Q- An ultraviolet photon with wavelength 172 nm strikes an aluminum surface with a work function φ = 3.87 eV and ejects an electron. What is the shortest wavelength λ that can be observed for the ejected electron?

Reading:

Phototubes operate on the principle of photoelectric effect. This effect is showing the particle nature of the light. When light of sufficiently small wavelength incident on the metal plate, the emission of electrons from the surface of metal takes place. For every metal, there is a cut off wavelength called threshold wavelength above that no emission of electrons takes place and the tube is cut-off.

The energy of photon of light is inversely proportional to the wavelength of light hence energy of photons of the light decreases with the wavelength. If the wavelength of light is larger than threshold wavelength, the photons are not having sufficient energy to extract electrons from the surface of that metal. This minimum energy required to extract electron from the surface of metal is called work function.

The Einstein's equation of photoelectric equation is relating the energy of emitted electron the work function of the surface and the energy of incident photon as

$$\frac{hc}{\lambda} - \phi = \frac{1}{2} mV^2$$

where h is the plank's constant, λ is the wavelength of light incident, and (1/2) mv^2 is the maximum energy of emitted electrons.

Solution:

If that is not correct then I think he is asking about the de Broglie wavelength associated with the electrons and then it will be like that

The maximum kinetic energy of the ejected electrons is given by

$$\frac{1}{2}mv^2 = \frac{hc}{\lambda} - \phi$$

Or $$\frac{1}{2}mv^2 = \frac{6.63*10^{-34}*3*10^8}{172*10^{-9}} - 3.87*1.6*10^{-19}$$

Or $$\frac{1}{2}mv^2 = 5.37*10^{-19}$$

Gives $v = 1.09*10^6$ m/s

Hence de-Broglie wavelength of the emitted electrons of maximum KE will be

$$\lambda = \frac{h}{mv} = \frac{6.63*10^{-34}}{9.11*10^{-31}*1.09*10^6} = 6.68*10^{-10}m$$

Or **λ = 0.668 nm**