Example 1 – Two 2.0-cm-diameter disks face each other, 1.0 mm apart. They are charged to $\pm 10 \text{ nC}$. A proton is shot from the negative disk toward the positive disk. What launch speed must the proton have to just barely reach the positive plate?

\[ V_0 = \sqrt{2a \Delta x} = \sqrt{\frac{2qE \Delta x}{m}} \]

\[ = \sqrt{\frac{2(1.6 \times 10^{-19} \text{ C}) E (0.001) \text{ m}}{1.67 \times 10^{-27} \text{ kg}}} \]

\[ = \sqrt{8.3 \times 10^5 \text{ m/s}} \]
Example 2 – An electron is launched at a 45° angle with a speed of $5.0 \times 10^6$ m/s from the positive plate of the parallel-plate capacitor shown. The electron lands 4.0 cm away. $v_x = 5.0 \times 10^6 \cos 45°$ $v_yi = 5.0 \times 10^6 \sin 45°$

What is the electric field strength inside the capacitor?

What is the smallest possible spacing between the plates?

$\boxed{E = 3.6 \times 10^3 \text{ N/C}}$
Example 3 – Dipole Problem

Three charges are placed at the corners of the triangle as shown in the figure below.

Is the triangle in equilibrium? If so, explain why. If not, draw the equilibrium orientation.

\[ \vec{F} = \vec{p} \times \vec{E} = pE \sin 90^\circ \]

Net force zero \( \rightarrow \) equal + and -

Net torque = \( pE \) since \( p \) and \( E \) \( \perp \)

In equilibrium, will the triangle move to the right, to the left, or remain in place? Explain.

Remain in place but will rotate 

\( \vec{p} \times \vec{E} \)

Counter clockwise
Example 4 – The figures show two cross sections of two infinitely long coaxial cylinders. The inner cylinder has a positive charge, the outer cylinder has an equal negative charge. Draw the correct electric field vectors using symmetry.

Side view

End view
Example 5

What type of net charge does the box below possess?

In: \(15 + 15 + 20 = 50\) \(\rightarrow\) Net is \(5 \frac{N}{C}\) in.

\[\text{out: } 10 + 15 + 20 = 45\]

\(\text{negative charge}\)

Field strengths in \(N/C\)

What electric field strength must be present through the front if a negative charge is inside? Which direction?

\[\text{In: } 15 + 20 = 35 \quad \text{There needs to move than}\]

\[\text{out: } 10 + 10 + 20 = 40 \quad 5 \frac{N}{C}\text{ in through the front.}\]