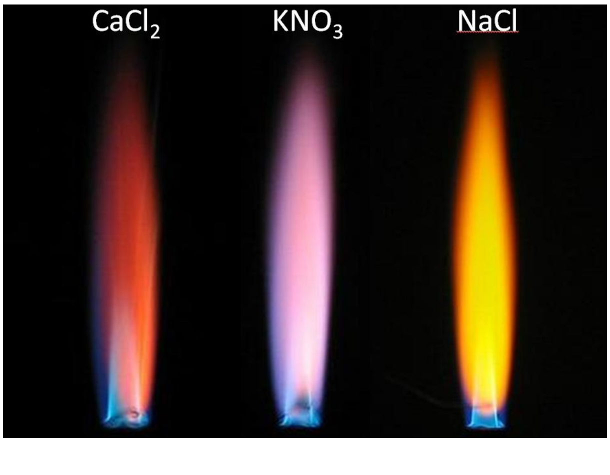
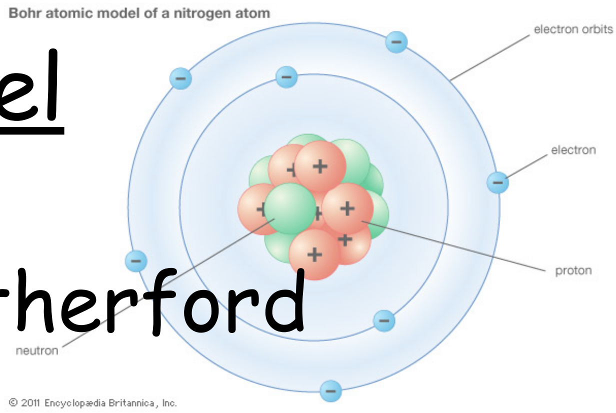
Models of the Atom

Rutherford - After discovering the nucleus, he proposed a model that had electrons moving around the nucleus.

His model, however, could not explain the chemical properties of elements. (like how colors are given off when elements are heated)



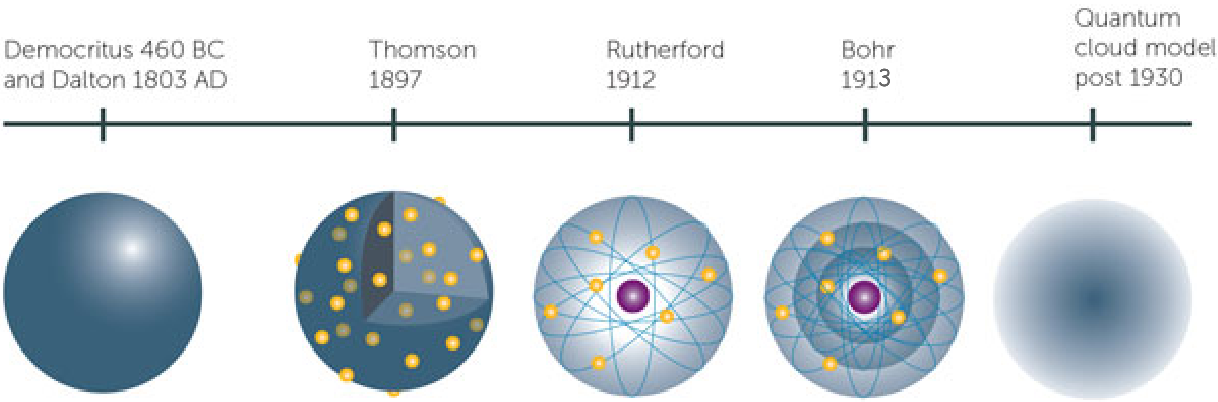
The Bohr Model



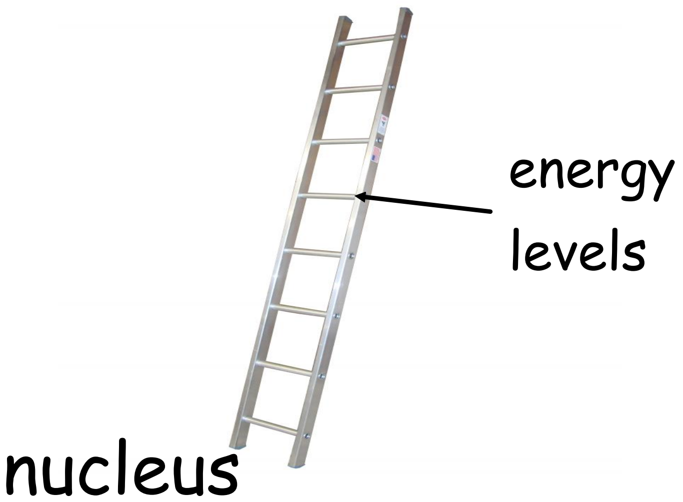
- Student of Rutherford

- Bohr proposed that an electron is found only in specific circular paths, or orbits, around the nucleus.

Electrons in Atoms

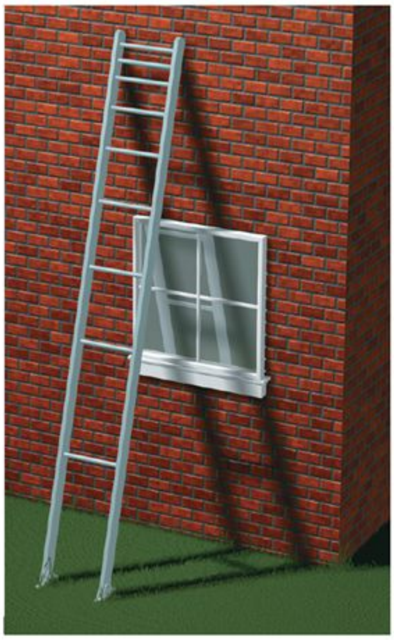


Each possible orbit in Bohr's model has a fixed energy. The fixed energies an electron can have are called ***energy levels***.



A **quantum** of energy is the amount of energy required to move an electron from one energy level to another energy level.

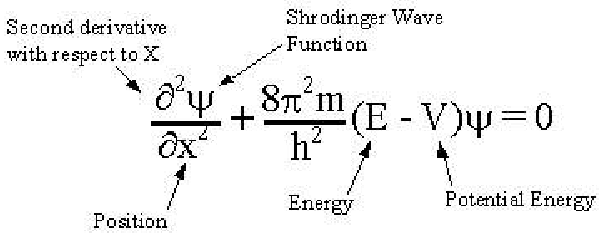
- Like the rungs of the strange ladder, the energy levels in an atom are not equally spaced.
- The higher the energy level occupied by an electron, the less energy it takes to move from that energy level to the next higher energy level.



The Quantum Mechanical Model

The Rutherford and Bohr models were inconsistent with describing electron motion.

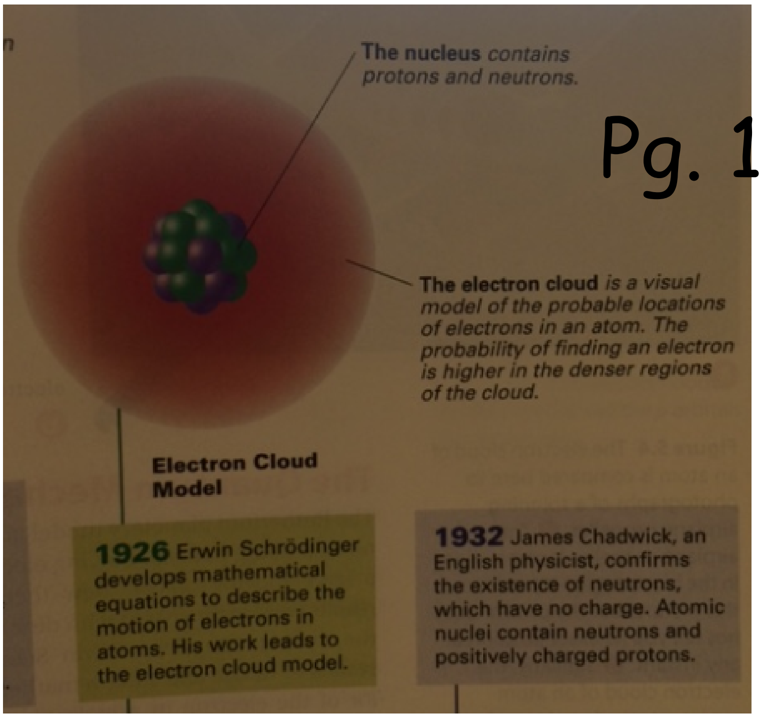
A physicist, Edwin Schrodinger, devised an equation to describe the electrons in atoms.



$$\frac{\partial^2 \psi}{\partial x^2} + \frac{8\pi^2 m}{h^2}(E - V)\psi = 0$$

The quantum mechanical model comes from the solution to the Schrodinger equation.

The quantum mechanical model determines the allowed energies an electron can have and how likely it is to find the electron in various locations around the nucleus.



Pg. 129

Atomic Orbitals

Solving the Schrodinger equation gives the energies an electron can have. These are its energy levels.

Atomic orbitals are a region in space where there is a high probability of finding an electron.

The energy levels of electrons are then labeled by principal quantum numbers (n) where

$$n = 1, 2, 3, 4, ...$$

For each principal energy level, there may be several orbitals with different shapes and at different energy levels.

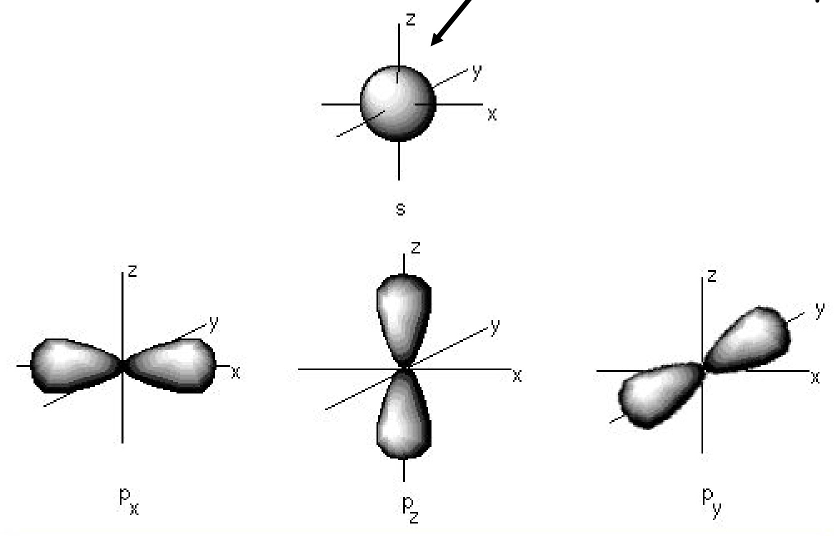
These are called sublevels

Each energy sublevel corresponds to an orbital of a different shape, which describes where the electron is likely to be found.

Different atomic orbitals are given different letters.

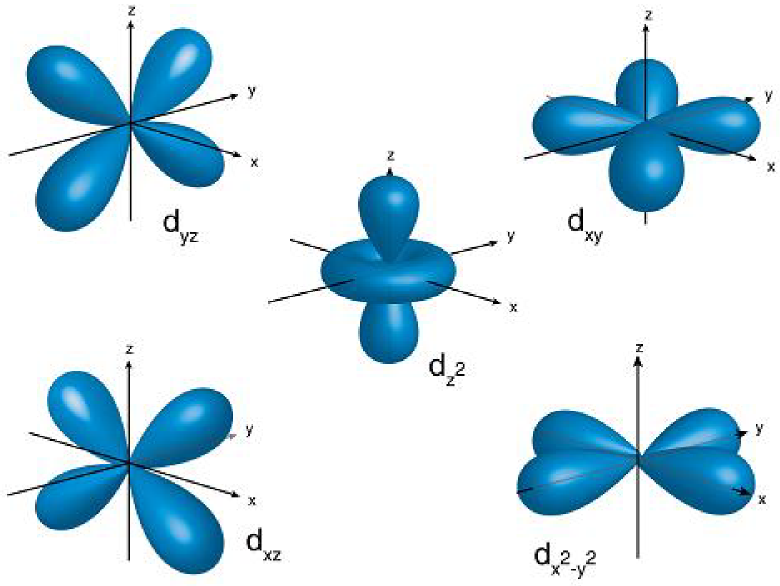
Table 5.1, page 131

probability of finding an electron in s does not depend on direction



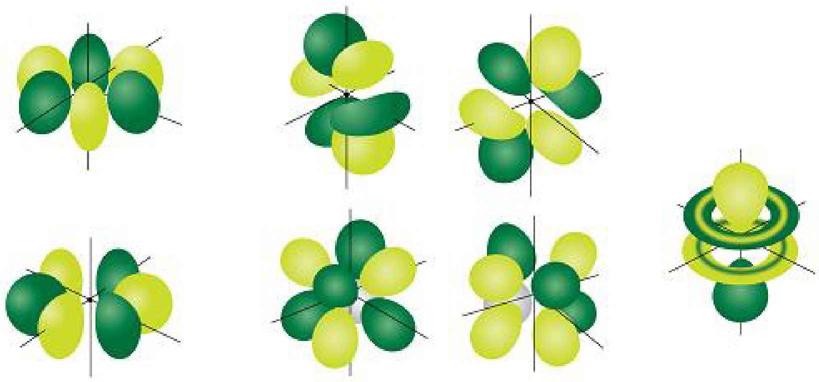
s orbitals are spherical while p orbitals are dumbbell-shaped.

There is one type of s orbital and 3 types of p orbitals.



There are 5 types of d orbitals that take on a clover leaf shape.

There are 7 different f orbitals that grow in complexity.



As the energy level increases, there is an increase in the number of orbitals

The number of orbitals follows the formula n^2 where n is the energy level.

Each orbital can fit
two electrons, so $2n^2$ will give the maximum number of electrons

So, in summary we have

Principal Energy Level	Number of Sublevels	Type of sublevel	Maximum number of electrons
n = 1	1	1s (1 orbital)	2
n = 2	2	2s (1 orbital), 2p (3 orbitals)	8
n = 3	3	3s (1 orbital), 3p (3 orbitals), 3d (5 orbitals)	18
n = 4	4	4s (1 orbital), 4p (3 orbitals), 4d (5 orbitals), 4f (7 orbitals)	32

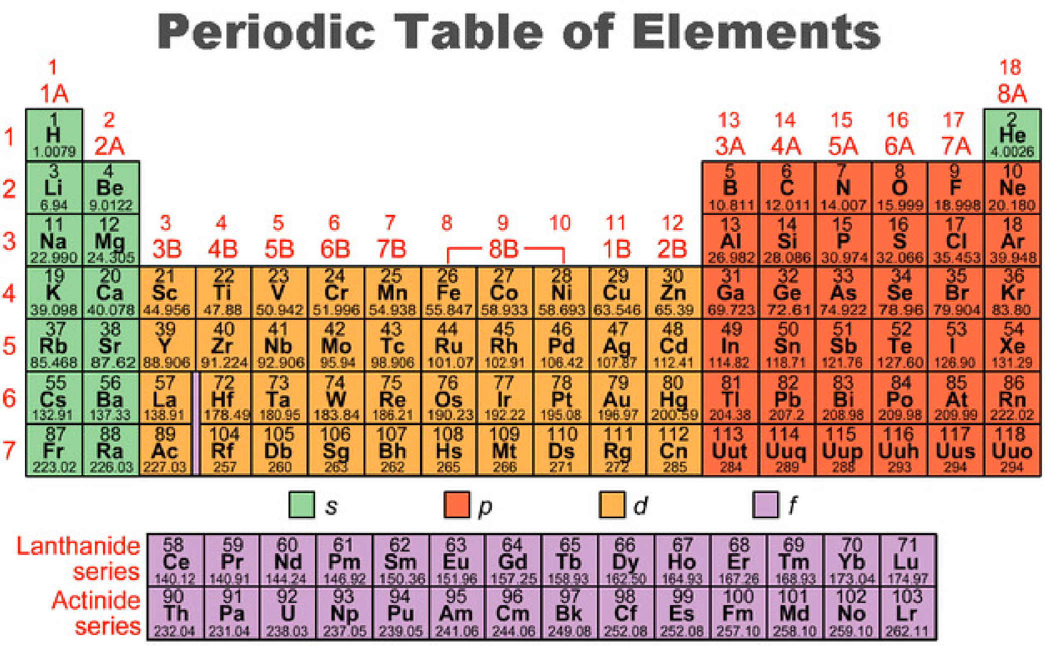
Writing orbitals

4p

energy level → 4

type of sublevel → p

Colour in Periodic Table



Try questions 1-7 on page 132