B8 · Extra practice

Energy conservation and 2-D motion of charges | Diploma-style set of 8

Constants from the Alberta Physics 30 data sheets: $k = 8.99 \times 10^{9}$ N·m²/C², $e = 1.60 \times 10^{-19}$ C, electron mass $m_e = 9.11 \times 10^{-31}$ kg, proton mass $m_p = 1.67 \times 10^{-27}$ kg, $g = 9.81$ m/s².

Easy · B8-X01. A charged pith ball of mass 2.00×10^{-4} kg is released from rest. It loses 8.00×10^{-7} J of electric potential energy as it moves, and no other energy changes. Find its final speed in m/s.

Response: _____

Easy · B8-X02. An electron enters the space between two plates moving parallel to them at 4.00×10^{6} m/s. The plates are 0.0800 m long. Find the time it takes to travel the length of the plates, in seconds.

Response: _____

Easy · B8-X03. A charge enters the space between horizontal plates moving sideways. While it is between the plates, what is true about its horizontal velocity?

A. It increases, because the electric force pushes it forward.

B. It decreases, because the plates slow it down.

C. It becomes zero halfway through.

D. It stays constant, because the electric force has no horizontal part.

Response: _____

Medium · B8-X04. A charged particle at A has 3.00×10^{-7} J of kinetic energy and 9.00×10^{-7} J of electric potential energy. At B its potential energy is 2.00×10^{-7} J. Only the electric force acts. Find its kinetic energy at B, in joules.

Response: _____

Medium · B8-X05. An electron enters between plates at 5.00×10^{6} m/s, parallel to them. The plates are 0.100 m long, and the electron has a constant acceleration of 2.20×10^{14} m/s² across the plates. Find its sideways shift across the plates, in metres.

Response: _____

Medium · B8-X06. A charge enters sideways between two plates. Which pair of equations describes its horizontal and vertical motion while it is between them?

A. Horizontal: $\Delta x = vt$; vertical: $\Delta y = \frac{1}{2}at^2$
B. Horizontal: $\Delta x = \frac{1}{2}at^2$; vertical: $\Delta y = vt$
C. Horizontal: $\Delta x = \frac{1}{2}at^2$; vertical: $\Delta y = \frac{1}{2}at^2$
D. Horizontal: $\Delta x = vt$; vertical: $\Delta y = vt$

Response: _____

Challenging · B8-X07. An electron enters midway between two plates that are 0.0400 m apart, moving parallel to them at 3.00×10^{6} m/s. The plates are 0.0900 m long. The electron must just miss the plate, so it can shift sideways by at most half the gap. Use $e = 1.60 \times 10^{-19}$ C and electron mass $m_e = 9.11 \times 10^{-31}$ kg. Find the largest potential difference that lets it leave, in volts.

Response: _____

Challenging · B8-X08. An electron is accelerated from rest through a potential difference, then enters the gap between two other plates sideways. Say which physics principle you use to find its speed entering the gap, and which two ideas you use to find how far it is shifted across the gap. Give the order.

Response: _____