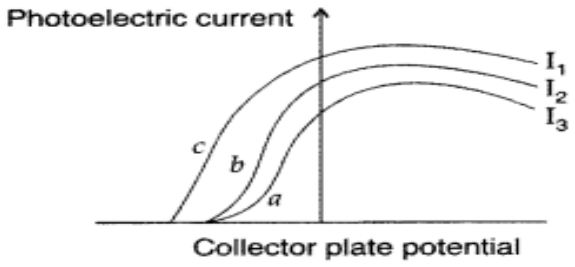
"DUAL NATURE OF RADIATION AND MATTER".

Worksheet for Module:1

Q.1] The figure shows a plot of three curves a, b, c, showing the variation of photocurrent vs. collector plate potential for three different intensities I_1, I_2 and I_3 having frequencies V_1, v_2 and v_3 respectively incident on a photosensitive surface.Point out the two curves for which the incident radiations have same frequency but different intensities.



Answer:
Stopping potential will be same for the same frequency. So its curves 'a' and 'b' which have same frequency but different intensities. ($I_2 > I_3$)

Q.2] The stopping potential in an experiment on photoelectric effect is 1.5 V. What is the maximum kinetic energy of the photoelectrons emitted?

Answer: **K.E. of the electron e– = 1.5 eV**

Q.3] The maximum kinetic energy of a photoelectron is 3 eV. What is its stopping potential?

Answer: Since $K_{max} = eV_0$

$\therefore$ Stopping potential $V_0 = \frac{K_{max}}{e} = \mathbf{3\ volt}$

Q.4] Define the term 'stopping potential' in relation to photoelectric effect.
Answer:
The value of the retarding potential at which the photo electric current becomes zero is called cut off or stopping potential for the given frequency of the incident radiation.

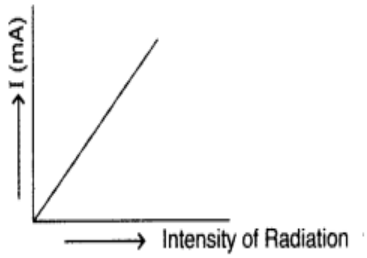
Q.5] Define 'intensity' of radiation in photon picture of light.

Answer:
It is the number of photo electrons emitted per second.

Q.6] Why is photoelectric emission not possible at all frequencies?

Answer:
Photoelectric emission is possible only if the energy of the incident photon (hv) is greater than the work function ($\omega_0 = hv_0$) of the metal. Hence the frequency v of the incident radiation must be greater than the threshold frequency v_0.

Q.7] Show on a plot the nature of variation of photoelectric current with the intensity of radiation incident on a photosensitive surface.



Answer:

Q.8] Name the phenomenon which shows the quantum nature of electromagnetic radiation.

Answer:
Photoelectric Effect is the phenomenon which shows the quantum nature of electro-magnetic radiation.

Q.9] State one reason to explain why wave theory of light does not support photoelectric effect.

Answer:
One reason why wave theory of light does not support photoelectric effect is that the kinetic

energy of photo electrons does not depend on the intensity of incident light.

Q.10]

(a) Define photoelectric work function? What is its unit?
(b) In a plot of photoelectric current versus anode potential, how does
    (i) Saturation current varies with anode potential for incident radiations of different frequencies but same intensity?
    (ii) The stopping potential varies for incident radiations of different intensities but same frequency.
    (iii) (iii) Photoelectric current vary for different intensities but same frequency of radiations? Justify your answer in each case?

Ans. (a) The minimum amount of energy required to take out an electron from the surface of metal. It is measured in electron volt (eV).

(b) (i) Saturation current depends only on the intensity of incident radiation but is independent of the frequency of incident radiation.

(ii) Stopping potential does not depend on the intensity of incident radiations.

(iii) Photoelectric current is directly proportional to the intensity of incident radiations, provided the given frequency is greater than the threshold frequency.

Q.11] How does the stopping potential applied to a photocell change if the distance between the light source and the cathode of the cell is doubled?

Ans. Stopping potential does not depend on the intensity of the light source which changes due to the change in distance from the light source.

Q.12] Assume that the frequency of the radiation incident on a metal plate is greater than its threshold frequency. How will the following change, if the incident radiation is doubled?

(1) Kinetic energy of electrons

(2) Photoelectric current

Ans.(1) If the frequency of the incident radiation is doubled ($h\nu - h\nu_{0)}$ is increased, hence kinetic energy is increased.

(2) If the frequency of the incident radiation is doubled there will be no change in the number of photoectrons i.e. photoelectronic current.