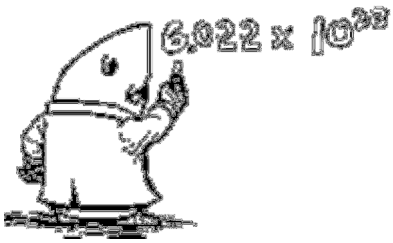
Introduction to Moles Name_____ Period_____

Do this assignment in order, don't skip ahead and work in pencil!!!



Before you begin, define the following:

Avogadro's Number:

Mole (abbreviated mol):

Molar Mass:

Introduction: *(Read all of this carefully)*

Chemists need a way to talk about amounts of atoms, ions, molecules or formula units of compounds. We could talk about a dozen atoms. Everyone knows that a dozen of anything contains 12 of that item. Do you know how many a baker's dozen is equal to? (FYI, a baker's dozen is 13 of something.) How many shoes in a pair of shoes? Did you know that a gross is the term for a dozen dozens (or 144 of something). A ream of printer paper has 500 sheets of paper. These terms: pair, dozen, bakers dozen, gross and ream all indicate a specific number. If we wanted to talk about atoms, ions, molecules, etc in chemistry we could use these terms, but in reality it is not practical to talk about a dozen atoms or a ream of atoms. Atoms are so small, we need a larger number to talk about atoms. That is why Amedeo Avogadro's contribution to chemistry is so EPIC. Avogadro gave us Avogadro's number. Avogadro's number represents how much is in a mole. Just like a dozen is equal to 12, Avogadro's number is equal to 602,214,130,000,000,000,000,000.0 of anything. You could have a dozen donuts or a mole of donuts. **A mole is simply an amount.** Since the value of a mole is such a large number, we can shorten it using scientific notation to 6.022×10^{23}. So if you have 1.00 moles of sodium atoms, you would have 6.022×10^{23} Na atoms. If you have 1 mole of golf balls, you have 6.022×10^{23} golf balls. The term mole works great for atoms, ions, molecules, and formula units because these particles are so small.

Section 1: How many atoms in the following amounts?

1. 1.00 moles of jolly rancher candy pieces = _____ jolly rancher candy pieces
2. 1.00 moles of Mg atoms = _____ Mg atoms
3. 1.0000 moles of Cl atoms = _____ Cl atoms
4. 1.0 moles of Ca atoms = _____ Ca atoms
5. 1 moles of Argon atoms = _____ Ar atoms
6. 1.0 moles of Water molecules = _____ H_2O molecules

Get the point?

1 mole of any substance is equal to 6.022×10^{23} atoms of that substance…No matter what the substance is.

Introduction Part II: *(Read all of this carefully)*

Which weighs more, a pound of feathers or a pound of bricks? Trick question, right? They both weight the same amount. Which weighs more a dozen feathers or a dozen bricks? Wait a minute….. 12 bricks weigh more than 12 feathers all day, every day.

Which weighs more, a dozen helium atoms (He) or a dozen iron atoms (Fe)? Consult the periodic table and see that iron (~56 amu) has more mass than helium (~4 amu). Therefore, a dozen iron atoms are much heavier than a dozen helium atoms.

Which weighs more, a mole of helium atoms or a mole of iron atoms? Which weighs more 6.022×10^{23} helium atoms or 6.022×10^{23} iron atoms? It should be obvious that if you have a mole of helium and a mole of iron, the iron has more mass (by a lot).

The Periodic Table of elements tells us the molar mass of elements. Be careful and don't get confused through. The periodic table tells us two things about every element: *(We will use iron for an example.)*

1. An individual iron (Fe) atom has an atomic mass of 55.845 amu (atomic mass units).
2. A mole of iron (Fe) atoms have a molar mass of 55.845 g/mol (grams "per" mol)

Notice that the number is the same (from the PT), but the units are different. In example #1, 55.845 is the amu (atomic mass unit) mass of 1 atom of iron, and in #2, 55.845 is the mass in grams per mol (g/mol) of 1 mol of iron atoms (6.022×10^{23} atoms of iron to be exact.)

Section 2: What is the mass of the following quantities? *(Use the STARR Periodic Table, and DON'T Round)*

7. What is the mass of 1 tungsten atom? _____ *(Be careful with units: amu or g/mol?)*
8. What is the mass of 1.0 mole of nickel? _____
9. What is the mass of 1 tin atom? _____
10. What is the mass of 1.0 mole of tin? _____
11. What is the mass of 1.0 mole of Al? _____
12. What is the mass of 1 Al atom? _____
13. What is the mass of 1.00 mol of potassium? _____
14. What is the mass of 1.000 mole of uranium? _____

We call the mass of one mol of a substance the molar mass.

Get the point?

You can determine the mass of 1 atom or 1 mole from the Periodic Table of Elements. Be careful of units!

Introduction Part III: *(Read all of this carefully)*

So now we know a mole is an amount. A mole of anything contains Avogadro's number of things. (Remember that Avogadro's number is 6.022×10^{23}). We also know the mass of a mole, AKA the molar mass, by looking up that substance in the periodic table.

The tricky thing is that we rarely ever have one mole or exactly 6.022×10^{23} of anything. So we have to do conversions using the mole. These conversions will cause us to have to use dimensional analysis.

I realize that dimensional analysis may give you nightmares, but… its back. I told you we would use it all year! Remember with dimensional analysis, you must work with quantities that are equal. We just learned 2 quantities that are always equal:

How many: 1 mol ____ = 6.022×10^{23} atoms _____

&

How massive: 1 mol ____= the molar mass on the PT

Dimensional Analysis Refresher:

1. Write the quantity you know you start with.
2. Set up the lines.
3. Place equalities so that the units cancel top to bottom.
4. Plug & Solve.
5. Remember to divide the product of the top by the product of the entire bottom.

Molar Conversions: (Show all your steps, set up all your work & include units)

15. How many aluminum atoms in 1.5 moles of aluminum?

16. How many moles of potassium are present in a sample of 8.12×10^{25} atoms of K?

17. If you have a sample containing 0.75 moles of beryllium, how many atoms are present?

18. What is the mass of a 2.5 mol sample of manganese (Mn)?

19. A partial roll of 1981 pennies (made from solid copper) has a mass of 45.5 grams. How many moles of Cu are present?

20. What is the mass of 3.5 moles of lead?

21. How many mols of xenon are present in a sample of Xe containing 8.12×10^{25} atoms?

22. In 1945, the United States used a nuclear weapon over Hiroshima, Japan in an effort to end World War II. The "little boy" bomb contained 64 kg of uranium-235. How many moles of ^{235}U were used in that bomb? (Hint, don't look at U on the PT, you are using the mass of an isotope of uranium. Also, kilograms are not your preferred unit.)

23. Now that you know how many moles of uranium-235 were used in that bomb, how many uranium-235 isotope particles were in the bomb?

24. A fishing sinker (AKA: a weight to hold the line underwater) has 9.8×10^{22} atoms of lead in it. How many moles of lead are present?

25. How many grams is the fishing weight from #24.