1) Charges $q_1 = 250 \text{nC}$ and $q_2 = -250 \text{nC}$ are separated by a distance $L = 6.0 \text{ cm}$ (see below). What is the electric field at position $(x,y) = (L/2,0)$, exactly half way between the charges?

Say $q_1 = +q$ and $q_2 = -q$. 

\[
E_1 = k \frac{q_1}{(L/2)^2} = 4k \frac{250 \times 10^{-9}}{L^2} = 2.5 \times 10^{-6} \frac{\text{N}}{\text{C}}
\]

\[
E_2 = k \frac{q_2}{L^2} = 4k \frac{-250 \times 10^{-9}}{L^2} = 2.5 \times 10^{-6} \frac{\text{N}}{\text{C}}
\]

\[
L = 0.060 \text{ m}
\]

\[
\vec{E} = \vec{E}_1 + \vec{E}_2 = (2.5 \times 10^{-6} \frac{\text{N}}{\text{C}}) \hat{i} + (-2.5 \times 10^{-6} \frac{\text{N}}{\text{C}}) \hat{i}
\]

\[
\vec{E} = (5.0 \times 10^{-6} \frac{\text{N}}{\text{C}}) \hat{i}
\]

2) An electron is placed in an electric field $\vec{E} = (3.0 \times 10^{-6} \frac{\text{N}}{\text{C}}) \hat{j}$. What is its acceleration?

\[
F = q \vec{E}, \quad q = -e, \quad e = 1.602 \times 10^{-19} \text{ C},
\]

\[
F = -(1.602 \times 10^{-19} \text{ C}) (3.0 \times 10^{-6} \frac{\text{N}}{\text{C}}) \hat{j}
\]

\[
F = (4.81 \times 10^{-29} \text{ N}) \hat{j}
\]

\[
\vec{F} = m \vec{a}, \quad \Rightarrow \vec{a} = \frac{\vec{F}}{m} = -(4.81 \times 10^{-29} \text{ N}) \hat{j}
\]

\[
= -(5.3 \times 10^5 \frac{\text{m}}{\text{s}^2}) \hat{j}
\]
SP212 Quiz 2 Extra Credit

Name:

A thin rod of length \( L = 20.0 \text{ cm} \) and uniformly distributed charge \(-q\), where \( q = 755 \text{nC} \), is situated on the \( x\)-axis of a coordinate system. What is the electric field produced by this rod at point \( P \), located a distance \( a = 10.0 \text{ cm} \) from the end of the rod?

\[ r = L + a - x \]

\( \lambda = \frac{-q}{L} \)

\[ dq = \lambda dx = -\frac{q}{L} dx \]

\[ dE = -k \frac{dq}{r^2} = -k \frac{\frac{q}{L} dx}{(L+a-x)^2} \]

\[ E = \int dE = -k \frac{q}{L} \int_0^L \frac{dx}{(L+a-x)^2} = -k \frac{q}{L} \frac{L}{a(a+L)} \]

\[ \hat{E} = -k \frac{q}{a(a+L)} \hat{\imath} \]

\[ E = -(8.99 \times 10^9 \text{ N} \text{ m}^2/\text{C}^2) \frac{755 \times 10^{-9} \text{ C}}{(0.10 \text{ m})(0.10 \text{ m} + 0.20 \text{ m})} \hat{\imath} \]

\[ = -(2.26 \times 10^3 \text{ N/C}) \hat{\imath} \]