There are three mole equalities. They are:
> 1 mol = 6.02 x 10^{23} particles
> 1 mol = molar mass in g (periodic table)
> 1 mol = 22.4 L for a gas at STP

Each equality can be written as a set of two conversion factors. They are:

$$\left(\frac{1\,mole}{6.02x10^{23}\,particles}\right) \qquad \left(\frac{6.02x10^{23}\,particles}{1\,mole}\right)$$

$$\left(\frac{1\,mole}{molar\,mass}\right) \qquad \left(\frac{molar\,mass}{1\,mole}\right)$$

$$\left(\frac{1\,mole}{22.4\,L}\right) \qquad \left(\frac{22.4\,L}{1\,mole}\right)$$

Using the factor label method: You weigh a 24 K gold chain, and find that it weighs 400 grams. Determine how many moles of Gold atoms you have.

$$400.\,g\,Au \cdot \frac{1\,mol\,Au}{196.97\,g\,Au} = 2.03\,mol\,Au$$

Mole-Particle Conversions (Use the factor label method and show your work.)

1. How many moles of magnesium is 3.01 x 10^{22} atoms of magnesium?

2. How many molecules are there in 4.00 moles of glucose, $C_6H_{12}O_6$?

3. How many moles are 1.20 x 10^{25} atoms of phosphorous?

4. How many atoms are in 0.750 moles of zinc?

5. How many molecules are in 0.400 moles of N_2O_5?

Mole-Mass Conversions

1. How many moles in 28 grams of CO_2 ?

2. What is the mass of 5 moles of Fe_2O_3 ?

3. Find the number of moles of argon in 452 g of argon.

4. Find the grams in 1.26×10^{-4} mol of $HC_2H_3O_2$.

5. Find the mass in 2.6 mol of lithium bromide.

Mole-Volume Conversions

1. Determine the volume, in liters, occupied by 0.030 moles of a gas at STP.

2. How many moles of argon atoms are present in 11.2 L of argon gas at STP?

3. What is the volume of 0.05 mol of neon gas at STP?

Mixed Practice

1. You have 23 moles of Tantalum (Ta). How many grams is this?

2. You discover that the head of a match contains 1.6 grams of Sulfur, S. How many atoms of S does a match contain?

3. While cleaning a cut, you spill a bottle of Iodine. The label says that the bottle holds 500 grams of I_2. How many moles of I_2 are there?

4. Your silver watchband has a mass of 326 g. How many moles of Ag do you have?

5. EXTRA STEP HERE! Can you catch it? While dropping off your recycling, you are overcome by the urge to weigh the tin cans you brought in. You find that the mass of cans in the box you brought had a mass of 23 kg. How many moles do you have?

6. Water has a molar mass of 18 grams (that's 18 grams per mole…). You drink a 2-liter bottle of water everyday, and you are such a smarty that you know that 1-ml of H2O weighs 1 g. Can you tell me how many moles of water you consume a day?

7. You pick any element that comes *after* oxygen, and tell me the mass of 17 moles of that particular element would weigh.

8. Your toothpaste probably contains around 62 g of fluorine per tube. How many moles are in one tube of toothpaste?

9. The head of a golf club might contain 250 grams of titanium. How many moles is this?

10. The shaft of that same golf club probably contains around 35 moles of graphite, a natural form of carbon. How much might the shaft of the club weigh?

Multiple Variable Conversions

1. How many oxygen molecules are in 3.36 L of oxygen gas at STP?

2. Find the mass in grams of 2.00 x 10^{23} molecules of F_2.

3. Determine the volume in liters occupied by 14 g of nitrogen gas at STP.

4. Find the mass, in grams, of 1.00 x 10^{23} molecules of N_2.

5. How many particles are there in 1.43 g of a molecular compound with a gram molecular mass of 233 g?

6. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed by G.D. Searle as *Nutra Sweet*. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.
    a) Calculate the molar mass of aspartame.

    b) How many moles of molecules are in 10 g of aspartame?

    c) What is the mass in grams of 1.56 moles of aspartame?

    d) How many molecules are in 5 **mg** of aspartame?

    e) How many atoms of nitrogen are in 1.2 grams of aspartame?