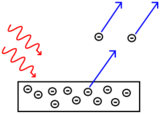
Behavior of the Electron

1. Photoelectric Effect-occurs when matter emits electrons upon exposure to electromagnetic radiation, such as photons of light. The photoelectric effect is studied in part because it can be an introduction to wave-particle duality and quantum mechanics.



The photoelectric effect occurs when matter emits electrons upon absorbing electromagnetic radiation, such as light.

If you shine light of high enough energy on to a metal, electrons will be emitted from the metal. Light below a certain threshold frequency, no matter how intense, will not cause any electrons to be emitted. Light above the threshold frequency, even if it's not very intense, will always cause electrons to be emitted.

The explanation for the photoelectric effect goes like this: it takes a certain energy to eject an electron from a metal surface. This energy is known as the work function (W), which depends on the metal. Electrons can gain energy by interacting with photons. If a photon has an energy at least as big as the work function, the photon energy can be transferred to the electron and the electron will have enough energy to escape from the metal. A photon with an energy less than the work function will never be able to eject electrons.

The threshold frequency is different for different materials. It is visible light for alkali metals, near-ultraviolet light for other metals, and extreme-ultraviolet radiation for nonmetals. The photoelectric effect occurs with photons having energies from a few electronvolts to over 1 MeV.

The work function (φ) of some metals is given below. Which of the following metals will show photoelectric effect when light of 300 nm wavelength falls on it?

**E= hυ h = 6.6260755 x 10-34 joule • seconds.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Metal | Li | Na | K | Mg | Cu | Ag | Fe | Pt | W |
| Φ (eV) | 2.4 | 2.3 | 2.2 | 3.7 | 4.8 | 4.3 | 4.7 | 6.3 | 4.75 |

2. Atoms and Spectra- When atoms or molecules absorb energy, that energy is often released as light energy,

Fireworks, neon lights, etc.

When that emitted light is passed through a prism, a pattern of particular wavelengths of light is seen that is unique to that type of atom or molecule – the pattern is called an emission spectrum.

Noncontinuous

Can be used to identify the material

Flame tests

3. Rydberg- mathematical formula used to predict the wavelength of light resulting from an electron moving between energy levels of an atom. It was shown that there is integer relationship between the wavenumbers of successive lines.

4. **de Broglie’s Equation**- because of the dual nature of of light (photons) that are absorbed or emitted from atoms, an equation can relate mass and wavelength.

h= Planck’s constant -6.6260755 x 10-34 joule • seconds

m= mass in kg ( because a joule = kg•m2/s2)

v = velocity in m/s

**λ = h**

**mv**

Mathematics and electrons

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Equation** | **velocity = λ υ** | **ΔE=n hυ** | **λ = h**  **mv** | **E = -2.178 X 10-18J ( 1 - 1 )**    **(nfinal)2 (ninitial) 2** |
| **variables** | **λ = wavelength**  **υ = frequency**  **v= speed of light** | **ΔE = energy absorbed or emitted**  **h= Planck’s constant =**6.6260755 x 10-34 joule • seconds.  **υ = frequency of photon given off**  **n= whole number integer** | **λ = wavelength**  **h= Planck’s constant =**6.6260755 x 10-34 joule • seconds  m = mass of particle in kg  v= velocity | E = allowable energy  n= energy level |
| **Why you care** | Id’s type of electromagnetic radiation. | Tells quantity of energy emitted | Relates particle properties to wave | Tells allowable energy levels for an electron |