

Periodicity

The birth of Quantum Mechanics

Lewis de Broglie – 1924

- French
- Combined the equations of Einstein and Planck to suggest that electrons have a **wave nature**

Wolfgang Pauli

Wolfgang Pauli -- 1925

- German
- Determined that no two electrons in the same atom can have exactly the same energy (same set of quantum numbers)
- Pauli Exclusion Principle

Erwin Schrodinger

Erwin Schrodinger -- 1926

- Austrian
- Developed a mathematical expression called a wave function (Ψ)
- Developed the concept of an orbital
- Evaluations of Ψ have led to specifics such as:
 - distance from the nucleus
 - orbital shape
 - energy of an electron within a given orbital
 - probability of finding an electron within some region of an orbital

Werner Heisenberg

Werner Heisenberg -- 1927

- German
- Determined that the exact position and momentum of an electron cannot be determined simultaneously
- Heisenberg Uncertainty Principle

Quantum Mechanics Conclusions

The exact location of an electron cannot be determined.

The energy of an electron is limited to discrete values.

Orbitals are characterized by the principal quantum number (n).

Orbital shapes are distinguished by a second quantum number, the azimuthal (angular-momentum) quantum number (l).

Orbitals having the same azimuthal quantum number differ in their orientation about the nucleus. This orientation is characterized by the magnetic quantum number (m).

Electrons within an orbital can rotate clockwise or counterclockwise. The direction of spin is specified by the spin quantum number (s).

The maximum number of electrons that may be found in a shell of principal quantum number n is $2n^2$.

The “s” Orbital

The “p” Orbital

The “d” Orbital

The “f” Orbital

Frederick Hund -- 1927

- German
- Determined that subshells will first fill singly with parallel spins
- Once half filled, subshells will then doubly fill
- Hund’s Rule

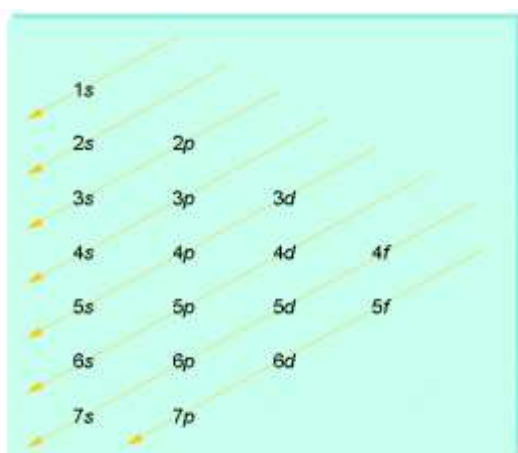
James Chadwick -- 1932

- British
- Identified the neutron
- Particles have no charge
- Mass of 1.0087 amu or $1.675 \times 10^{-27} \text{Kg}$
- Unstable outside of the nucleus (Disintegrates into a proton and an electron)

Nucleons: The total of all nuclear particles. Includes both protons & neutrons.

The Aufbau Process: Arrangement of Electrons

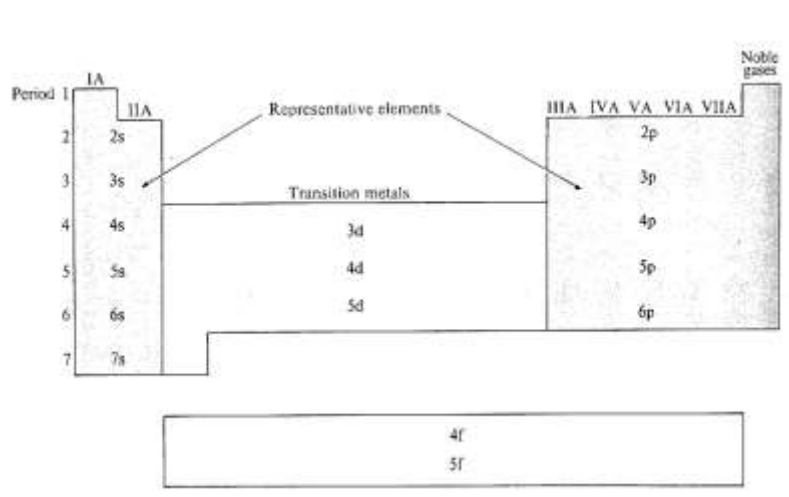
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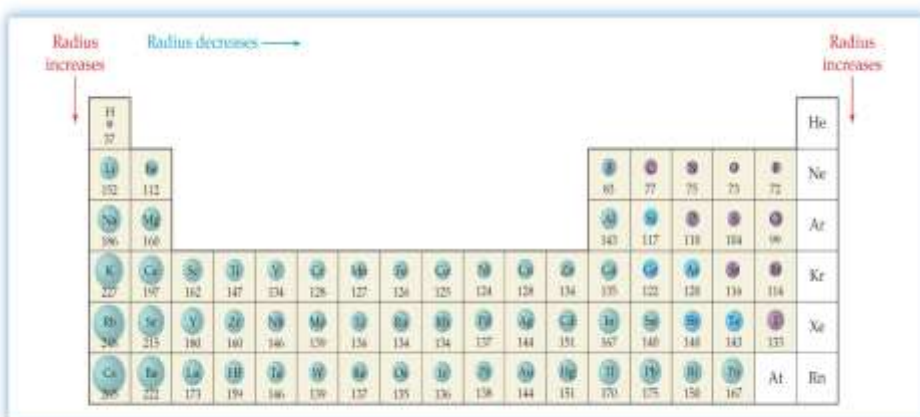
Orbital Notation

Electron Configuration

Electron Dot Notation



Atomic Radius



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