Lecture Notes: Atomic Mass and The Mole

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Atomic Mass

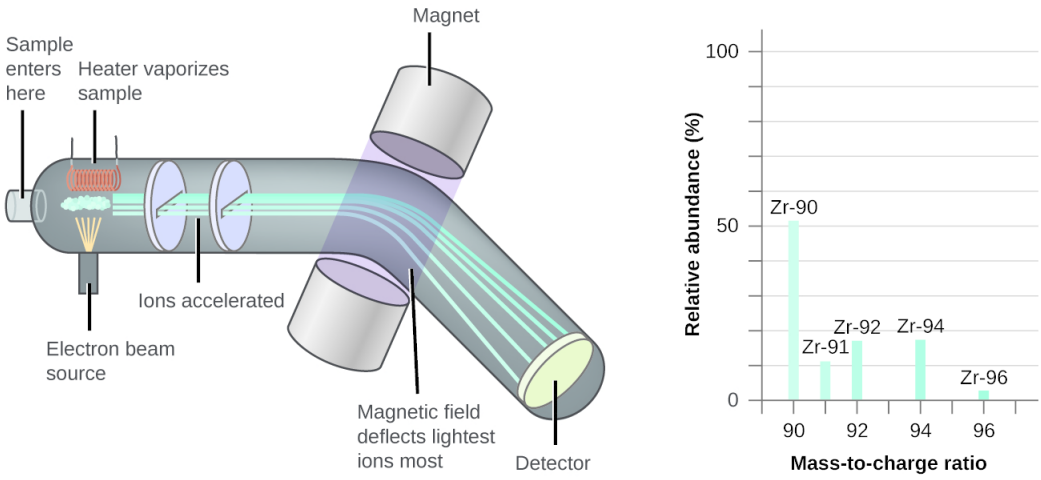

Figure 1: (left)Diagram of a mass spectrometer and its key components. (right)Mass spectrometer data for different isotopes of Zirconium.

- **Atomic Mass Unit**: a measure of mass defined such that the mass of pure ^{12}C is exactly 12 atomic mass units. Unit is denoted as "amu" (i.e the mass of ^{12}C is 12 amu)

Question 1: If pure ^{12}C is supposed to be exactly 12 amu, then why does the periodic table have carbon's atomic mass listed as 12.01 amu?

Question 2: You work at a bulk food market and a customer is requesting to buy 800 almonds. You could sit and count the almonds one by one, however you quickly realize this would be a highly inefficient process. How would you fulfill this customers order?

Problem 1: Figure 1 shows the mass spec data for zirconium, using this mass spec data, the following natural abundances were obtained:

Mass Number	Abundance	Mass(amu)
90	51.45%	89.90
91	11.22%	90.91
92	17.15%	91.91
94	17.38%	93.91
96	2.80%	95.91

Use this data in order to calculate the atomic mass of zirconium

The Mole/Dimensional Analysis with Molar Quantities

- **Mole**: number equal to the number of carbon atoms in exactly 12 grams of pure ^{12}C.
  - the mole is defined such that a sample of a natural element with a mass equal to the element's atomic mass in grams contains 1 mole of atoms

Problem 2: Compute both the number of moles and the number of atoms in a 10.0g sample of zirconium(Zr).

Problem 3: Calculate the mass of a sample of cobalt (Co) containing 5.00×10^{20} atoms.

Molar Mass

- **Molar Mass**: mass in grams of one mole of the compound.
  - Obtained by summing the masses of the component atoms in a molecule

Problem 4: The chemical formula for the common pain reliever ibuprofen is $C_{13}H_{18}O_2$:

a) Calculate the molar mass of ibuprofen.

b) How many atoms are in a 3.2g sample of ibuprofen.

Problem 5: Potassium perchlorate is an inorganic salt with the chemical formula $KClO_4$ formed by the ionic attraction of K^+ and ClO_4^- ions.

a) Calculate the molar mass of potassium perchlorate.

b) A certain sample of potassium perchlorate contains 5.78 moles What is the mass in grams of this sample? What is the mass of the ClO_4^- ions present?

Percent Composition of Compounds

- **Mass Percent**: a method of characterizing the concentration of an element in a compound.
  - obtained by comparing the mass of each element present in 1 mole of the compound to the total mass of 1 mole of the compound.

Problem 5: Phenazine ($C_{12}H_8N_2$) is a drug commonly used as an appetite supressant. Compute the mass percent of each element in phenazine.