Answer on Question #45662, Physics, Electromagnetism

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 $9.11 * 10^{-31}kg$ and electronic charge is $1.6 * 10^{-19}C$.

a. $8.4 * 10^{7}\frac{m}{s}$
b. $3.8 * 10^{6}\frac{m}{s}$
c. $6 * 10^{6}\frac{m}{s}$
d. $4.7 * 10^{7}\frac{m}{s}$

Solution.

Kinetic energy of electron accelerated from rest is equal to its potential energy change.

$$\frac{m_e v_e^2}{} = q_e V$$

$$m_e = 9.11 * 10^{-31}kg - electron\ rest\ mass;$$

$$q_e = 1.6 * 10^{-19}C - electronic\ charge;$$

$$V = 20\ 000\ V - potential\ difference;$$

$$v_e - ?\frac{m}{s} - the\ speed\ of\ the\ electrons;$$

From the equation:

$$v_e^2 = \frac{q_e V}{m_e}$$

$$v_e = \sqrt{\frac{q_e V}{m_e}} = \sqrt{\frac{* 1.6 * 10^{-19} * 20\ 000}{9.11 * 10^{-31}}} = 0.84 * 10^{8} = 8.4 * 10^{7}\frac{m}{s}$$

Answer: the electron speed is a $8.4 * 10^{7}\frac{m}{s}$.