Answer on Question #46020 – Physics – Electromagnetism

Question.

The electron beam in a television tube consists of electrons accelerated from rest through a potential difference of about 20,000V. What is the speed of the electrons? (Ignore relativistic effects). Electron rest mass is 911×10−31kg and electronic charge is 16×10−19C.

Given:

$U = 20000\ V$

$m = 9.11 \cdot 10^{-31}\ kg$

$q = 1.6 \cdot 10^{-19}\ C$

Find:

$v = ?$

Solution.

Use the law of energy conservation. Electrons are accelerated to a speed v by the electric field. So, the kinetic energy of electrons $\frac{1}{2}mv^2$ is equal to the energy of charge q moving through a potential difference U:

$$\frac{1}{2}mv^2 = qU$$

Therefore,

$$v = \sqrt{\frac{2qU}{m}}$$

Calculate:

$$v = \sqrt{\frac{2 \cdot 1.6 \cdot 10^{-19} \cdot 2 \cdot 10^4}{9.11 \cdot 10^{-31}}} = \sqrt{70.25 \cdot 10^{14}} = 8.38 \cdot 10^7\ \frac{m}{s}$$

Answer.

$$v = \sqrt{\frac{2qU}{m}} = 8.38 \cdot 10^7\ \frac{m}{s}$$