**Electrostatics**

\[ E = \frac{kq}{r^2}, \quad k = 9.0 \times 10^9 \, \text{N} \cdot \text{m}^2/\text{C}^2 \]

If you need a refresher on vectors, visit [http://hyperphysics.phy-astr.gsu.edu/hbase/vect.html](http://hyperphysics.phy-astr.gsu.edu/hbase/vect.html) or any other suitable resource.

1. **Charge Distribution.** A large positive charge is brought in proximity to a conductor, as shown in figure 1.

   ![Figure 1](image)

   a) Using **plus and minus** signs, draw into the rectangular conductor the induced charge distribution. [1 pt]

   b) Add a few arrows representing the electric field. [1 pt]

   c) Would there be any forces between the charge and the conductor? Why? [2 pts]

   Yes, the induced negative charge on the conductor would pull stronger than the induced positive charge would repel since it is closer.
2. **Superposition.** Two charges are arranged as shown in figure 2.

![Figure 2](image)

-10 \( \mu C \)

![\( 100 \text{ m} \)]

\( P \) \( 300 \text{ m} \)

+90 \( \mu C \)

a) Using an arrow, represent the electric field at point P due to the positive charge. [1 pt]

b) Calculate the **magnitude** of the electric field at point P. [2 pts]

\[
E = \frac{k(10 \ \mu C)}{(100 \text{ m})^2} + \frac{k(90 \ \mu C)}{(300 \text{ m})^2} = 9 + 9 = 18 \text{ N}
\]

3. **Decay of electric field.** A positive point charge is alone in free space. The magnitude of the electric field at a distance 8 meters from the charge is 10 N/C.

![Figure 3](image)

![\( 3 \text{ m} \)]

\( Q \) \( 4 \text{ m} \)

\( P \)

a) What is the **magnitude** of the electric field at point P? [1 pt]

\[
E(r = 5 \text{ m}) = \frac{(8 \text{ m})^2}{(4 \text{ m})^2} E(r = 8 \text{ m}) = 40 \text{ N/C}
\]

b) What is the **magnitude** of the electric field at point Q? [2 pts]

\[
r = \sqrt{3^2 + 4^2} = 5 \text{ m} \Rightarrow E(r = 5 \text{ m}) = \frac{(8 \text{ m})^2}{(5 \text{ m})^2} E(r = 8 \text{ m}) = \frac{128}{5} N = 25.6 \text{ N}
\]