

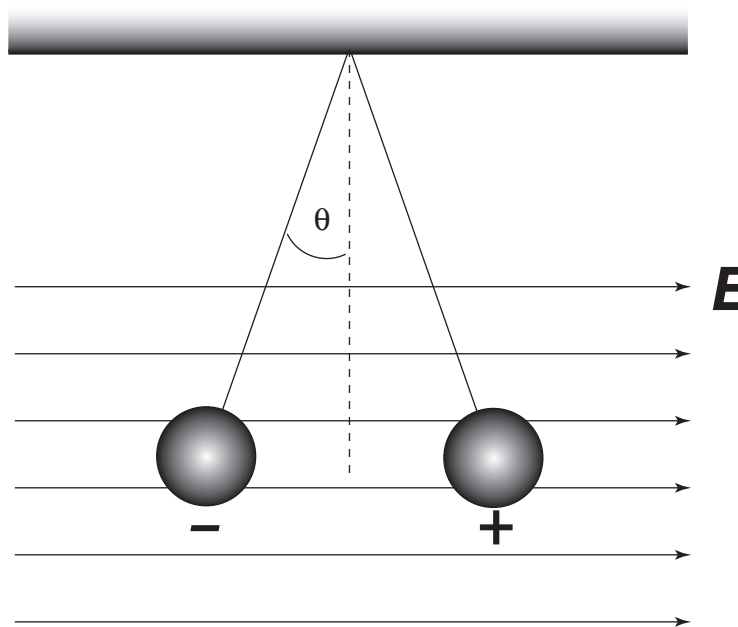
Problem Session

Electric Field

1. An isolated system of four point charges is distributed as follows

	Charge	Location
q_1	$-10 \mu\text{C}$	$(0,-6) \text{ m}$
q_2	$+8 \mu\text{C}$	$(8,-3) \text{ m}$
q_3	$-12 \mu\text{C}$	$(-6,2) \text{ m}$
q_4	$+14 \mu\text{C}$	$(8,6) \text{ m}$

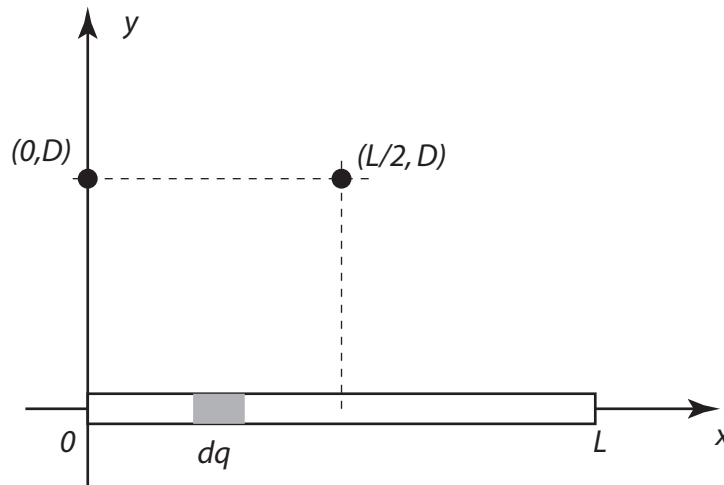
- a) Determine the electric field at the point where q_3 is located.
 b) What is the resultant electric force acting on q_3 ?
2. Two small spheres each of mass 2 g are suspended by light strings 10 cm in length. A uniform electric field is applied in the positive x -direction. The left sphere has a charge of $-5 \times 10^{-8} \text{ C}$, and the right a charge of $+5 \times 10^{-8} \text{ C}$. Determine the electric field intensity that enables the sphere to be in static equilibrium when the angle θ is 10° . (drawing is not to scale).



3. A thin glass rod is bent into a semicircle of radius $R = 60$ cm. A charge $Q = +8 \mu\text{C}$ is uniformly distributed along the upper half and a charge $Q = -8 \mu\text{C}$ is uniformly distributed along the lower half. Find the electric field at the center of the semicircle.

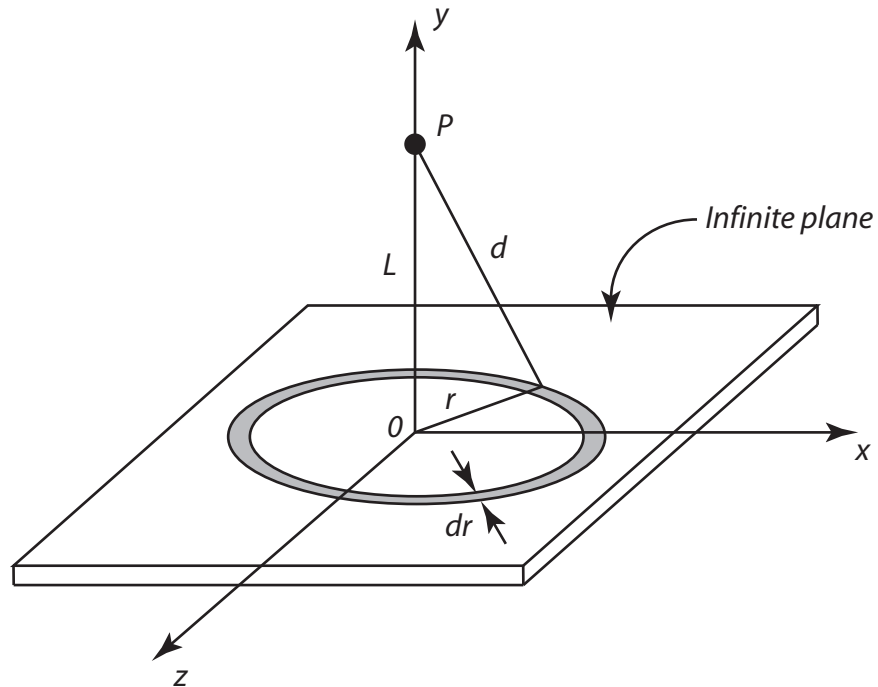


4. A total charge Q is distributed uniformly over a rod of length L . The rod is aligned on the x -axis, with one end at the origin and the other at the point $x = L$.



- a) Calculate the electric field at a point $(0, D)$, and
 b) compare this result to the field at point $(L/2, D)$.

5. Calculate the electric field due to an infinite thin plane of charge density σ . Use the following figure to set up the calculation. **Use a result derived in class as your starting point.** Write your final result in terms of ϵ_0 , the permittivity of vacuum. I remind you that $k = 1/4\pi\epsilon_0$.



Answers

1. a) 843.9 N/C at 246.4°
b) 0.01 N at 66.4°
2. 4.4×10^5 N/C
3. 2.55×10^5 N/C in the negative y-direction.
4. a) $\vec{E} = \left[\frac{k\lambda}{\sqrt{L^2 + D^2}} - \frac{k\lambda}{D} \right] \hat{i} + \frac{k\lambda L}{D\sqrt{L^2 + D^2}} \hat{j}$
b) $\vec{E} = \frac{2k\lambda L}{D\sqrt{4D^2 + L^2}} \hat{j}$
5. $\frac{\sigma}{2\epsilon_0} \hat{j}$