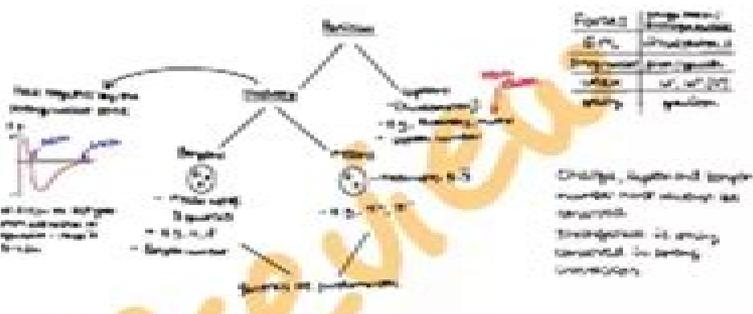


Particles and Quantum



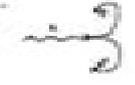
Force	Direction
EM	Electromagnetic
Gravitational	Gravitational
Weak	Weak
Strong	Strong

Charge, spin and baryon number must always be conserved. Conservation is only conserved in every interaction.

To convert mass to energy, use $E=mc^2$. Annihilation - pair of particles and its corresponding antiparticle collide and their rest energy is converted into photons.



Pair production - when photons collide, one particle and its corresponding antiparticle. The photon must have at least the same amount of energy as the rest energy of the particles.



Excitation

Exciting means they gain energy through energy to climb their atomic shells. Alpha particles - Helium nucleus, ${}^4_2\text{He}$. - Highly ionising, so it is dangerous. - Relatively penetrating - stopped by a piece of paper or foil on their back. Beta - fast moving electron $\rightarrow e^-$. - Medium penetrating and relatively ionising - stopped by a few cm of aluminium. - Not ionising - ${}^0_{-1}\text{e}$ or ${}^0_{+1}\text{e}$ - penetrates to several centimeters.



Gamma - high energy. EM ray or photon emitted from a high energy nucleus. - Highly penetrating - stopped by a few m of concrete.

Isotopes - Same element - same number of protons. - Different relative atomic mass - different number of neutrons. ${}^A_Z\text{X}$ where A is mass number and Z is atomic number.



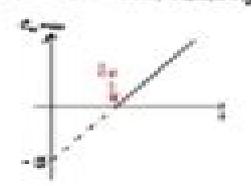
Specific charge - $\frac{Q}{m}$ (C/kg). - charge to mass ratio.

Electron rest mass - charge of an electron when stationary through a bit of the shell. - 9.11×10^{-31} kg. - 0.511 MeV.

Photoelectric effect

Use photons of sufficient energy or absorbed by electrons in the surface of a metal, liberating them.

- 1. Photon absorbed - $E_{photon} = hf$
- 2. Frequency
- 3. Work function - minimum energy to liberate electrons
- 4. Kinetic energy left over after ϕ is subtracted
- 5. Stopped potential - minimum potential needed for electrons to be liberated



The photoelectric effect proved the particle nature of light due to the fact that the maximum kinetic energy of electrons is 0 if the frequency is less than the threshold frequency. Increasing the intensity of light would increase the E_k of the electrons liberated but it would not if $f < f_0$ increase the number of electrons that are emitted per second.

Stopping potential - the pd needed to stop any electrons from reaching the other side.

- 1. $E_{k,max} = hf - \phi$
- 2. Change in momentum
- 3. Stopping potential

De Broglie

The de Broglie wavelength is the wavelength that a particle can have. The wave nature of a particle was proven by diffraction of a crystal. This is because the electron is diffracting which is wave like.



$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

λ = de Broglie wavelength
 p = momentum / mass x velocity

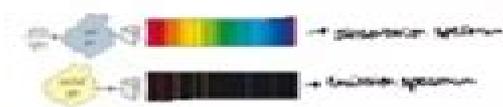
Fluorescent tubes



These tubes contain mercury under a high voltage is applied. This excites the gas resulting in which some of the mercury atoms emit photons when they relax. When the gas relaxes it emits UV light which is higher energy than what the electrons liberate, they emit photons in the UV range. A phosphor coating in the tube absorbs the photons and emit visible light.

Energy levels

Electrons can be excited to higher energy levels. Either by absorbing photons from the light or by the collision. In a gas discharge tube or in a gas discharge cell when ionizing the electron liberates. Ionization energy - is enough energy to pull an electron out of an atom, so will completely remove the electron.



A Level Physics Notes

M Woodhall



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