DUAL NATURE OF MATTER AND RADIATION

EASY AND SCORING AREAS:-

1. PHOTOELECTRIC EFFECT.
2. DUAL NATURE OF MATTER
3. DE-BROGLIE WAVELENGTH

One mark questions

Q.1 Define work function for a given metallic surface.

Ans. Work function of a metal is the minimum energy required by an electron to escape from the metal surface.

Q.2. Define threshold frequency.

Ans. For a given metal there exists a certain minimum frequency of the incident radiation below the emission of photoelectron takes place. This frequency is called threshold frequency.

Q.3. Define stopping potential.

Ans. It is the minimum retarding potential which should be applied across a photoelectric tube in order to make photoelectric current zero.

Q.4. If the intensity of the incident radiations on a photosensitive surface is doubled, how does the kinetic energy of emitted electron get affected?

Ans. No change.

Q .5. How will the photoelectric current changes on decreasing the wavelength of incident radiation for a give photosensitive material?

Ans. It remains same.

Q.6 Two metals A and B have work function 2ev and 5ev respectively which metal has lower threshold wavelength.

Ans. Metal B (as $w_0 = hv_0$, $w_0 = h\frac{c}{\lambda_0}$)

Q.7 How does the maximum kinetic energy of electron emitted vary with the work function of the metal?

Ans. As $\frac{1}{2} V_{MAX}^2 = hv - w_0$. If work function of metal increased then maximum value of kinetic energy emitted decreases.

Q.8 Write down the Einstein's photoelectric equation.

Ans. $\frac{1}{2} V_{max}^2 = hv - \phi_0$

Q.9 Write De- Broglie's wave equation.

Ans. $\lambda = \frac{h}{mv}$

Q .10 What is the momentum of a photon of frequency v?

Ans. $p = \frac{hv}{c}$ (p= mass x velocity)

($p = \frac{hv}{c^2} \times c$)

Q .11 What is the momentum of a photon of wavelength λ?

Ans. $p = \frac{h}{\lambda}$ (as $p = \frac{h}{c/v}$)

Two marks

Q .12 If the potential difference used to accelerate electrons is doubled, by what factor does the de- Broglie wavelength of the electron beam charge?

Ans. $\lambda = \frac{12.27A}{\sqrt{v}}$

It become $\frac{1}{\sqrt{2}}$ times the initial value. ($\lambda' = \frac{\lambda}{\sqrt{2}}$)

Three marks

1. State laws of photoelectric emission.

Ans. A) For a given photosensitive material and frequency of incident radiation (above the threshold frequency) the photoelectric current is directly proportional to the intensity of light. The saturation current is directly proportional to the intensity of incident radiations.

B). For a photosensitive material there exists a certain minimum cut-off frequency below which no photoelectrons are emitted, however high is the intensity of incident radiation. This frequency is called threshold frequency.

c) Above the threshold frequency, the stopping potential or the maximum kinetic energy of the photoelectron is directly proportional to the frequency of incident radiation, but is independent of its intensity.

D) The photoelectric emission is an instantaneous process. The time lag between the incidences of light radiation and the emission of photoelectrons is very small less than 10^{-9} s.

2. Deduce de Broglie wavelength of electrons accelerated by a potential of V volt.

Ans. $\lambda = \frac{h}{\sqrt{2meV}}$

$\lambda = \frac{12.27}{\sqrt{V}}$ X 10^{-10} m.