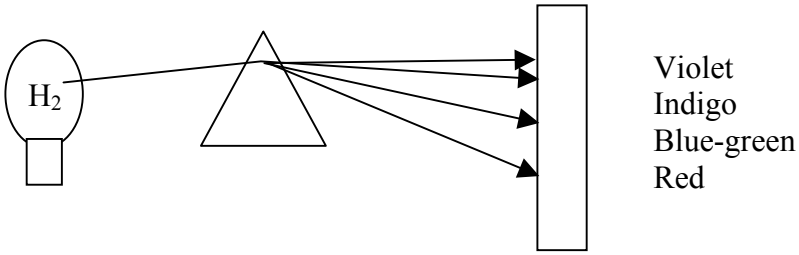
Toward a Modern Atomic Theory

- Definitions
  - Energy level
  - Orbit
  - Transition
  - Ground state
  - Line spectrum
  - Continuous spectrum
  - Flame test
  - Quantum mechanics
  - Principle quantum number (n)
  - Electron cloud
  - Valence electrons

Line Spectra

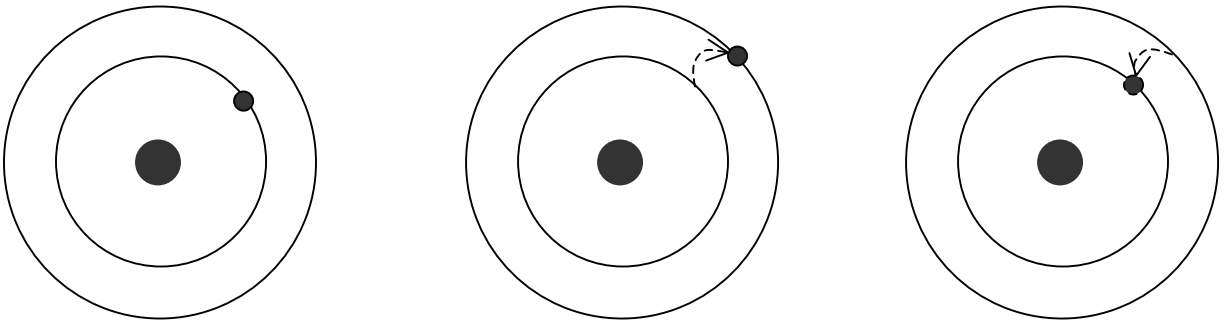
- Ancient alchemist used a flame test to determine the presence of an element. E.g. Sodium always burns bright yellow.



- All gases produce line spectra when heated (energized).
- White light give a continuous spectrum (roygbiv)
- Bohr explained these line spectra using his theory of energy levels.

Bohr Model

- Rutherford's model of the atom good but it raised some very important questions.
  - How did the nucleus stay together?
  - Why didn't the electrons crash into the nucleus?
- To explain what was going on in the nucleus a new force was introduced – the strong nuclear force – an attractive force within the nucleus.
- To explain the motion of elections, Rutherford did not have an answer but Niels Bohr did – Bohr used energy levels to explain the motion of electrons.
- Bohr's theory was the foundation of the Quantum Model of the atom. He said that electrons have specific amount of energy that keeps them a specific distance from the nucleus if you add energy the electron will absorb it and move to a higher energy level, it will eventually lose it and drop back down.



- Bohr's Theory depends on the following assumptions:
  - An electron can travel forever within an energy level without losing energy.
  - The greater the distance from the nucleus, the greater the energy of the electrons in that energy level.
  - An electron cannot exist between orbits.

- For an electron to jump (transition) from one orbit to another a quantum (a specific unit of energy) must be absorbed. When it drops down it releases that same quantum.
- See figures 2 and 3 on page 38 and figure 5 on page 39.

The Quantum Mechanical Theory

- Bohr's theory was only good for hydrogen. Therefore a better theory was needed to describe an atom.
- The primary difference between Bohr and Quantum Theory is that Quantum Theory uses orbitals (electron clouds) instead of orbits.
- An orbital is a region of space where the probability of finding an electron is high. We will never know the exact location but we will know generally where it is. Heisenberg's Uncertainty Principle says we can know either position or motion but never both.
- The principle quantum number (n) is the same as Bohr's energy levels.
- Each energy level has multiple levels.

The maximum number of electrons in a given energy level is $2n^2$.

Principle energy level (Principle Quantum Number = *n*)	Maximum number of electrons for the energy level ($2n^2$)	Number of energy sublevels	Number of electrons per sublevel
1	2	1	2
2	8	2	2+6
3	18	3	2+6+10
4	32	4	2+6+10+14

- This gives us our understanding of valence electrons.
- The periodic table give us clues to the information we need to determine the number of electrons for each principle quantum number. (n=1, H and He, $2n^2=2$) (we can also look at the group numbers)

Homework

- Metals in flame demo
- Practice questions: 1,2,3,4,5,6,7,8,10,11,12
- Section 1.4 Questions: 2