

Answer on Question #74934-Physics-Other

Calculate the de Broglie wavelength of an electron accelerated by a potential of 1000 V. Also calculate the wavelength of the X-rays that would be produced when these electrons strike a solid.

Solution

$$E_{el} = qU = (1.602 \cdot 10^{-19})(1000) = 1.602 \cdot 10^{-16} J$$

The de Broglie wavelength of an electron is

$$\lambda = \frac{h}{\sqrt{2mE}} = \frac{6.626 \cdot 10^{-34}}{\sqrt{2(9.109 \cdot 10^{-31})(1.602 \cdot 10^{-16})}} = 3.88 \cdot 10^{-11} m.$$

$$E_{photon} = \frac{hc}{\lambda_{photon}}$$

The wavelength of the X-rays is

$$\lambda_{photon} = \frac{hc}{E_{photon}} = \frac{(6.626 \cdot 10^{-34})(3.00 \cdot 10^8)}{1.602 \cdot 10^{-16}} = 1.24 \cdot 10^{-9} m = 1.24 nm.$$

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