

## Worksheet # C16: Atomic Mass: Grams and the Mole

1. The atomic mass number on the periodic chart tells us two things. It tells us the average number of protons plus neutrons that are in the atoms of that element. It also tells us how many grams of that element it takes to have 6.02 x 10<sup>23</sup> atoms of that element. 6.02 x 10<sup>23</sup> is called "Avagadro's Number" (after the guy who thought of it first) or just a mole.

2. How many grams of each of the following elements would you need to measure out in order to get one mole of each? (Round your answers to the second place after the decimal.)

- a. carbon 12.01 g                      c. aluminum 26.98 g                      e. iron 55.85g  
 b. gold 196.97 g                      d. silver 107.87                      f. antimony 121.76 g

3. There are 6.02 x 10<sup>23</sup> atoms in 1.00 mole. This makes for two great conversion factors!

a. What are these two conversion factors?

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

4. Use these conversion factors (from #3) to solve the following. Show your set-ups. Don't forget units and sig figs!

a. How many atoms of carbon are in 3.85 moles of carbon?

$$3.85 \text{ moles} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mole}} = 2.32 \times 10^{24} \text{ atoms}$$

b. If you had 5.98 x 10<sup>25</sup> atoms of silicon, how many moles would that be?

$$5.98 \times 10^{25} \text{ atoms} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} = 99.3 \text{ moles of silicon}$$

c. How many atoms of silver are in .00452 moles of silver?

$$.00452 \text{ moles} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mole}} = 2.72 \times 10^{21} \text{ atoms of silver}$$

d. If you had 9.31 x 10<sup>18</sup> atoms of manganese, how many moles would that be?

$$9.31 \times 10^{18} \text{ atoms} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} = 1.55 \times 10^{-5} \text{ moles of manganese}$$

5. The atomic mass on the periodic table tells us how many grams it takes to have 1.000 mole of the element. For carbon, the mass is 12.01 grams. This makes for two more conversion factors.

a. What are the two conversion factors for 1.000 moles of carbon?

$$\frac{1 \text{ mole carbon}}{12.01 \text{ g}} \quad \text{and} \quad \frac{12.01 \text{ g}}{1 \text{ mole carbon}}$$

b. How many grams of carbon would you need to have 2.49 moles of carbon? (Set-up)

$$2.49 \text{ moles} \times \frac{12.01 \text{ g}}{1 \text{ mole}} = 29.9 \text{ grams}$$

c. If you had 200.0 grams of carbon, how many moles would that be? (Set-up)

$$200.0 \text{ g} \times \frac{1 \text{ mole}}{12.01 \text{ g}} = 16.65 \text{ moles}$$

6. How many grams of lead would you need to have 2.49 moles of lead? (lead is 207.2 g/mole)

$$2.49 \text{ moles} \times \frac{207.2 \text{ g Pb}}{1 \text{ mole}} = 516 \text{ grams lead}$$

7. If you had 200.0 grams of lead, how many moles would that be?

$$200.0 \text{ g} \times \frac{1 \text{ mole}}{207.2 \text{ g}} = .9653 \text{ moles Pb}$$

8. Now put the two kinds of conversion factors (# atoms and moles, moles and grams) together:

a. How many atoms are there in 450.0 grams of carbon?

$$450.0 \text{ g} \times \frac{1 \text{ mole}}{12.01 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mole}} = 2.26 \times 10^{25} \text{ atoms carbon}$$

b. What would be the mass of  $4.59 \times 10^{24}$  atoms of lead?

$$4.59 \times 10^{24} \text{ atoms} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{207.2 \text{ g Pb}}{1 \text{ mole}} = 1580 \text{ grams lead}$$

c. How many atoms are there in 0.762 grams of copper?

$$0.762 \text{ g} \times \frac{1 \text{ mole}}{63.55 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mole}} = 7.22 \times 10^{21} \text{ atoms copper}$$

d. What would be the mass of  $2.98 \times 10^{20}$  atoms of magnesium?

$$2.98 \times 10^{20} \text{ atoms} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{24.31 \text{ g Mg}}{1 \text{ mole}} = .0120 \text{ grams Mg}$$