PREVIOUS YEAR QUESTION

If p is the momentum of the fastest electron ejected from a metal surface after the irradiation of light having wavelength λ, then for 1.5 p momentum of the photoelectron, the wavelength of the light should be: (Assume kinetic energy of ejected photoelectron to be very high in comparison to work function)

A 1/2 λ

B 3/4 λ

C 4/9 λ

D 2/3 λ

Explanation

From photoelectric effect,

E = ϕ + KE

$\frac{hc}{\lambda} = \phi + \frac{p^2}{2m}$ ..... (1)

Now when momentum = 1.5p then let wavelength = λ_1

$\therefore \frac{hc}{\lambda_1} = \phi + \frac{(1.5p)^2}{2m}$ ..... (2)

Given,

kinetic energy(KE) of ejected photoelectron to be very high in comparison to work function(ϕ).

$\therefore$ We can neglect work function(ϕ).

$\therefore$ Equation (1) and (2) becomes,

$\frac{hc}{\lambda} = \frac{p^2}{2m}$ ..... (1)

$\frac{hc}{\lambda_1} = \frac{(1.5p)^2}{2m}$ ..... (2)

Dividing (1) by (2) we get,

$\frac{\lambda_1}{\lambda} = \frac{p^2}{(1.5p)^2}$

$\Rightarrow \frac{\lambda_1}{\lambda} = \frac{4}{9}$