311/312 Chemistry

# Grams, Moles, Atoms

*Conversion Practice II*

Convert the mass of a substance to the number of moles of a substance, and moles to mass.

**There are two *definitions* (conversion factors) of the mole that we use during our mole conversions:**

1 mole = $6.02 \times 10^{23}$ particles? (*particles* could mean atoms, molecules, or formula units)

1 mole = molar mass of an element, molecule, or compound.

**Each definition can be written as a set of two conversion factors, what are they?**

1 mole = molar mass of an element, molecule, or compound can be written as: $\left(\frac{1 \text{ mole}}{\text{molar mass}}\right)$ or $\left(\frac{\text{molar mass}}{1 \text{ mole}}\right)$

1 mole = Avogadro's number can be written as: $\left(\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ particles}}\right)$ or $\left(\frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mole}}\right)$

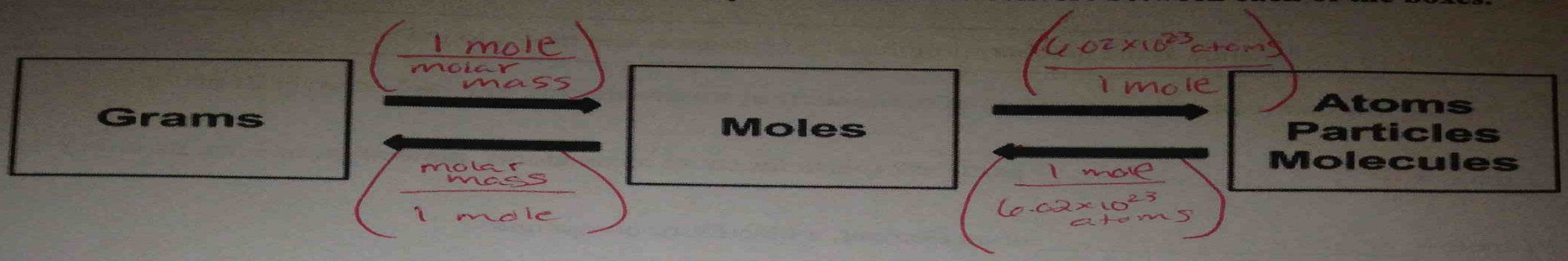
**How do you choose which conversion factor to use?** *Look at what you were given in the problem.*

- *If you are given particles, then you would choose the conversion factor so that "particles" will cancel out.*
- *If your are given moles and want to go to particles, then use the conversion factor so that the "moles" can cancel out and not be in your final answer.*

## The Steps to Solving Mole Problems:

1. Determine what you are given, and what you need to convert to.
2. Determine what conversion factors you will need. Calculate molar mass if needed.
3. Set up conversion so that units cancel out.

**Next to each arrow draw in the conversion factor you would use to convert between each of the boxes.**




**Solve the following mole conversion problems, you must use the *unit analysis technique*!**

1) How many moles are there in 24 grams of $FeF_3$?

$$(24\text{g } FeF_3) \times \left(\frac{1 \text{ mol } FeF_3}{112.85\text{g } FeF_3}\right) = 0.21 \text{ moles } FeF_3$$

Fe: (55.85)(1) = 55.85
F: (19.00)(3) = 57.00
112.85

2) How many molecules are there in 4.5 mole of $Na_2SO_4$?

$$(4.5 \text{ mol } Na_2SO_4) \times \left(\frac{6.02\times10^{23} \text{ molecules}}{1 \text{ mole } Na_2SO_4}\right) = 2.7\times10^{24} \text{ molecules } Na_2SO_4$$

Na: (22.99)(2) = 45.98
S: (32.07)(1) = 32.07
O: (16.00)(4) = 64.00
142.05

3) How many grams are there in $2.3 \times 10^{24}$ atoms of silver?

$$(2.3\times10^{24} \text{ atoms Ag}) \times \left(\frac{1 \text{ mole}}{6.02\times10^{23} \text{ atoms}}\right) \times \left(\frac{107.87\text{g Ag}}{1 \text{ mole}}\right) = 4.1\times10^{2}\text{ g Ag}$$

4) How many grams are there in $7.4 \times 10^{23}$ molecules of $AgNO_3$?

$$(7.4\times10^{23} \text{ molecules } AgNO_3) \times \left(\frac{1 \text{ mole}}{6.02\times10^{23} \text{ molecules}}\right) \times \left(\frac{169.88\text{g } AgNO_3}{1 \text{ mole } AgNO_3}\right) = 208.8$$

$2.1\times10^{2}$ g $AgNO_3$

Ag: (107.87)(1) = 107.87
N: (14.01)(1) = 14.01
O: (16.00)(3) = 48.00
169.88

5) How many moles are there in $7.5 \times 10^{23}$ molecules of $H_2SO_4$?

$$7.5\times10^{23} \text{ molecules } H_2SO_4 \times \left(\frac{1 \text{ mole } H_2SO_4}{6.02\times10^{23} \text{ molecules } H_2SO_4}\right) = 1.2 \text{ moles } H_2SO_4$$

6) How many molecules are there in 122 grams of $Cu(NO_3)_2$?

$$\left(122\text{g } Cu(NO_3)_2\right)\left(\frac{1\text{ mole}}{187.60\text{ g } Cu(NO_3)_2}\right)\left(\frac{6.02\times10^{23}\text{ molecules}}{1\text{ mole}}\right) = 3.91\times10^{23}\text{ molecules } Cu(NO_3)_2$$

Cu: (63.55)(1) = 63.55
N: (14.01)(2) = 28.02
O: (16.00)(6) = 96.00
187.60

7) How many grams are there in $9.4 \times 10^{25}$ molecules of $H_2$?

$$\left(9.4\times10^{25}\text{ molecules } H_2\right)\left(\frac{1\text{ mol}}{6.02\times10^{23}}\right)\left(\frac{2.02\text{g}}{1\text{ mol } H_2}\right) = 315.49 = 3.2\times10^{2}\text{ g } H_2$$

H: (1.01)(2) = 2.02

8) How many molecules are there in 230 grams of $CoCl_2$?

$$\left(230\text{g } CoCl_2\right)\left(\frac{1\text{ mol}}{129.83\text{g } CoCl_2}\right)\left(\frac{6.02\times10^{23}\text{ molecules}}{1\text{ mol}}\right) = 1.1\times10^{24}\text{ molecules } CoCl_2$$

Co: (58.93)(1) = 58.93
Cl: (35.45)(2) = 70.9
129.83

9) How many molecules are there in 2.3 grams of $NH_4SO_2$?

$$\left(\frac{2.3\text{g } NH_4SO_2}{1}\right)\left(\frac{1\text{ mole}}{82.11\text{g}}\right)\left(\frac{6.02\times10^{23}}{1\text{ mole}}\right) = 1.7\times10^{22}\text{ molecules } NH_4SO_2$$

N: (14.01)(1) = 14.01
H: (1.01)(4) = 4.04
S: (32.06)(1) = 32.06
O: (16)(2) = 32.00
82.11

10) How many moles are there in $3.3 \times 10^{23}$ molecules of $N_2I_6$?

$$\left(3.3\times10^{23}\text{ molecules}\right)\left(\frac{1\text{ mole}}{6.02\times10^{23}\text{ molecules}}\right) = 0.55\text{ moles } N_2I_2$$

11) How many molecules are there in 200 moles of $CCl_4$? *Ignore Sig Figs*

$$\left(200\text{ moles } CCl_4\right)\left(\frac{6.02\times10^{23}\text{ molecules}}{1\text{ mole}}\right) = 1.2\times10^{26}\text{ molecules}$$

12) How many grams are there in $1 \times 10^{24}$ molecules of $BCl_3$? *Ignore Sig Figs*

$$\left(1\times10^{24}\text{ molecules } BCl_3\right)\left(\frac{1\text{ mole}}{6.02\times10^{23}\text{ molecules}}\right)\left(\frac{117.16\text{g}}{1\text{ mole}}\right) = 194.6\text{ grams } BCl_3$$

B: 10.81(1)
Cl: (35.45)(3)
117.16

13) How many grams are there in $4.5 \times 10^{22}$ molecules of $Ba(NO_2)_2$?

$$\left(4.5\times10^{22}\text{ molecules}\right)\left(\frac{1\text{ mole}}{6.02\times10^{23}\text{ molecules}}\right)\left(\frac{229.35\text{g}}{1\text{ mole}}\right) = 17\text{ grams } Ba(NO_2)_2$$

Ba: (137.33)(1) = 137.33
N: (14.01)(2) = 28.02
O: (16.00)(4) = 64.00
229.35