

Lab: Number of Molecules in Chemicals

Task:

You are to determine the number of molecules in a quantity of chemical, provided by your teacher. You must design and carry out the experiment yourself or with your group. You will be given one class period to perform the experiment. You must come up with a procedure and have it checked out by your teacher prior to starting.

Prelab Discussion:

One of the most important and widely used concepts in chemistry is the *mole*. The word *mole* is derived from Latin, meaning “heap” or “pile”. In chemistry, a mole is an amount of substance having a specific mass and containing a given number of particles. There are 6.02×10^{23} particles in one mole. This number is known as *Avogadro's number*.

In terms of particles, the concept of the mole is usually applied to atoms, ions, molecules, or electrons. In terms of mass units, the mole is the number of grams numerically equal to the atomic, molecular, or formula mass of a substance. For example, one mole of oxygen atoms has a mass of 16.0 g and is composed of 6.02×10^{23} atoms. One mole of oxygen molecules, O_2 , has a mass of 32.0 g and is composed of 6.02×10^{23} molecules. One mole (formula mass) of sodium chloride, NaCl, has a mass of 58.5 g and contains 6.02×10^{23} sodium ions and 6.02×10^{23} chloride ions.

This suggests that we can count molecules, atoms, or ions of a given substance by measuring their mass and then converting the measured mass into moles. The number of particles in the given mass may be then determined by knowing Avogadro's Number in a mole.

Prelab Assignment

1. From the prelab discussion, formulate a problem statement to determine the number of molecules in the given chemicals.
2. State the hypothesis of your experiment. (A theory that allows you to predict something that you have not already observed. Theories are assumed to be correct until proven otherwise).
3. Design an appropriate procedure to determine the number of molecules in the chemical provided.

Data Table

Tabulate your data in an appropriate table.

Data Analysis

1. Carry out the calculations necessary to determine the number of molecules in your chemical.
2. Write the chemical name and formula for your chemical.
3. List the sources of errors, and where possible, indicate what modifications you would make to obtain a more accurate result.

Conclusion

Provide a valid conclusion. What assumptions were made in your calculations? Were they justified?

Extension

1. Account for the observation that 22 g CO_2 contain the same number of molecules as 32 g SO_2 .
2. Account for the observation that 10 g CaCO_3 contain the same number of particles as 4 g NaOH .
3. How many grams of NaCl furnish one mole of Na^+ ions?
4. How many grams of BaCl_2 furnish one mole of Cl^- ions?
5. How many carbon atoms are there in one mole of sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ molecules?