Answer on Question #45701 – Physics – Electromagnetism

Question: the electron beam in a television tube consists of electrons accelerated from rest through a potential difference of about $20\ 000$ V. What is the speed of the electrons? (Ignore relativistic effects). Electron rest mass is $9{,}11 \cdot 10^{-31}$ kg and electronic charge is $1{,}6 \cdot 10^{-19}$ C.

Solution: we can use the law of conservation of energy: the work done by electric field accelerating every electron in the beam is equal to the final kinetic energy of each electron. Thus, we get the equation

$$\frac{mv^2}{2} = eU,$$

where U is the potential difference between the ends of a television tube. Therefore the speed of each electron is

$$v = \sqrt{\frac{2eU}{m}} = \sqrt{\frac{2 \cdot 1{,}6 \cdot 10^{-19} \cdot 20000}{9{,}11 \cdot 10^{-31}}} \simeq 8{,}4 \cdot 10^7 \frac{\text{m}}{\text{s}}.$$

Answer:

$$v = \sqrt{\frac{2eU}{m}} \simeq 8{,}4 \cdot 10^7 \frac{\text{m}}{\text{s}}.$$