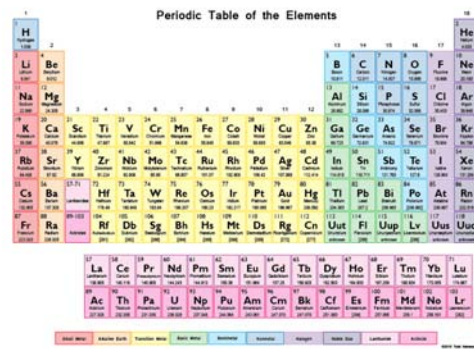


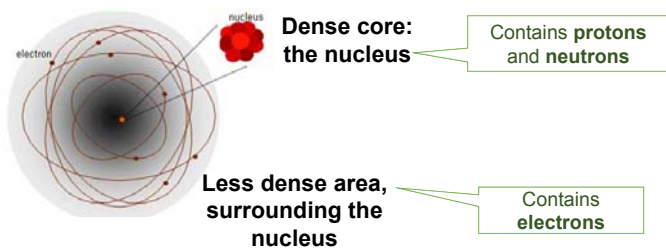
# Atomic Structure

Section 1.2

An **atom** is the smallest particle of an element that still has the property of that element.

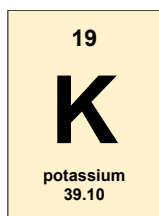


## Basic Atomic Structure



Expressed in atomic mass units (a.m.u)

Particle	Mass	Charge	Location in the atom
proton	1	1+	nucleus
neutron	1	0	nucleus
electron	~1/2000	1-	orbiting the nucleus, contained within energy "shells"



atomic number

atomic mass  
• round to mass number

**Isotopes** are atoms of the same element that have the same number of protons, but different number of neutrons.

How would isotopes compare...

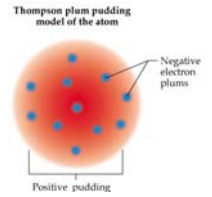
- physical properties?
- chemical properties?



Thomson's Observation	Inference
Particles emitted from the cathode are <b>attracted to positive charges</b>	The cathode ray particles must be <b>negatively-charged</b>
The cathode ray particles have a much <b>lower mass than hydrogen atoms</b>	Cathode particles are much <b>smaller than hydrogen atoms</b>
All metals that he tested emit <b>identical cathode rays</b>	All atoms contain the <b>same negatively-charged particles</b>
<b>Atoms</b> are electrically <b>neutral</b>	Atoms must therefore contain <b>positively-charged particles</b> to balance the negative ones

### Thomson's Model of the Atom

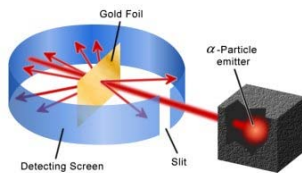
- "plum pudding"
- positively-charged mass, with negatively-charged particles embedded within



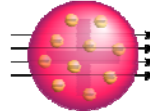
## Discovery of the Nucleus

Video: [Discovery of the nucleus](#)

- Ernest Rutherford, 1911
- Gold foil experiment
  - aimed positively-charged  $\alpha$  particles at thin gold sheets
  - observed the deflection of a small number of  $\alpha$  particles



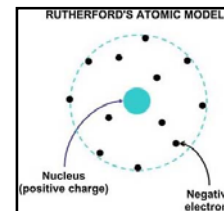
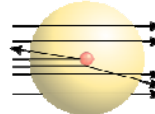
Expected outcome



Inferences:

- The alpha particles bounced backwards because they hit a region of **positive charge**.
- The majority of the atom's volume is empty space.

Observed outcome

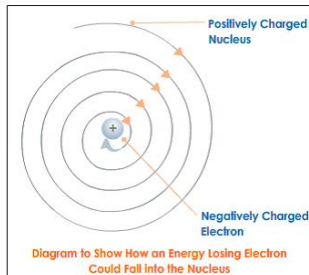


**Rutherford's Model:**

The Nuclear Atom

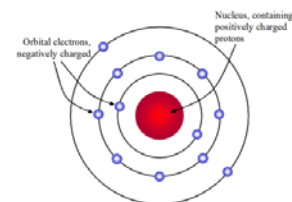
Opposition to Rutherford's model:

*Why don't the negative electrons fall into the positive nucleus?*



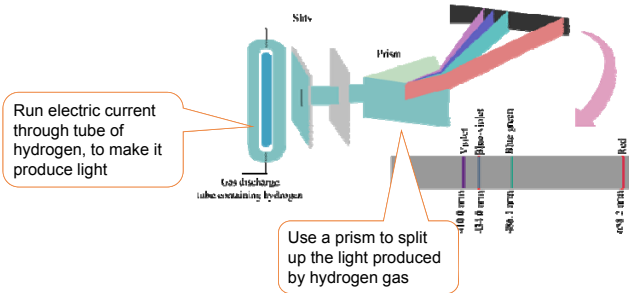
### The Bohr Model, 1922

- Neils Bohr proposed that electrons were restricted to **fixed orbits**.
- Each orbit represents an **energy level**, and has a different distance from the nucleus.

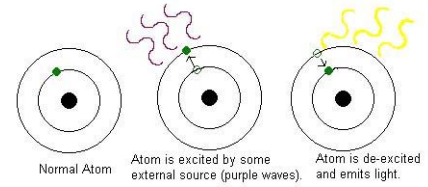


Each electron shell represents an energy level.

Bohr developed this model by observing the **emission spectrum** of hydrogen.



Light is emitted when an electron **absorbs energy** (is "**excited**"), and then **releases it** as it falls down to its original energy state.



### Continuous Spectrum



• If the electrons could absorb any quantity of energy, a continuous spectrum would be produced.

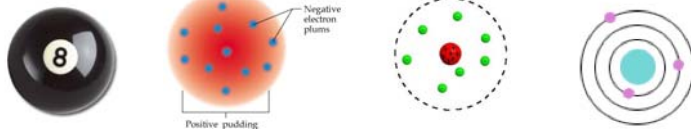
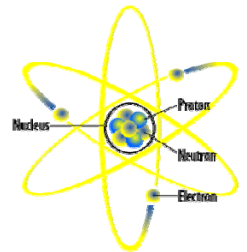
### Emission Lines



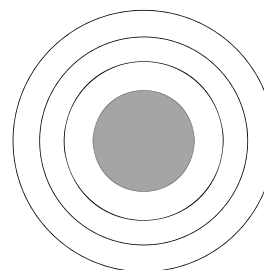
• Since a non-continuous line spectrum is observed, this means electrons can only absorb **fixed** packets of energy (**quanta**, *sing. quantum*).

## James Chadwick, 1932

- Showed experimentally that **neutral particles** exist in the nucleus, along with the protons.



## Bohr-Rutherford Diagrams



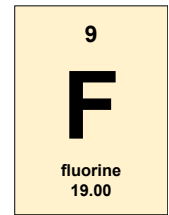
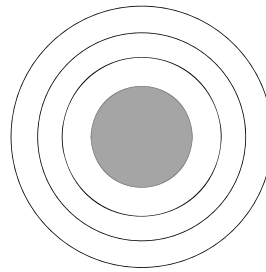
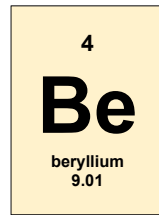
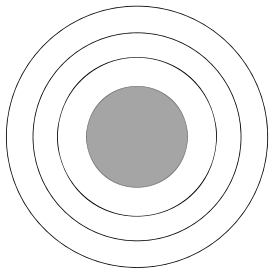
### In nucleus:

Number of protons  
Number of neutrons

### In orbits:

1<sup>st</sup> 2 electrons  
2<sup>nd</sup> & 3<sup>rd</sup> 8 electrons  
4<sup>th</sup> 18 electrons  
Beyond? *don't worry about it..*

In an orbit, place electrons singly before pairing



## Summary

- Atoms are made up of three particles: protons, electrons, and neutrons. Their composition can be deduced using Atomic Number and Atomic Mass.
- Our understanding of the nature of matter, and of atomic structure, have evolved due to the combined work of many philosophers and scientists.

## Homework

- p. 16 #1,2,4,5,9-11
- Bohr-Rutherford & Lewis diagrams for first 20 elements