol KCl}}$ =

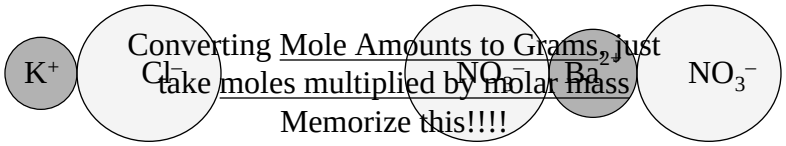
ANS: 3.15 x 10^2 grams KCl

0.0196 moles barium nitrate

$Ba(NO_3)_2$
1 Ba x 137.3 = 137.3
2 N x 14.0 = 28.0
6 O x 16.0 = 96.0
261.3 g/mol

0.0196 mol $Ba(NO_3)_2$ x $\frac{261.3\text{ g } Ba(NO_3)_2}{1\text{ mol } Ba(NO_3)_2}$ =

ANS: 5.12 grams $Ba(NO_3)_2$



Converting Mole Amounts to Grams, just take moles multiplied by molar mass
Memorize this!!!!

KCl $Ba(NO_3)_2$