Lecture tutorial 2B

Task L2B.1.

Why do birds sitting on high voltage power lines not get electrocuted?

Task L2B.2.

es28

2A.6. An electron moving through an electric field

electron, schiefer wurf

An electron, moving a velocity v, enters perpendicularly into the space between two charged plates. The plates generate the electric field E. how fast does the eletrcon travel when entering the eletric field to generate afterwards move on a circle within the field with a radius of 10 cm. electric field is 1000 N/C

To determine the velocity of an electron entering an electric field such that it moves in a circular path with a radius of 10 cm, we equate the electric force to the centripetal force:

$$ qE = \frac{mv^2}{r} $$

Solving for $ v $:

$$ v = \sqrt{\frac{qE \cdot r}{m}} $$

Plugging in the known values:

- $ q = 1.6 \times 10^{-19} , \text{C} $
- $ E = 1000 , \text{N/C} $
- $ r = 0.1 , \text{m} $
- $ m = 9.11 \times 10^{-31} , \text{kg} $

$$ v = \sqrt{\frac{(1.6 \times 10^{-19} , \text{C}) \cdot (1000 , \text{N/C}) \cdot 0.1 , \text{m}}{9.11 \times 10^{-31} , \text{kg}}} $$

Calculating step by step:

1. Multiply $ q $ and $ E $:

$$ 1.6 \times 10^{-19} , \text{C} \times 1000 , \text{N/C} = 1.6 \times 10^{-16} , \text{N·m} $$

2. Multiply by $ r $:

$$ 1.6 \times 10^{-16} , \text{N·m} \times 0.1 , \text{m} = 1.6 \times 10^{-17} , \text{N·m}^2 $$

3. Divide by $ m $:

$$ \frac{1.6 \times 10^{-17} , \text{N·m}^2}{9.11 \times 10^{-31} , \text{kg}} = 1.758 \times 10^{13} , \text{m}^2/\text{s}^2 $$

4. Take the square root:

[v = \sqrt{1.758 \times 10^{13} , \text{m}^2/\text{s}^2} \approx 1.326 \times 10^{6} , \text{m/s}]

Final Answer: The electron must be moving at approximately $\mathbf{1.326 \times 10^{6}}$ meters per second when it enters the electric field to move in a circular path with a radius of 10 cm.