

Std: XII

Topic: Dual nature of matter and radiation

① An electromagnetic wave of wavelength λ is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from this surface have the de-Broglie wavelength λ_1 , prove that $\lambda = \left(\frac{2mc}{h}\right) \lambda_1^2$

② An electron of mass m and charge e initially at rest gets accelerated by a constant electric field E . Find the rate of change of de-Broglie wavelength of this electron at time t , ignoring relativistic effect.

③ The K.E of the most energetic electrons emitted from a metallic surface is doubled when the wavelength of the incident radiation is reduced from 400nm to 310nm. Find the work function of the metal.

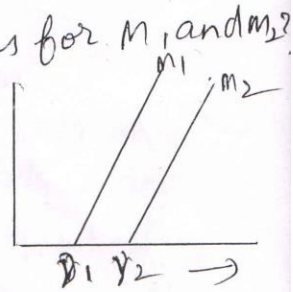
④ Visible light cannot eject photoelectrons from copper surface, whose work function is 4.4 eV. Why? prove it mathematically.

⑤ Lights of two different frequencies, whose photons have energies 1 eV and 2.5 eV respectively, successively illuminate a metal whose work function is 0.5 eV. Find the ratio of the maximum speeds of the emitted electrons.

⑥ The given graphs show the variation of the stopping potential V with the frequency ν of the incident radiations for two different photo-sensitive materials M_1 and M_2

(i) what are the values of work functions for M_1 and M_2 ?

(ii) The values of the stopping potential for M_1 and M_2 for a frequency ν_3 ($> \nu_2$) of the incident radiations are V_1 and V_2 respectively. show that the slope of the lines equals $\frac{V_1 - V_2}{\nu_1 - \nu_2}$



⑦ Draw a graph to show the variation of stopping potential with frequency of radiations incident on a metal plate. How can the value of Planck's constant be determined from this graph?

⑧ The wavelength λ of a photon and de-Broglie wavelength of an electron have same value. show that energy of photon is $\frac{2\pi mc}{h}$ times the kinetic energy of the electron where m , c and h have their usual meaning.

⑨ Light of wavelength 3500 \AA is incident on two metals A and B. which metal will yield photoelectrons if their work functions are 4.2 eV and 1.9 eV respectively.

⑩ Monochromatic X-ray when reflected from a crystal with lattice spacing 2 \AA , produce first order diffraction maximum at 30° . what is the wavelength of X-rays?