Question #31252, Physics, Other

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. 8.4×107 m/s

b. 3.8×106 m/s

c. 6×106 m/s

d. 4.7×107 m/s

Solution.

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

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

where $m_e = 9.11 \cdot 10^{-31}$, kg – is electron rest mass;

$q_e = 1.6 \cdot 10^{-19}$, C – is electron electronic charge;

$V = 20\,000$, V(J/C) - potential difference;

v_e , m/s– is the speed of the electrons;

Find the electron speed:

$$v_e = \sqrt{\frac{2 \cdot q_e \cdot V}{m_e}} = \sqrt{\frac{2 \cdot 1.6 \cdot 10^{-19} \cdot 20000}{9.11 \cdot 10^{-31}}} = \sqrt{\frac{2 \cdot 1.6 \cdot 10^{-19} \cdot 20000}{9.11 \cdot 10^{-31}}} = 0.84 \cdot 10^8 = 8.4 \cdot 10^7 \text{ m/s.}$$

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