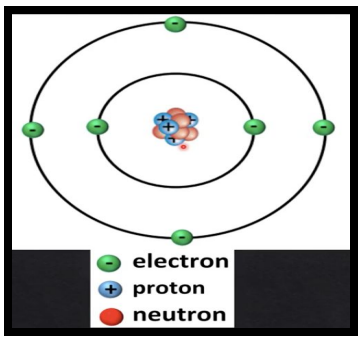
2.1/2.2 Sub-atomic particles and structure of an atom

Understandings: 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 A more detailed model of the atom describes the division of the main energy level into s, p, d and f sublevels of successively higher energies.

Summary: Protons and neutrons are located in the nucleus of the atom with energy levels surrounding them. Protons are positively charged, neutrons have no charge, and electrons have only a negative charge. The mass of an atom is concentrated in a positively charged nucleus. There are up to 4 main energy levels surrounding the nucleus that as well have sublevels that range from 1s - 4f



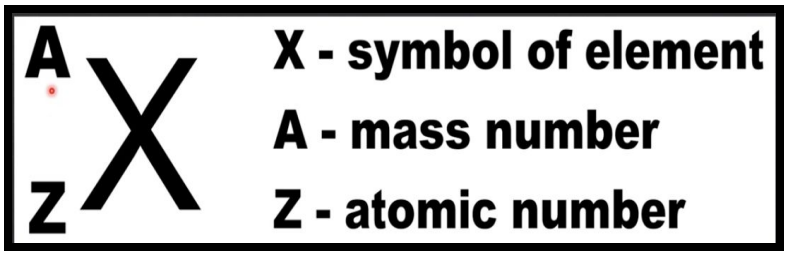
sub-atomic particle	relative charge	relative mass
proton	+1	1
neutron	no charge	1
electron	-1	1/2000

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	2	8
	2p	6	
3	3s	2	18
	3p	6	
	3d	10	
4	4s	2	32
	4p	6	
	4d	10	
	4f	14	

2.1 Atomic number and mass number

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

Summary: In the photo below X represents an element, its atomic number is determined by how many protons an atom of the element contains. The mass number is found by adding the neutrons and protons to get a sum. An element can as well have a charge which is determined by the electrons.



2.1 Isotopes

Understandings: *N/A*

Summary: Isotopes are atoms of the same element, meaning they have the same number of protons but different mass numbers. Differing mass numbers are due to a difference in how many neutrons the atom has. Overall, isotopes are atoms with different amount of neutrons making their mass different. A person can find the number of neutrons by subtracting the mass number from atomic number.

2.1 Calculating relative atomic mass

Understandings: The mass spectrometer is used to determine the relative atomic mass of an element from its isotopic composition.

Applications and skills: Calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra.

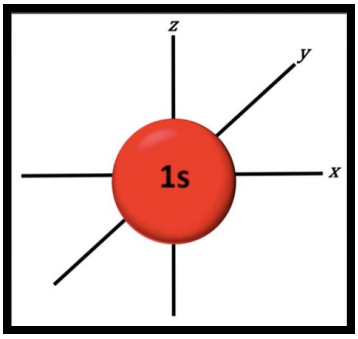
Summary: Relative atomic mass is the percent abundance of all the isotopes multiplied by their mass number.

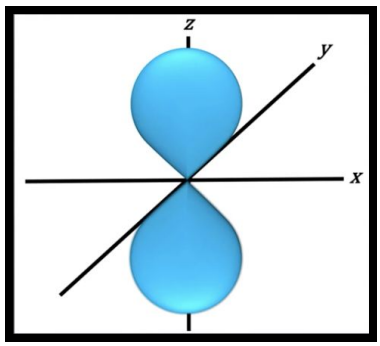
2.2 Atomic orbitals

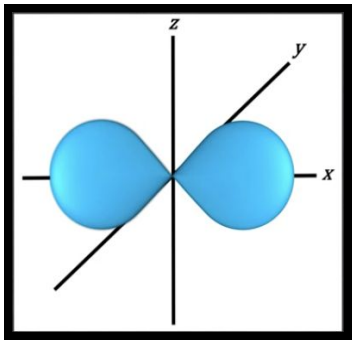
Understandings: Sublevels contain a fixed number of orbitals, regions of space where there is a high probability of finding an electron.

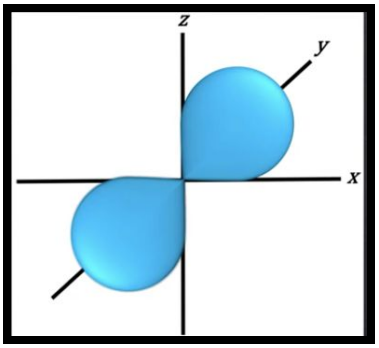
Applications and skills: Recognition of the shape of an s atomic orbital and the px, py and pz atomic orbitals.

Summary: orbitals are regions where there is a 90% chance of finding an electron. The orbitals are s, p, d, and f and they each have their sublevels. 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p





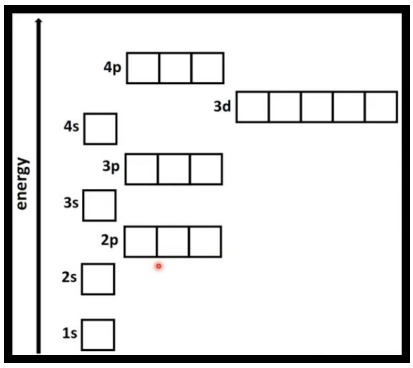


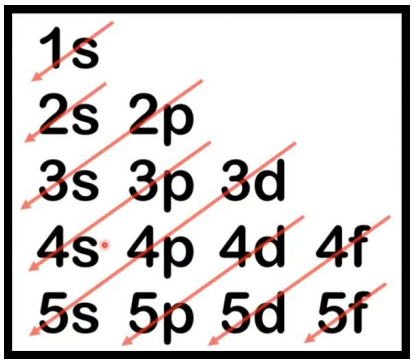


2.2 The Aufbau principle

Understandings:
Each orbital has a defined energy state for a given electronic configuration and chemical environment and can hold two electrons of opposite spin.
Applications and skills:
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.
Guidance:Orbital diagrams should be used to represent the character and relative energy of orbitals.

Summary:
Aufbau principle: Electrons go in the lowest energy level available.
Hund's rule: there must be one electron in each orbital of a sublevel before the second electron can be added.
Pauli exclusion: there is a max of two electrons in any one orbital, both with opposite spins





2.2 Electron configurations

Applications and skills: 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.

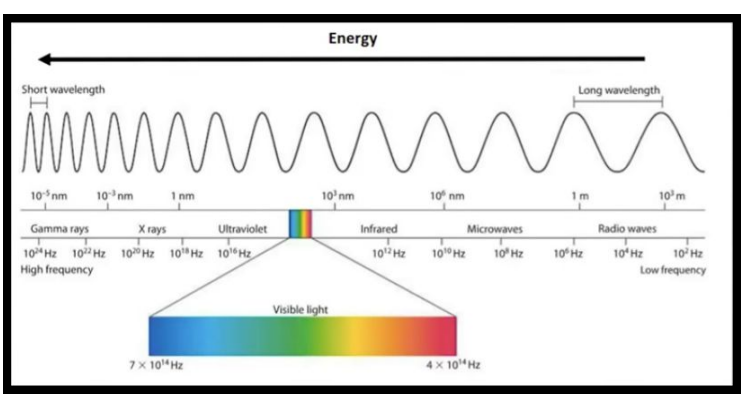
Guidance: Orbital diagrams should be used to represent the character and relative energy of orbitals.
The electron configurations of Cr and Cu as exceptions should be covered.

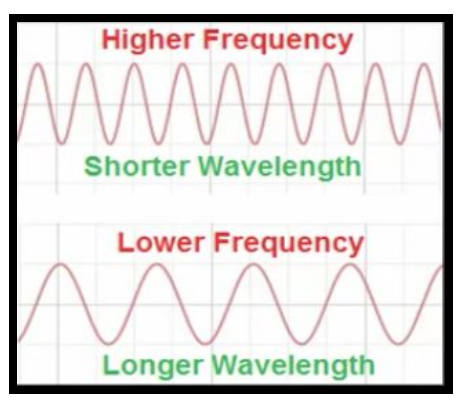
Summary: An example of a sublevel is $3p^4$. The 3 denotes that the sublevel is in the third main energy level. The p denotes the type of sublevel (s,p,d,f). The 4 denotes the number of electrons currently in the sublevel.

2.2 Electromagnetic spectrum

Applications and skills: Description of the relationship between colour, wavelength, frequency and energy across the electromagnetic spectrum.

Summary: Frequency is inversely proportional to wavelength. They are related by the equation c = λv, where "c" is the speed of light, "λ" is the wavelength, and "v" is the frequency. High energy waves have a high frequency and a short wavelength. Low energy waves have a low frequency and a long wavelength.

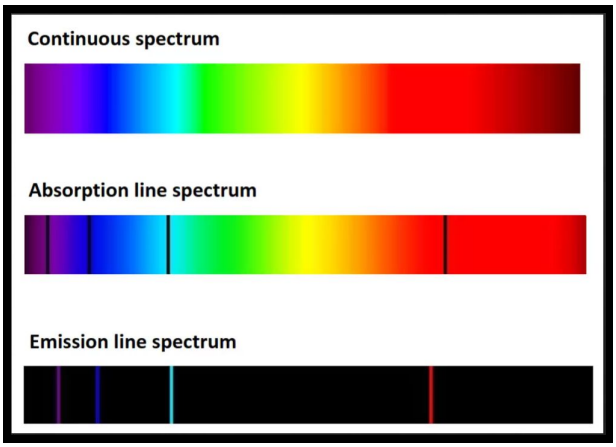


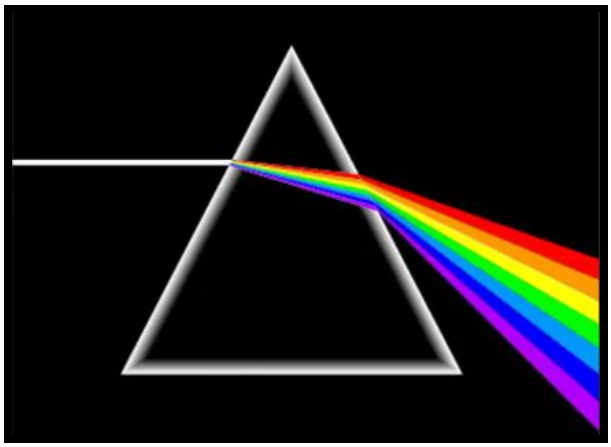


2.2 Line Spectra

Applications and skills: Distinction between a continuous spectrum and a line spectrum.

Summary: The continuous spectrum shows all the wavelengths of visible light (red to violet). This can be demonstrated by shining a white light on a prism. The absorption line spectrum shows the continuous spectrum, but with certain wavelengths colored black. The emission line spectrum only shows certain wavelengths with the rest being colored black.



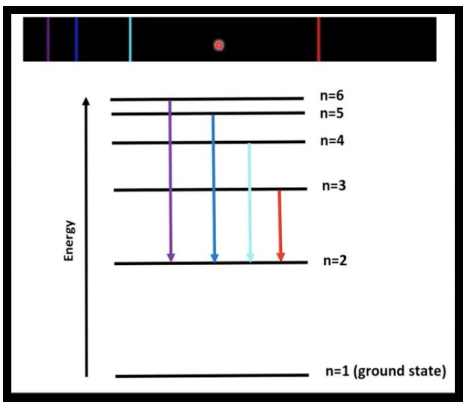


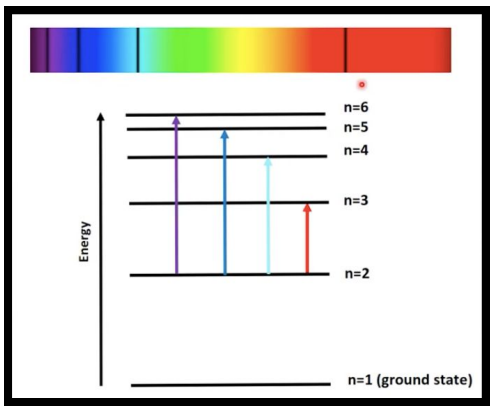
2.2 Hydrogen emission spectrum

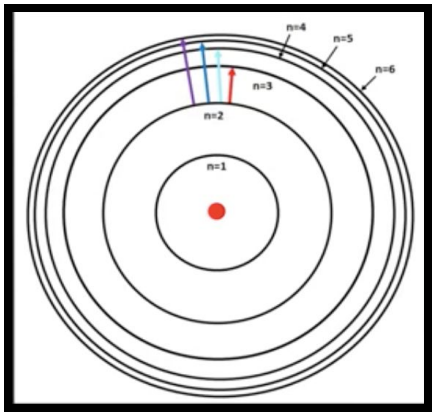
Understandings: Emission spectra are produced when photons are emitted from atoms as excited electrons return to a lower energy level.
The line emission spectrum of hydrogen provides evidence for the existence of electrons in discrete energy levels, which converge at higher energies.

Applications and skills: 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: All atoms can be excited and when they return to their ground state they release photons that correspond to their element. This technique can be used to determine the elements that compose a sample. The frequency of light emitted by the atom is determined by the energy level that the electrons came from and the level that they return to.







2.2 Exceptions to the Aufbau principle Derek

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

Summary:
Cu has a configuration of: [Ar] 4s1 3d10
Cr has a configuration of: [Ar] 5d5 4s1

2.2 Orbital diagrams Derek

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

Guidance: Orbital diagrams should be used to represent the character and relative energy of orbitals.

Summary: