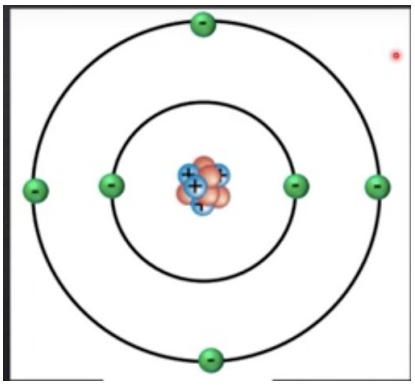
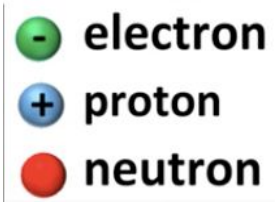
Group 5

Video title: Subatomic Particles and Structure of an atom



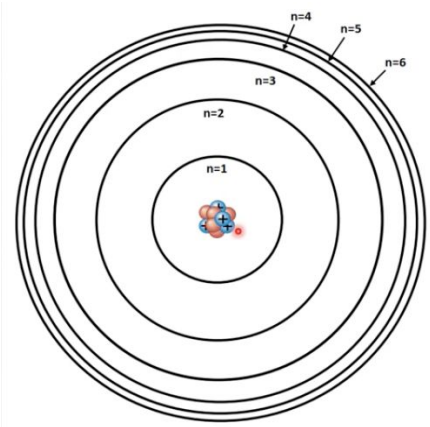
Objectives:

- Atoms contain a positively charged dense nucleus composed of protons and neutrons (nucleons).
- Negatively charged electrons occupy the space outside the nucleus.
- The main energy level or shell is given an integer number, *n*, and can hold a maximum number of electrons, 2*n*2.
- A more detailed model of the atom describes the division of the main energy level into s, p, d and f sub-levels of successively higher energies.



Summary:

Atoms are made up of very small subunits, these are called protons, neutrons, and electrons. These subunits hold charges that affect the overall charge of an atom. Of theses subunits only neutrons and protons have mass large enough to be relevant. Electrons hold a negative charge and circle the nucleus. The order of electrons in the orbitals fall into levels and sublevels. See table below.



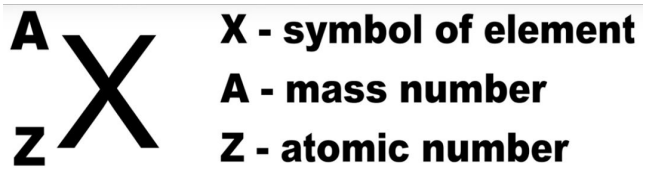
sub-atomic particle	relative charge	relative mass
proton	+1	1
neutron	no charge	1
electron	-1	1/2000

main energy level (n)	sub-level	number of electrons in sub-level	number of electrons in main energy level
1	1s	2	2
2	2s 2p	2 6	8
3	3s 3p 3d	2 6 10	18
4	4s 4p 4d 4f	2 6 10 14	32

Video title: Atomic Number and Mass Number

Objectives:

- Use of the nuclear symbol notation to deduce the number of protons, neutrons and electrons in atoms and ions.

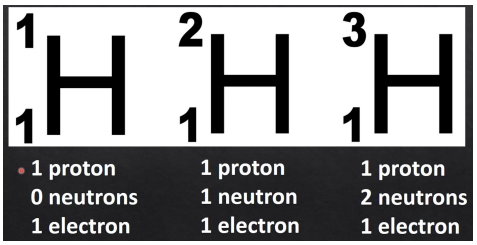


Summary: Atomic number is the number of protons in the atom and mass number is the number of protons plus the number of neutrons in an atom. Mass number minus the atomic number is how many neutrons in the atom. The number of electrons is equal to the number of protons if no charge is present. With a positive charge, subtract the charge from the number of electrons. If the charge is negative, add the charge to the number of electrons.

Video title: Isotopes

Objectives:

- Definition and properties of isotopes



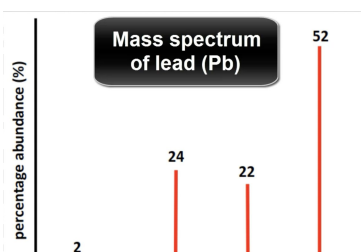
Summary: Isotopes are atoms of the same element that have the same number of protons, but a different number of neutrons. Resulting in a different mass number. To find the number of neutrons, subtract the atomic number from the mass number.

Video title: Calculating Relative Atomic Mass

Objectives:

- The mass spectrometer is used to determine the relative atomic mass of an element from its isotopic composition.
- Calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra.

Summary: Relative Atomic Mass is calculated by multiplying the mass to charge ratio by the percentage abundance, add them together and divide by 100. The relative atomic mass of the element should be similar to those on the periodic table.



Isotope	^{54}Fe	^{56}Fe	^{57}Fe
Relative abundance / %	5.95	91.88	2.17

$$A_r = \frac{(54 \times 5.95) + (56 \times 91.88) + (57 \times 2.17)}{100}$$

$$A_r = 55.90$$

Europium (A_r = 151.96) has two naturally isotopes, ^{151}Eu and ^{153}Eu. Calculate the percentage abundance of each isotope.

$$151.96 = \frac{153(x) + 151(100 - x)}{100}$$

The 153 and 151 are the mass numbers of the isotopes.

$$151.96 = \frac{153x + 15100 - 151x}{100}$$

$$100 \times 151.96 = \frac{153x + 15100 - 151x}{100} \times 100$$

$$15196 = 153x + 15100 - 151x$$

$$15196 - 15100 = 153x - 151x$$

$$96 = 2x$$

$$x = 48$$

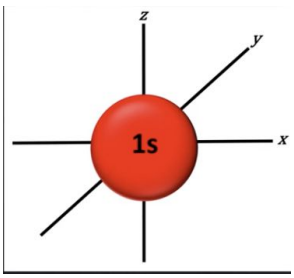
$^{153}Eu = 48\%$

$^{151}Eu = (100 - 48) = 52\%$

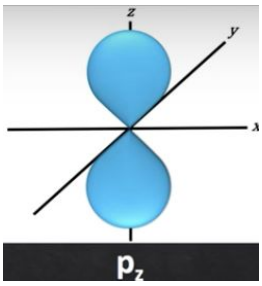
Video title: Atomic Orbitals

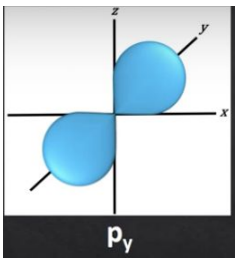
Objectives:

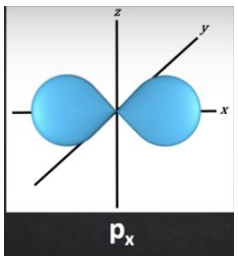
- Sub-levels contain a fixed number of orbitals, regions of space where there is a high probability of finding an electron.
- Recognition of the shape of an s atomic orbital and the px, py and pz atomic orbitals.



Summary: Atomic orbitals represent a region of space where there is a high probability of finding an electron. Because we cannot know the exact location of an electron in an atom, the orbitals help give us an idea. There are two types of orbitals; s orbitals and p orbitals. S orbitals are spherical and can hold a maximum of 2 electrons with opposite spins. P orbitals are dumbbell shaped. There are three p orbitals in the p sublevel. Each orbital can hold 2 electrons with opposite spins, meaning the p orbital can hold 6 electrons.







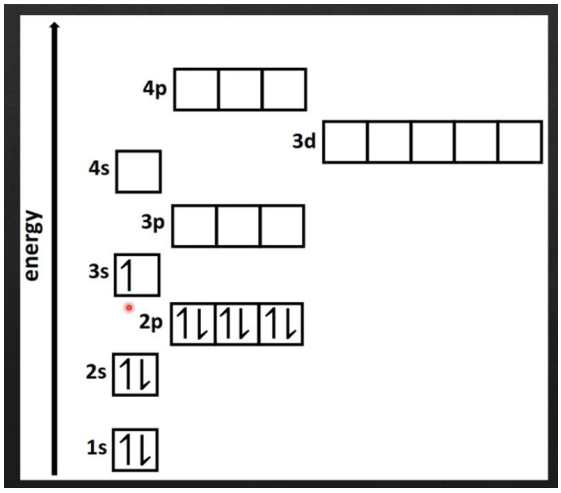
Video title: The Aufbau Principle

Objectives:

- Each orbital has a defined energy state for a given electronic configuration and chemical environment and can hold two electrons of opposite spin.
- Application of the Aufbau principle, Hund's rule and the Pauli exclusion principle to write electron configurations for atoms and ions up to Z = 36.
- Orbital diagrams should be used to represent the character and relative energy of orbitals.

Summary:

- The Aufbau Principle states that electrons will fill lower energy levels before higher energy levels, allowing configurations to be predicted according to the energy level of the orbital.
- The Pauli Exclusion Principle states that 2 electrons may occupy the same orbital, so long as they have opposite spins.
- Hund's rule states that electrons will fill unoccupied orbitals before occupied ones.



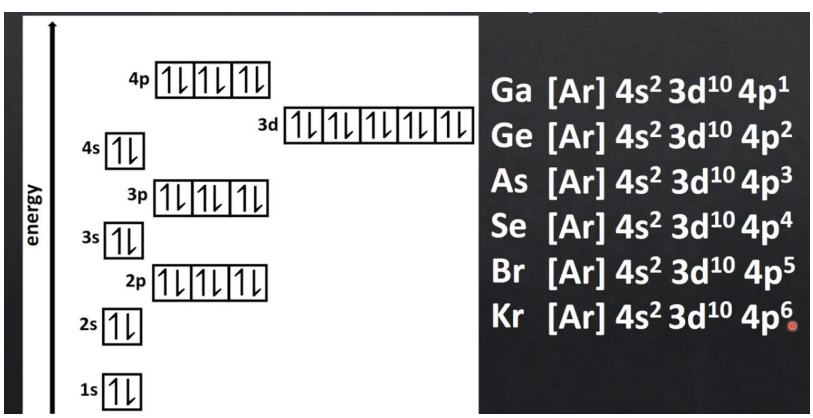
Video title: Electron Configurations

Objectives:

- Application of the Aufbau principle, Hund's rule and the Pauli exclusion principle to write electron configurations for atoms and ions up to Z = 36.
- Orbital diagrams should be used to represent the character and relative energy of orbitals.
- The electron configurations of Cr and Cu as exceptions should be covered

Summary:

- The electron configurations of the first 36 elements follow the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule, with the exception of Cr and Cu, which have abnormal electron configurations.



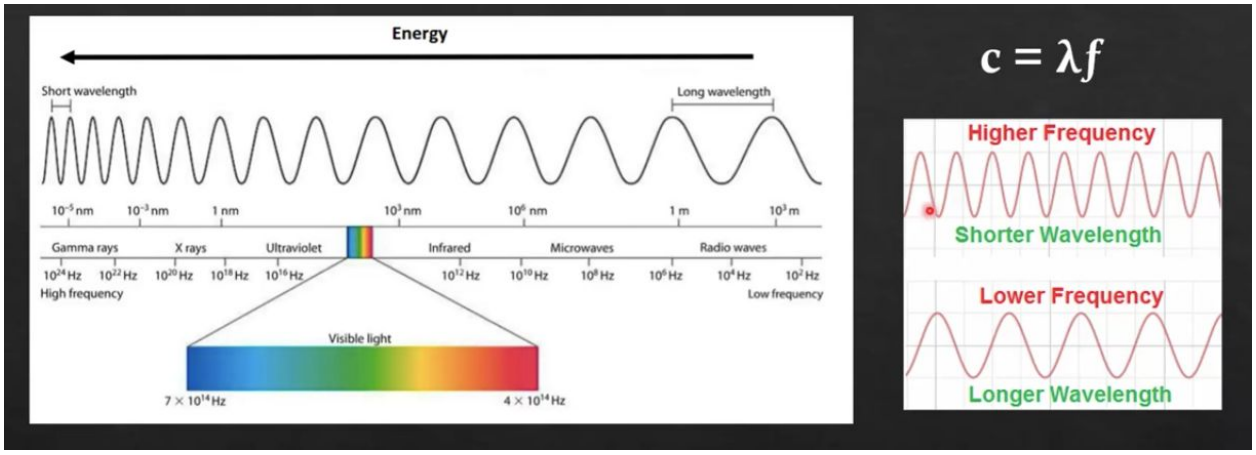
Video title: Electromagnetic Spectrum

Objectives:

- Description of the relationship between colour, wavelength, frequency and energy across the electromagnetic spectrum.

Summary:

- Frequency and wavelength are inversely proportional, as they multiply together to equal the constant speed of light
- The higher a frequency of a wave, the higher its energy
- Within the wavelengths of visible light, violet light has the highest energy, and red light has the lowest energy.



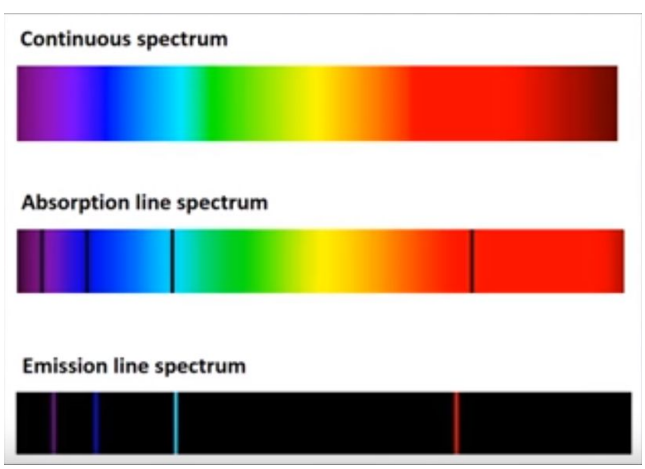
Video title: Line Spectra

Objectives:

- Distinction between a continuous spectrum and a line spectrum.

Summary:

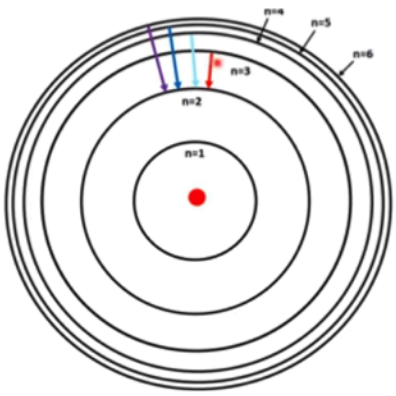
- Continuous line spectrum shows all visible wavelengths of light
- Absorption line spectrum is black lines on a continuous spectrum to show which wavelengths are missing
- Emission spectrum is colored lines on a black background to show wavelengths that are visible



Video title: Hydrogen Emission Spectrum

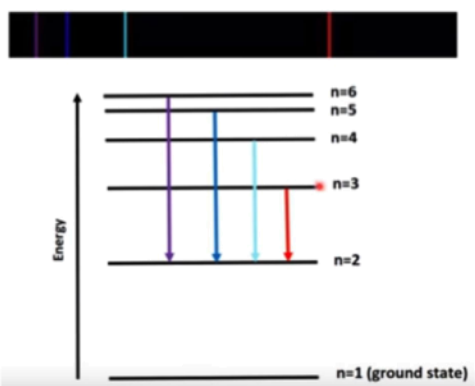
Objectives:

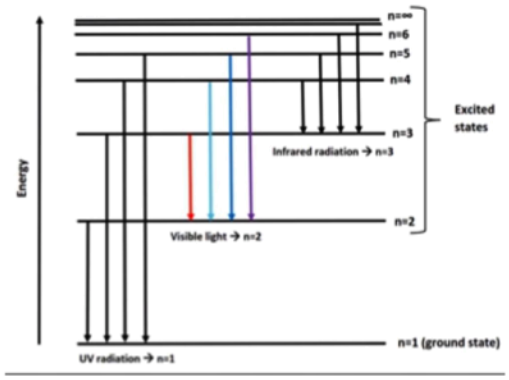
- Emission spectra are produced when photons are emitted from atoms as excited electrons return to a lower energy level.
- The line emission spectrum of hydrogen provides evidence for the existence of electrons in discrete energy levels, which converge at higher energies.
- Description of the emission spectrum of the hydrogen atom, including the relationships between the lines and energy transitions to the first, second and third energy levels.



Summary:

- Electrons exist at discrete energy levels and can absorb certain amounts of energy to move between the levels.
- The energy absorbed by the electron corresponds to the black line on the absorption spectrum of light.
- Electrons can also emit light and the colored line on the emissions spectrum represents the jump in energy level.<-hydrogen



- 

Video title: Exceptions to the Aufbau Principle

Objectives: This video covers exceptions to the Aufbau principle (Cu and Cr) as well as writing abbreviated electron configurations.

Summary: Chromium (Cr) and Copper (Cu) are both exceptions to the Aufbau principle.

- Chromium's Electron configuration:

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$$

- Copper:

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$$

Electron configurations can be abbreviated by using the previous noble gas to represent the electron configuration to that point. [noble gas] continued configuration.

Block d elements lose 4s orbitals.

Video title: Orbital Diagrams

Objectives: Each orbital has a defined energy state for a given electronic configuration and chemical environment and can hold two electrons of opposite spin.

Summary:

Each box represents an orbital. Electron configurations (electrons in the boxes) are written with the following rules & principles:

- Electrons are represented by arrows (up or down) that represent spin
- Each number represents an energy level
- Each letter is an orbital
- Aufbau principle- Electrons fill the lowest orbitals first
- Pauli Exclusion Principle- Orbital holds two electrons with opposite spins
- Hund's Rule- Each energy sub-level needs to be filled with an electron with the same spin before being filled with two