Answer on Question # 69004– Physics - Mechanics - Relativity :

Question: An electron microscope accelerates an electron (mass of an electron is

9.11×10^{-31} kg) from rest to 2.8×10^7 m/s in a distance of 2.80 cm.
(a) How much work is done on the electron?
(b) What is the average force on the electron?

Solution: According to work energy theorem,

Work done (W) = Change in kinetic energy

$$= \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 \qquad\qquad v_f = \text{final velocity} = 2.8 \times 10^7 \text{ m/s}$$

$$= \frac{1}{2} mv_f^2 \qquad\qquad\qquad \& \ v_i = \text{initial velocity} = 0 \text{ m/s.}$$

$$= \frac{1}{2} \times 9.11 \times 10^{-31} \times (2.8 \times 10^7)^2$$

$$= 35.71 \times 10^{-17} \text{ Joule.}$$

Now,

Work done = Force x Displacement

Or, Force $= \dfrac{\text{Work done}}{\text{Displacement}}$

Or, Force $= \dfrac{35.71 \times 10^{-17}}{0.028} \qquad\qquad$ Distance = 2.80 cm = 0.028 m.

$$= 1.275 \times 10^{-14} \text{ Newton.}$$

Answer: a. So, work done on the electron = 35.71×10^{-17} Joule.

b. Average force on the electron = 1.275×10^{-14} Newton.