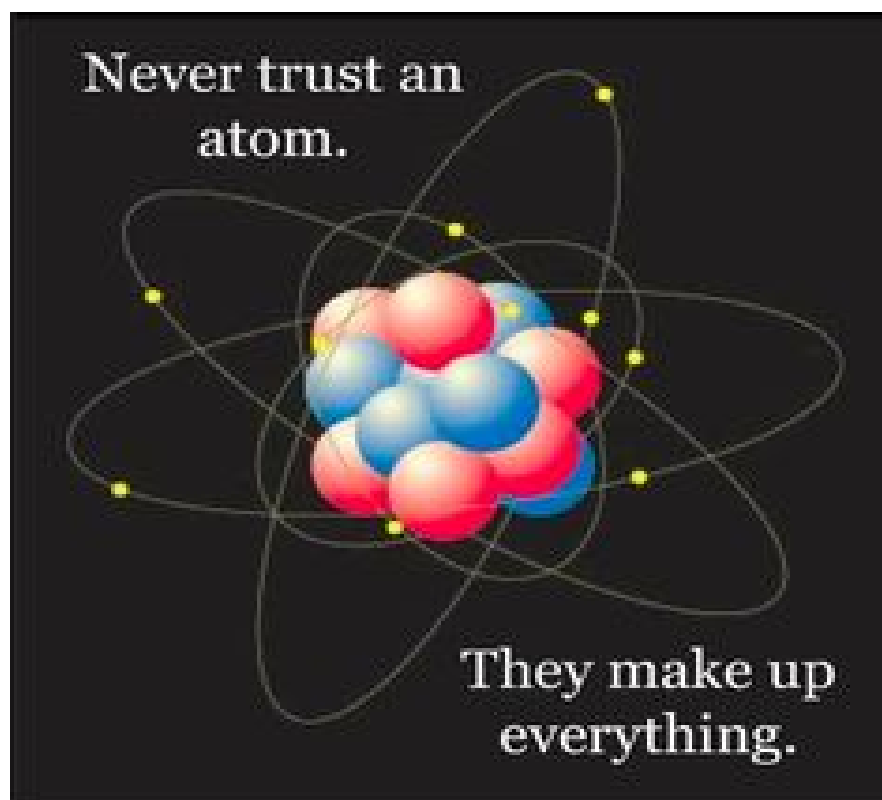


Atomic Model



It all started in Greece about 2500 years ago

- Democritus
- matter is discontinuous
- indivisible
- like grains of sand
- differences in arrangement account for all elements



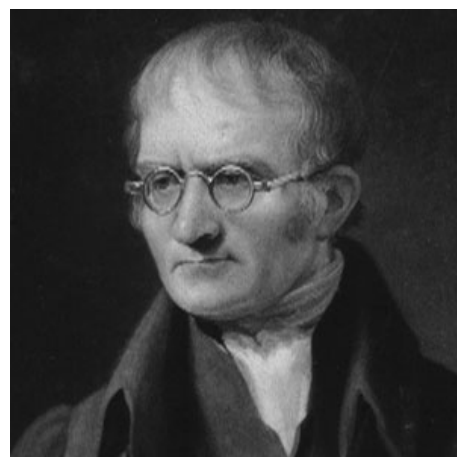
Along came Aristotle about 100 years later...

- matter is continuous
- made of earth, wind, water, fire
- a magic knife could cut it forever
- particles divisible



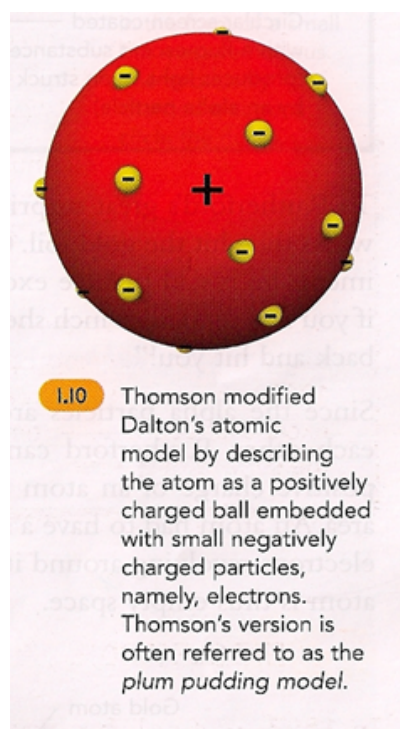
John Dalton - 1800's

- all matter made of atoms (indivisible)
- atoms of same element are identical
- atoms of different elements are different
- during chemical reactions atoms combine in definite proportions to form products

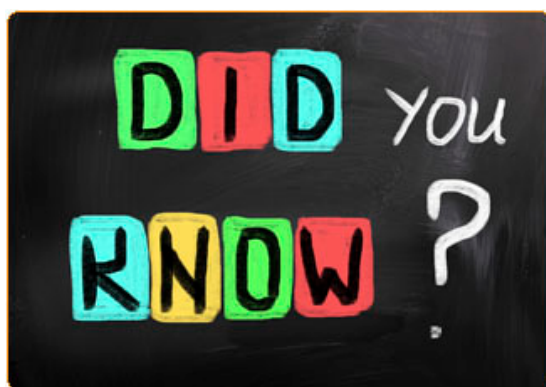


J.J. Thompson - 1906

- discovered the electron, a negative (-) particle that makes up part of the atom.
- They can detach themselves easily (static electricity)
- The atom is a positively (+) charged ball with electrons (-) imbedded
- Atoms are neutral $+$ = $-$
- Atoms are divisible



An **atom** is the smallest particle of matter. It cannot be divided chemically.



*A sheet of paper is a million atoms thick.

* The diameter of the period at the end of this sentence is the length of at least 50 trillion atoms all lined up in a row.

Protons: particle that makes up the atom, positively charge.

Electrons: particle that makes up the atom, negatively charged

Past Knowledge: An atom is generally in a neutral state. This means it has the same amount of protons (p^+) and electrons (e^- .)

of protons = # of electrons

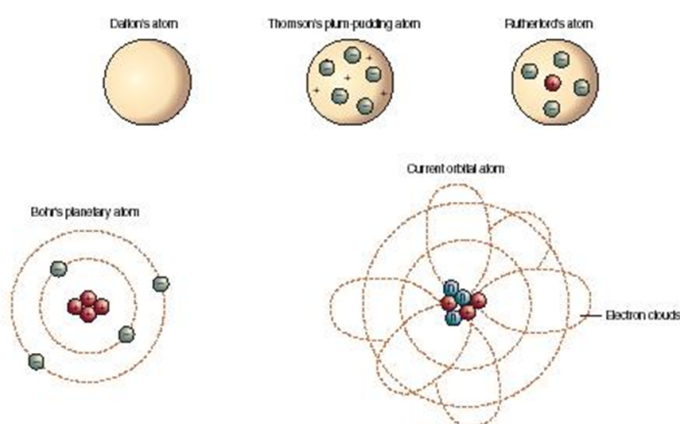
(atom = neutral charge)

Atomic Model is a model used to demonstrate what particles are in the atom.

Atoms are small and difficult to examine.
Many theories about atoms existed.

The Evolution of the Atomic Model

Textbook pages 6-15



Our Changing View of the Atom

"Atoms" are the building blocks of matter.



Early Greek Philosophers
400 B.C.

Negative electrons are embedded in a sea of positive charge.



J.J. Thomson
1898 - 1903

Positive charge is located within a central nucleus.



Ernest Rutherford
1911

Electrons are in circular orbits with quantized energy levels.



Neils Bohr
1913

Electrons occupy regions of space whose shape is described by complex mathematical equations.



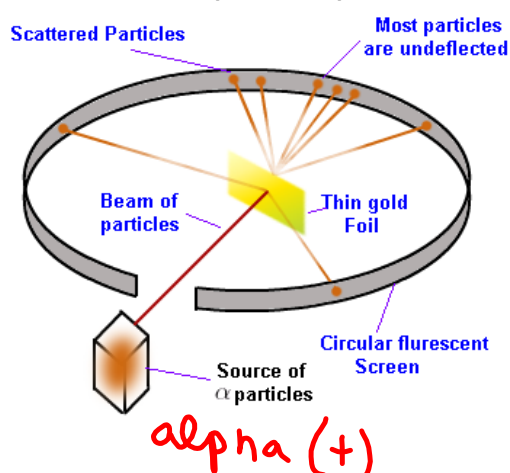
Quantum Mechanics
Modern Model

Rutherford and the Gold Foil Experiment

1911

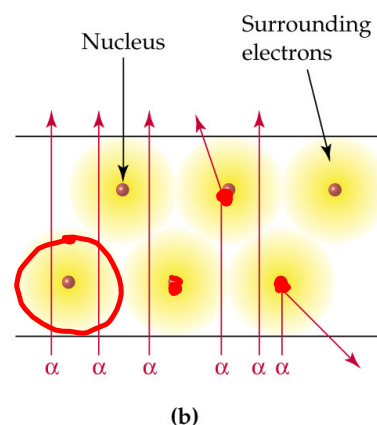
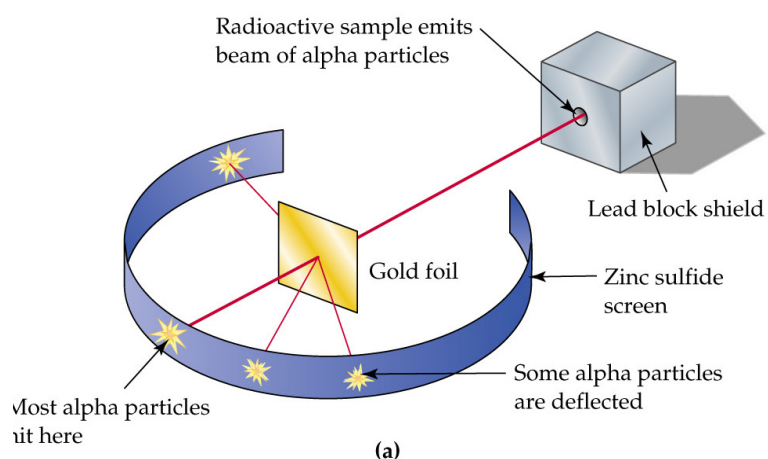
* Rutherford used a Gold foil experiment to come up with his theories.

*used radioactive substances and observed how positive (alpha) particles were dispersed.



-alpha particles (+ charge) were fired at a piece of gold foil

-Some went through, some bounce back, some get deflected



<https://www.youtube.com/watch?v=ecsgC1wSp5l>



https://www.youtube.com/watch?v=5pZj0u_XMbc



<https://www.youtube.com/watch?v=Q8RuO2ekNGw>



1. The atom is very small and almost empty. T or F

Why?

3. The nucleus is positively charged. T or F

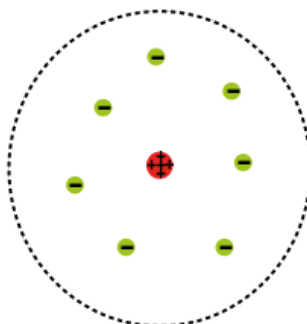
Why? True: the positive rays that hit the nucleus bounce back because like charges repel.

4. Electrons revolve around the nucleus and are freely moving. T or F

False: Why?

Same # of electrons and protons to make it neutral!

However, if like charges repel then opposites attract so the negatives charges of electrons would crash into nucleus.



Observations:

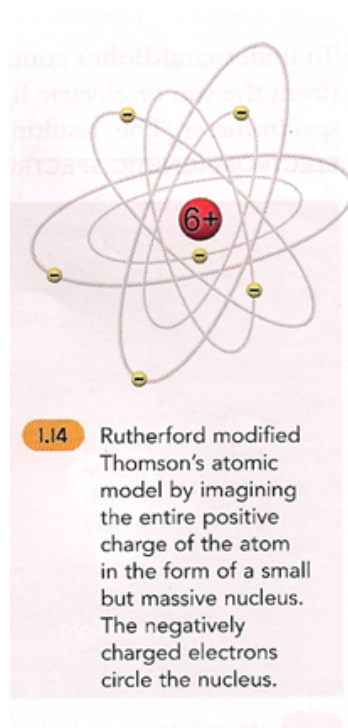
- Most alpha (+) particles passed straight through
- A few hit the gold foil and bounced back
- A few were redirected at an angle

Conclusions:

- The atom is mostly empty
- The (+) alpha particles must have collided with something since they bounced back
- That "something" was the nucleus, a positively charged core

Rutherford's Atomic Model

- The nucleus contains positively (+) charged particles called **Protons**
- An equal number of negatively (-) charged **Electrons** surround the nucleus in a cloud
- An atom is generally in a **neutral state**. This means it has the same amount of protons (+) and electrons (-).



The Problem with Rutherford's Model

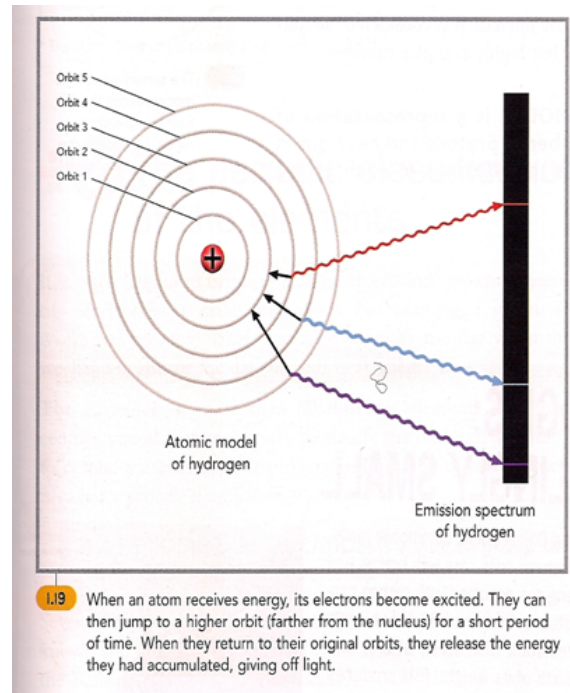
- We know that opposite charges attract. The **atom would collapse.** (the negatively charged electrons would crash into the nucleus, which is positively charged)
- Positive charges in the core should **push away from each other**

Bohr: 1913

Agrees with all of Rutherford's theories except the placement of the electrons.

- Bohr concluded electrons could occupy **specific orbits (energy levels, shells)**
- Electrons could move only when energy was applied (heat or electricity)
- How small is an atom?

<https://www.youtube.com/watch?v=yQP4UJhNn0I>

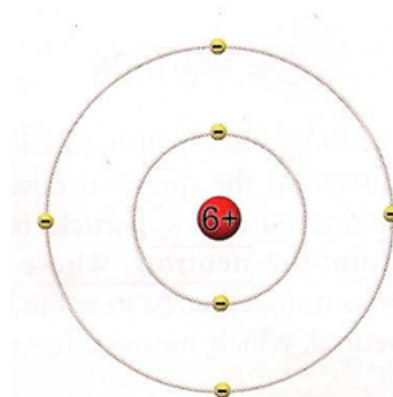


Rutherford-Bohr Model

Bohr.mp4



- Look at the atomic #
- Atomic # = the # of protons (in nucleus)
- # of protons = the # of electrons (in orbit)



1.18 Bohr modified Rutherford's atomic model by describing the orbits in which electrons move.

Electrons were found on orbits which were continually moving. This would keep them from attracting to the nucleus.

The orbits can hold a specific # of electrons:

- 1st shell: 2 e⁻
 - 2nd shell: 8 e⁻
 - 3rd shell: 8 e⁻
 - 4th shell: 2 e⁻
- **This only works for the first 20 elements...it gets complicated after this.

*** you must fill a shell before placing electrons on the next shell

Electrons stick to the orbits because of the speed the orbit is moving at.

Electrons can move from one orbit to another when stimulated by heat or electricity.

<https://www.youtube.com/watch?v=PLpZfJ4rGts>

Practice

Method 1:

- Model must contain the following info:
 - *nucleus
 - *protons
 - *orbits
 - *eletrons
- Draw a small nucleus in center
- Draw the # of protons
- Draw the orbits
- Draw the electrons (first in cardinal position, then pair up till the orbit is full)

He

Method 2:

- Model must contain the following info: (same)
 - *nucleus
 - *protons
 - *orbits
 - *eletrons
- Draw a small nucleus in center
- Write the # of protons
- Instead of drawing the full orbit just draw an arch to represent the orbit
- Write the # of electrons under each orbit arch

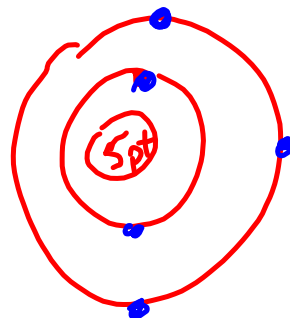
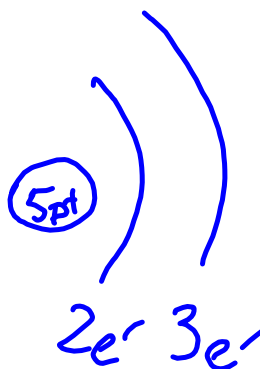
He

Practice:

He 2 protons
2 electrons



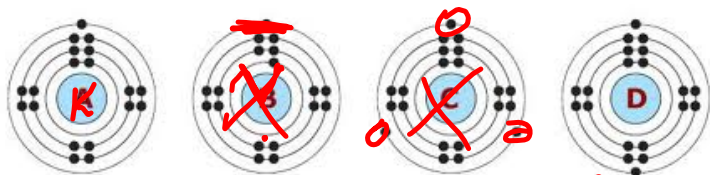
B 5⁺
5⁻



P

Ca

Which picture is incorrect? B and C



Potassium

Calcium

Name the elements of the correct pictures?

A is Potassium and D is Calcium

Past exam questions

1. Rutherford modified the atomic model after doing experiments where the alpha particles were dispersed by a sheet of gold foil. Considering the statements below, which statements are based on Rutherford's experiments only?

~~1-~~ The number of protons is equal to the number of electrons.

2- Protons are concentrated in a small positive space at the center of the atom.

3- Atoms consist of mostly empty space.

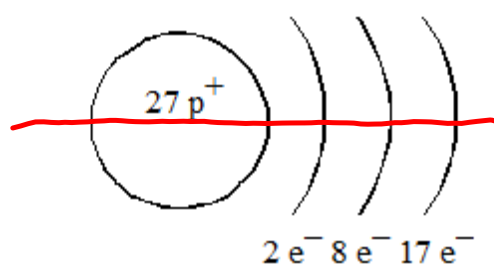
~~4-~~ Electrons are contained in a positive sphere made up of protons.

5- Electrons move about in specific energy levels. ^{Bohr}

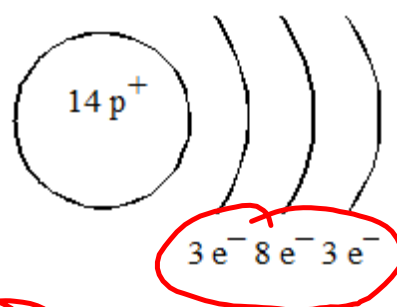
~~A) 1 and 2~~ ~~B) 1 and 4~~ C) 2 and 3 D) 2, 3 and 5

2. Which of the following best represents the aluminum (Al) atom according to the Rutherford-Bohr model?

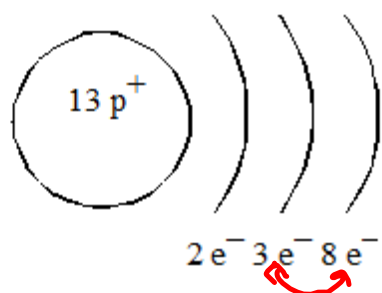
A)



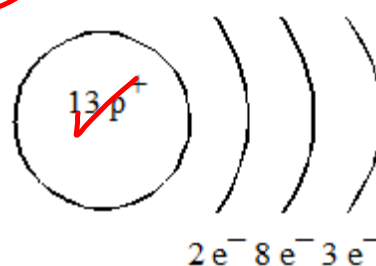
C)



B)



D)



The Simplified Model (Similar to Rutherford-Bohr except...)

- Chadwick discovered the Neutron
- It is in the nucleus
- It holds protons together
- It is neutral
- The number of Neutrons is determined by,
 $\text{Atomic Mass} - \text{Atomic \#} = \# \text{ neutrons}$
- The Atomic Mass can also be determined by
 $\# \text{ Protons} + \# \text{ neutrons} = \text{Atomic Mass}$

Ex:
Magnesium (Mg)

Ex:
Aluminum (Al)

Attachments

Bohr.mp4



Nucleus of an atom.mp4



Ernest Rutherford's Gold Foil Experiment Chemistry Visual.mp4



Human Bohr Model.mp4