Atomic Theory Nuclear Theory

   400 BC Greeks said matter consists of tiny particles called atoms.

   Dalton’s atomic theory (1766-1814)

   1. Each element is made of individual particles called atoms.
   2. Atoms are indivisible, cannot be created or destroyed.
   3. All atoms of one element are identical.
   4. Atoms of one element are different from atoms of any other atom.
   5. Atoms of different elements can combine to form compounds.

   \[
   \begin{align*}
   \text{O}_2 + \text{C} & \rightarrow \text{CO}_2 \\
   \text{O} \quad \text{C} & \text{CO}_2
   \end{align*}
   \]

   Whole number ratios

2. Subatomic particles.

   A)

<table>
<thead>
<tr>
<th></th>
<th>Mass</th>
<th>charge</th>
<th>symbol</th>
<th>amu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrons</td>
<td>(9.107 \times 10^{-28} \text{g})</td>
<td>-1</td>
<td>e'</td>
<td>0</td>
</tr>
<tr>
<td>Proton</td>
<td>(1.672 \times 10^{-24} \text{g})</td>
<td>+1</td>
<td>p</td>
<td>1</td>
</tr>
<tr>
<td>Neutron</td>
<td>(1.672 \times 10^{-24} \text{g})</td>
<td>0</td>
<td>n</td>
<td>1</td>
</tr>
</tbody>
</table>

   1 amu = 1/12 the weight of one carbon-12 atom, 1 amu = 1 proton or 1 neutron
B) Nuclear atom (use overhead)

- **nucleus**
- **electron**
- **positive charge**
- **empty space**
- **pea 0.6 mile or 1 km**

**Things learned**

1. Small dense nucleus
2. Positive charge contained in nucleus
3. Nucleus surrounded by a large amount of empty space.
4. Outside of nucleus is thinly populated by electrons, in a neutral atom electrons = protons

**3. Isotopes**

- Number of protons = atomic number
- Mass number = protons + neutrons

**Ex. Look at carbon.**

- Atomic number = 6, contains 6 protons.
- Mass number = 12, 12 – 6, must contain 6 neutrons.

**Isotopes** – atoms of the same element that have different masses due to different number of neutrons.

**Ex.**

- Carbon 13 = mass number
  - How many neutrons? 13 – 6 = 7
Can write as carbon-13, or element-mass number

\[ ^{13}_{6} \text{C} \]

mass number

Atomic symbol

atomic number

Ex. How many neutrons in

\[ ^{14}_{7} \text{N} \quad ^{2}_{1} \text{H} \]

<table>
<thead>
<tr>
<th>Elemental symbol</th>
<th>Atomic number</th>
<th>Number of Protons</th>
<th>Number of neutrons</th>
<th>Mass Number</th>
<th>Name of isotope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium</td>
<td>Ba</td>
<td>56</td>
<td>56</td>
<td>82</td>
<td>138</td>
</tr>
</tbody>
</table>

Nuclear symbol

\[ ^{138}_{56} \text{Ba} \]

B) abundance of isotopes.

1 amu = 1 proton or 1 neutron

1 amu = \(1.66 \times 10^{-24}\) g

Look at periodic table they list atomic mass-

Atomic mass = average of all atoms of an element as they occur in naure.

For chlorine

<table>
<thead>
<tr>
<th>Atomic mass</th>
<th>abundance</th>
<th>Mass amu</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>75.53</td>
<td>34.96885</td>
</tr>
</tbody>
</table>
$$\text{abundance} \times \text{weight} + \text{abundance} \times \text{weight} = \text{atomic mass}$$

$$(0.7553)(34.96885) + (0.2447)(36.96590) = 35.453 \text{ amu}$$

$$26.41 + 9.046 = 35.456 \text{ amu}$$