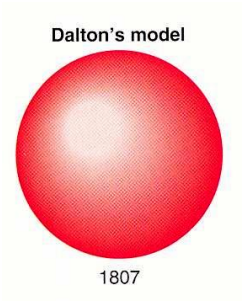
# EARLY CONCEPTS OF THE ATOM

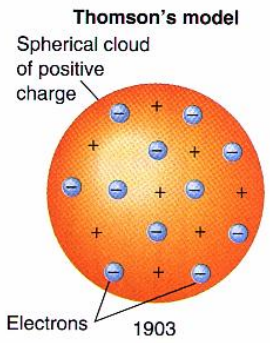
- The ***smallest*** particle of an ***element*** that still ***retains its properties*** is called an ***atom***.

- The Greek philosopher ***Democritus*** was the first person that theorized that matter was made of small, ***indivisible*** (Greek: ***atomos***) parts.




- The first model of the atom ("***soccer ball***") was introduced by ***John Dalton*** in early 1800. He thought of the atom as a featureless ***ball of uniform density***.

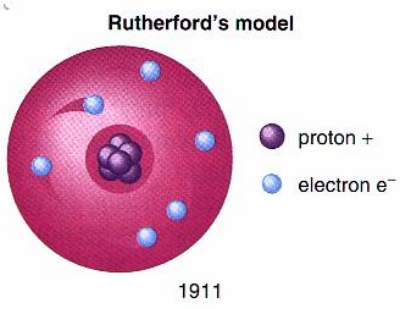
- This model is referred to as the "**soccer ball**" model.




- Dalton's model was refined by ***J.J. Thomson***, who discovered the ***electron*** and the ***charged nature of the atom***.

- Thomson's model is called "***plum pudding***" model.

- Thomson's model was further refined by ***Ernest Rutherford***, who discovered the ***atomic nucleus*** through his "gold foil experiment".

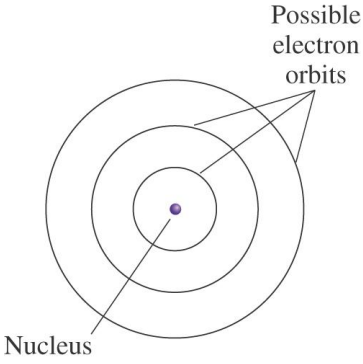



- This model is called the ***"nuclear"*** model.

- The nuclear model describes the atom as having a dense positively charged center (nucleus) surrounded by negatively charged particles (electrons).

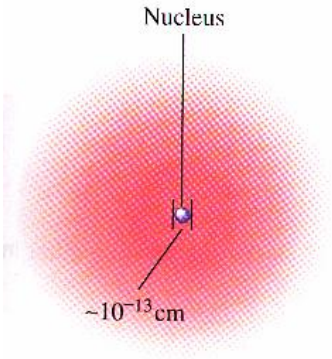
- Further refinement of the atomic model by ***Neils Bohr*** lead to the "***planetary***" model.

- This model describes the atom as a positively charged center (nucleus) surrounded by negatively charged particles (electrons).




- In this model the electrons occupy fixed energy levels called ***orbitals***.

# ATOMIC STRUCTURE



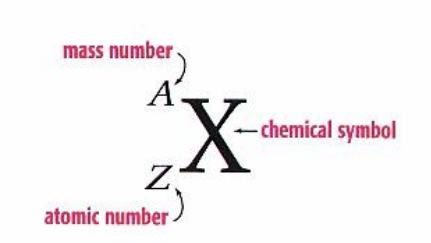

- The ***modern atom*** consists of a ***small positively charged nucleus***, surrounded by a cloud of ***negatively charged*** particles (***electrons***).
- The ***nucleus*** of an atom consists of positively charged ***protons***, and neutral particles called ***neutrons***.
- The modern atom consists of 3 subatomic particles:

| Particle | Charge | Relative Mass |
|---|---|---|
| Proton | +1 | ~1800 |
| Neutron | 0 | ~1800 |
| Electron | –1 | 1 |

- The number of ***protons*** in an atom determines its identity, and is called ***atomic number (Z)***.
- In a neutral atom, the number of ***protons (+)*** are ***equal*** to the number of ***electrons (–)***.
- Almost ***all the mass*** of the atom rests in the ***nucleus***. Therefore the ***number of protons and neutrons*** in an atom are called the ***mass number (A)***.

# ATOMIC STRUCTURE

- The general ***designation*** for an ***atom*** is shown below:




Number of protons ($p^+$)= Atomic no. (Z)
Number of electrons ($e^-$) = number of protons ($p^+$)
Number of neutrons ($n^0$) = A – Z

***Examples:***

1. Determine the number of protons, electrons and neutrons in a fluorine atom, $^{19}_{9}\mathrm{F}$.

   Number of protons =
   Number of electrons =
   Number of neutrons =

2. Argon (Ar) has 18 protons, 18 electrons and 22 neutrons. Write a formula designation for an argon atom.

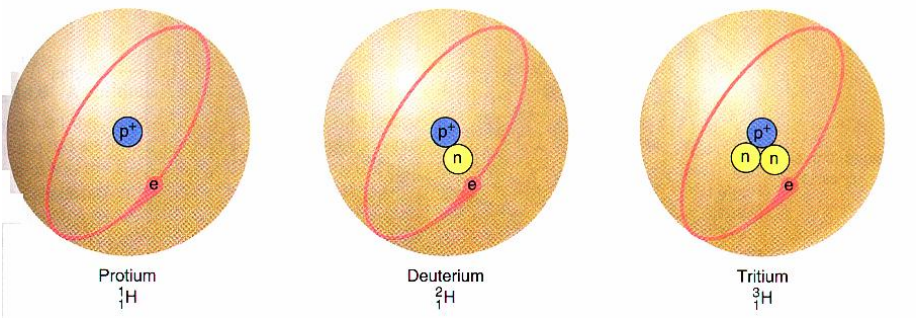
   Atomic number =
   Mass number = protons + neutrons =

$$^{??}_{??}\mathrm{Ar}$$

# ISOTOPES

- Atoms of the ***same element*** that possess a ***different number of neutrons*** are called ***isotopes***.

- ***Isotopes*** of an element have the ***same atomic number (Z)***, but a ***different mass number (A)***.




**The three isotopes of hydrogen**

- The **mass** of an atom is due to the **number of protons and neutrons** in its nucleus.

- The atomic mass of an element is determined to be the **weighted average** of the atomic **masses of its isotopes**.

- Therefore the atomic mass of an element is ***closer*** to the mass of the isotope with the ***most abundance***.

***Examples:***

1. Which pair of the following elements are isotopes?

$^{207}_{82}X$ $^{207}_{83}Y$ $^{209}_{84}Z$ $^{209}_{82}R$

2. Based on the information below, which is the most abundant isotope of boron (atomic mass = 10.8 u) ?

| Isotope | $^{10}B$ | $^{11}B$ |
|---|---|---|
| Mass (u) | 10.0 | 11.0 |