

3.3 - How Atoms Differ

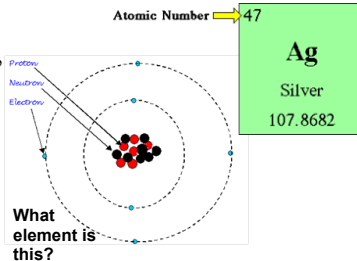
Atomic Number

Def: Number of protons in an atom.

Elements are defined by their number of protons.

Also equals the number of electrons in electrically neutral atom. 1. Why neutral?

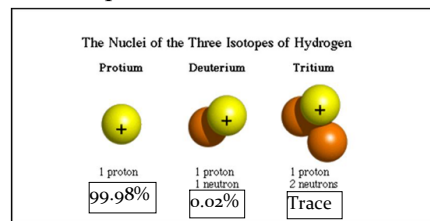
Protons & electrons have opposite charge, and charges cancel out.



Isotope

Def: Atoms of the same element with different numbers of neutrons.

Elemental isotopes have different abundance.



Isotopes have the same chemical properties, but some different physical ones: mass, boiling point.

Mass Number

Def: Number of protons + neutrons of an isotope.

2. What is the mass number of a sodium isotope that has 13 neutrons in the nucleus?

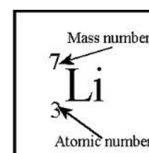
Sodium has 11 protons, so the mass number will be:

11 protons + 13 neutrons = mass number = 24

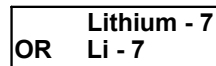
Isotope Notation

There are two ways of symbolically writing isotopes:

Superscript/Subscript method:
mass number is superscripted,
atomic number is subscripted.



Element - Mass Number method: Element's name/
symbol is followed by the mass number.



3. Isotope Guided Example



What element is this? Nitrogen

How many electrons, protons, and neutrons does it have?

Electrons = Protons = 7

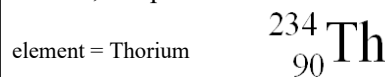
Neutrons = Mass Number - Atomic Number = 8

Write this isotope in element - mass number notation.

N-15.

4. Thorium Example

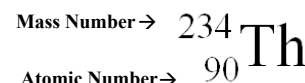
What is the following element, and how many electrons, neutrons, and protons does it have?



electrons = 90

neutrons = Mass Number - Atomic Number = 144

protons = 90



Chem 3.3 Notes - How Atoms Differ.notebook

Atomic Mass Unit (amu) (also called a Dalton (Da))

Scientists realized the importance of standardizing atomic masses in chemistry.

In 1803, John Dalton proposed using hydrogen's mass as a standard. Later, oxygen was used.

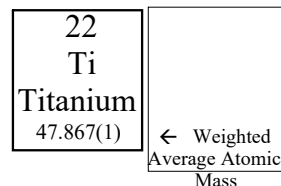
With the discovery of isotopes in 1912, the original standards became invalid.

Finally, in 1961, carbon-12 was adopted.

AMU Definition: the mass of 1/12th of a carbon-12 atom.

Atomic Mass

Since it's impossible to weigh every atom of an element on Earth and find the average, a weighted average mass of an element's isotopes is made.

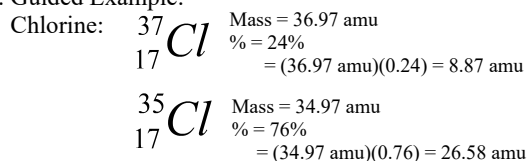


Average Mass Process

A. Multiply isotope's atomic mass by % abundance (as decimal) for every isotope to determine each contribution.

B. Add contributions.

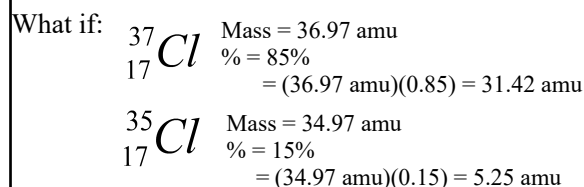
5. Guided Example:



Weighted average mass: 8.87 amu + 26.58 amu
= 35.45 amu

6. Changing Abundance

If isotopic abundance changes, the weighted average mass does too.



Average: 31.42 amu + 5.25 amu = 36.67 amu.
Heavier than 35.44 amu from the earlier distribution.

Isotope Abundance

Analyzing an element's mass can indicate the most abundant isotope of that element.

7. Mn has atomic mass of 54.938 amu.

It has four isotopes: Mn-52, Mn-53, Mn-54, & Mn-55.
Which is the most abundant?

Mn-55



8. Isotope Review!

Write the following elements in both forms of isotope notation.

Protons = 33
Neutrons = 38



Arsenic - 71

Neutrons = 11
Protons = 9



Fluorine - 20

Homework

Preview 3.4
3.3 Problems in your Booklet
Due: Next Class.