Answer on Question 60745, Physics, Other

Question:

An X-ray tube operates at $40\ kV$. Calculate the minimum wavelength of the emitted rays.

Solution:

There is an inverse relationship between the energy of the emitted rays and its wavelength:

$$E = \frac{hc}{\lambda},$$

here, $h = 6.626 \cdot 10^{-34}\ J \cdot s$ is the Planck's constant, c is the speed of light, λ is the wavelength of the emitted rays.

From the other hand:

$$E = eU,$$

here, $e = 1.6 \cdot 10^{-19}\ C$ is the charge of the electron, U is the voltage at which the X-ray tube operates.

Then, we can equate these relationships and find the minimum wavelength of the emitted rays:

$$eV = \frac{hc}{\lambda},$$

$$\lambda = \frac{hc}{eU} = \frac{6.626 \cdot 10^{-34}\ J \cdot s\ \cdot 3 \cdot 10^{8}\ \frac{m}{s}}{1.6 \cdot 10^{-19}\ C \cdot 40 \cdot 10^{3}\ V} = 3.1 \cdot 10^{-11}\ m.$$

Answer:

$\lambda = 3.1 \cdot 10^{-11}\ m.$