

PHYSICS

KEY TERMS

Dual Nature of Matter

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1. **Work Function.** The minimum energy required by the free electron to just leave (without moving in space) the metal surface is known as the **work function** of the metal. Work function is denoted by ϕ and can be measured in electron volt (eV).
The work function of a metal depends upon the nature of the metal, condition of the surface and impurities etc.
2. **Photoelectric effect.** The phenomenon of emission of electrons from mainly metal surfaces exposed to light energy of suitable frequency is known as **photoelectric effect**.
3. **Photoelectric Current.** When light of suitable frequency falls on the metallic plate C, photoelectrons are emitted. These electrons get accelerated towards anode and constitute the current called **photoelectric current**.
4. **Saturation Current.** When the photoelectric current attains maximum value it is called **saturation current**.
5. **Stopping Potential.** The minimum negative potential (V_0) applied to anode for which photo electric current becomes zero is called **cut off potential** or **stopping potential**.
6. **Threshold frequency.** There is a minimum value of frequency (ν_0) of the incident light below which photoelectric emission is not possible. This frequency is known as threshold frequency or cut off frequency (ν_0).
7. **Laws of Photo-electric Emission.** (i) For a given substance, there is a minimum frequency of incident light called **threshold frequency** (ν_0) below which no photoelectric emission takes place, whatsoever, the intensity of incident light may be.

For every substance, the value of threshold frequency is different.

(ii) The number of photoelectrons emitted per second by a substance (i.e. **photo electric current**) is directly proportional to the intensity of incident light, provided the frequency of the incident light is greater than the threshold frequency.

(iii) The **maximum kinetic energy** of the photo –electrons is directly proportional to the frequency of the incident light, provided the frequency of incident light is greater than the threshold frequency.

The maximum kinetic energy of the emitted photoelectrons is independent of the intensity of the incident light.

(iv) The process of photoelectric emission is **instantaneous** i.e. as soon as the light of suitable frequency (more than threshold frequency) incident on the substance, it emits the photo-electrons without any significant delay.

It has been estimated that photo electrons are emitted 10^{-9} s after the light falls on the metallic surface.

8. Planck's Hypothesis

(a) **Energy (E)** of an electromagnetic wave is an integral multiple of the product of constant h (i.e. Planck's constant) and the frequency ν of the wave.

(b) A source of electromagnetic waves (say oscillator) emits energy when it goes from higher to lower energy state and absorbs energy when it goes from lower to higher energy state.

9. Photon. Electromagnetic radiations carry energy in packets or bundles known as **photons** or **quanta**.

A **photon** is packet or bundle of energy and the energy associated with a photon is given by

$$E = h\nu$$

where h is the planck's constant and $h = 6.625 \times 10^{-34}$ Js. ν is the frequency of radiation on photon.

10. Photo cell (i.e. Photo electric cell). A device which converts light energy into electrical energy is called **photo – electric cell**.

11. Photo emissive cell (photo tube). When light incident on the cathode, it emits photoelectron which are attracted by the anode. The photoelectrons constitute a small current which flows through the external circuit.

12. Photo conductive cell. It is based on the principle that conductivity of a semiconductor increases with increase in the intensity of incident light.

13. Photovoltaic cell. It works on the principle that photoelectric emission can develop potential difference between suitable substances.

14. de- Broglie's wave. The waves associated with the moving material particles are known as **de-Broglie waves** or **matter waves**. de-Broglie or matter wave is independent of the charge on the material particle. de-Broglie waves are not electromagnetic in nature.

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