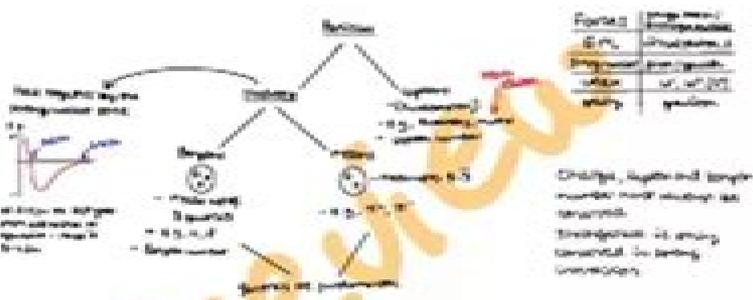


Particles and Quantum



To absorb must be energy... $E_{photon} = h\nu$
 Annihilation - pair of particles and its corresponding antiparticle created and their rest energy is converted into photons

Pair production - when photon turns into a particle and its corresponding antiparticle. The photon must have at least the sum amount of energy which rest energies of particles

Excitation
 Existing more than just excited through energy to count their atoms

Alpha particles - Helium nucleus, ^4_2He
 - highly ionizing, so it is dangerous
 - relatively penetrating - stopped by a piece of paper or foil on skin

Beta - fast moving electron $\rightarrow e^-$
 - medium penetrating and relatively ionizing - stopped by a few cm of aluminium
 - fast moving - $\frac{1}{18}c$ to $\frac{1}{3}c$ = $\frac{1}{3}mv^2 = \frac{1}{2}mv^2$ = $h\nu$ = $h\nu$ = $h\nu$ = $h\nu$



Gamma - high energy EM ray or photon emitted from a high energy nucleus $\rightarrow \gamma$
 - highly penetrating - stopped by a few m of concrete

Isotopes - same element - same number of protons
 - different relative atomic mass - different number of neutrons
 $^{12}_6\text{C}$ and $^{13}_6\text{C}$

Nuclear charge - $\frac{Q}{4\pi\epsilon_0} \left(\frac{1}{r^2}\right)$
 - charge to mass ratio

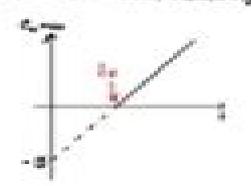
Electron rest - charge of an electron when stationary through a bit of rest mass
 - $9.109 \times 10^{-31} \text{ kg}$
 - $1.6 \times 10^{-19} \text{ C}$



Photoelectric effect

Use photons of sufficient energy on electrons on the surface of the metal, liberating them

- $E_{photon} = hf = \phi + E_{kin}$
- ϕ - work function - minimum energy to liberate electrons
- E_{kin} - kinetic energy of electrons
- $E_{photon} < \phi$ - no electrons emitted
- $E_{photon} = \phi$ - threshold frequency - minimum frequency needed for electrons to be emitted



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. The intensity of light does not affect the number of electrons emitted per second.

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

- $E_{photon} = hf = \phi + eV_s$
- eV_s - charge of electron
- V_s - 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 nature.



- $\lambda = \frac{h}{p} = \frac{h}{mv}$
- λ - de Broglie wavelength
- p - momentum / mass x velocity

Fluorescent tubes

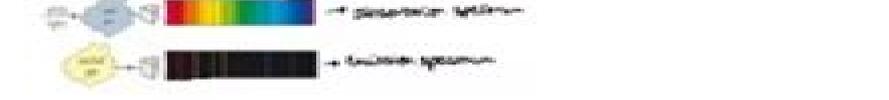


The tube contains mercury under a high voltage is applied. This excites the gas atoms to which some of the mercury atoms emit photons when they relax. When the gas relaxes it emits light. The light is higher energy than when the electrons relax, say the photons in the UV range. A phosphor coating in 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, when the gas is excited, the electrons energy is transferred to the gas atoms.

Ionization energy - is enough energy to pull an electron out of an atom, so will completely change the atom.



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