PHYS 111
1ST semester 1439-1440

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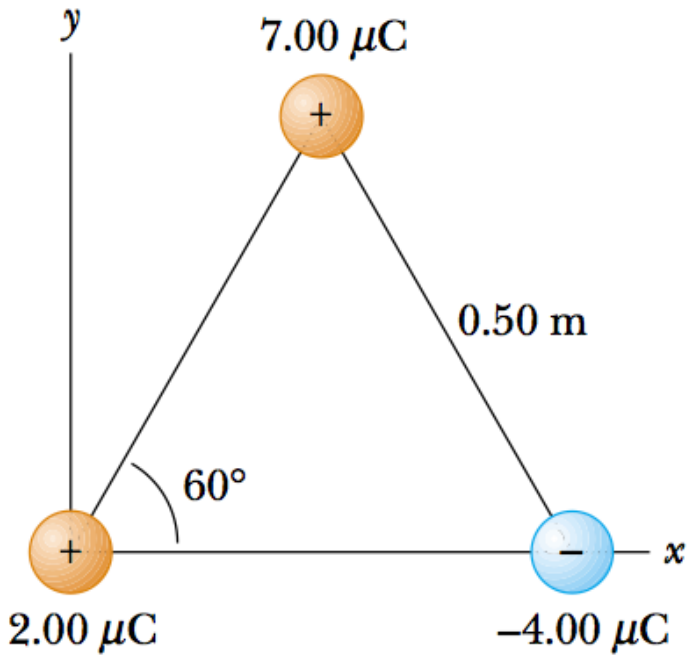
Lecture 3

Problem (Electric Force)

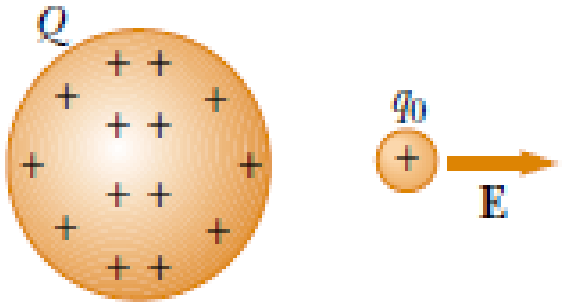
- Three point charges are located at the corners of an equilateral triangle as shown in the Figure. Calculate the resultant electric force on the 7.00μC charge.



23.4 The Electric Field

- an **electric field** is said to exist in the region of space around a charged object—the **source charge.** When another charged object—the **test charge**—enters this electric field, an electric force acts on it.
- **The electric field vector E** at a point in space is defined as the electric force $\mathbf{F}_e$ acting on a positive test charge q_0 placed at that point divided by the test charge:

$$\mathbf{E} \equiv \frac{\mathbf{F}_e}{q_0}$$

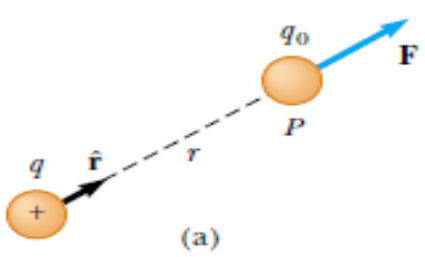


23.4 The Electric Field

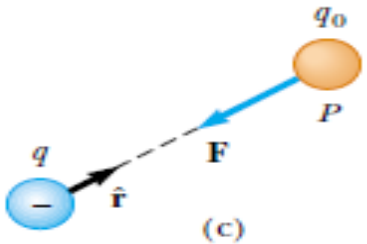
- The force on a charged particle placed in an electric field.

$$\mathbf{F}_e = q\mathbf{E}$$

- If *q* is positive, the force is in the same direction as the field. If *q* is negative, the force and the field are in opposite directions.



(a)



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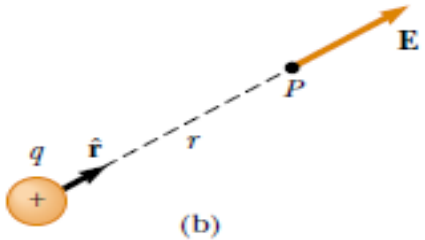

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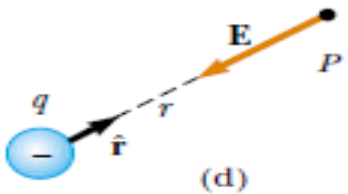


(d)

23.4 The Electric Field

- According to Coulomb's law, the force exerted by q on the test charge is

$$\mathbf{F}_e = k_e \frac{q q_0}{r^2} \hat{\mathbf{r}}$$

- where $\hat{\mathbf{r}}$ is a unit vector directed from q toward q_0.
- The electric field created by q at P is

$$\mathbf{E} = k_e \frac{q}{r^2} \hat{\mathbf{r}}$$

23.4 The Electric Field

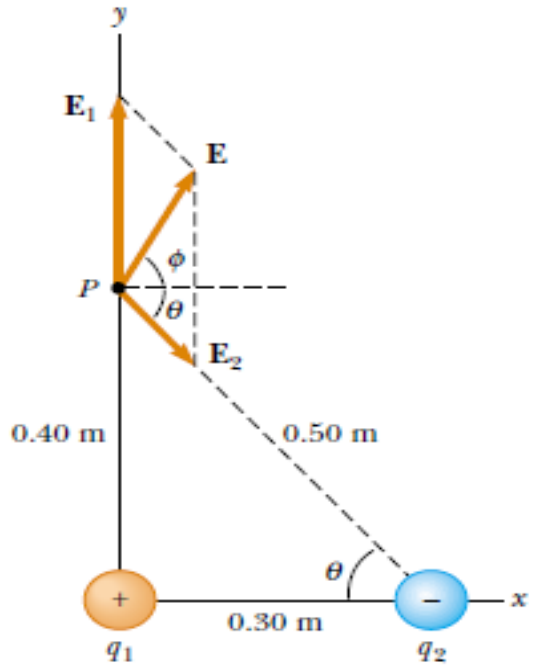
- at any point *P*, the total electric field due to a group of source charges equals the vector sum of the electric fields of all the charges.

$$\mathbf{E} = k_e \sum_i \frac{q_i}{r_i^2} \hat{\mathbf{r}}_i$$

- where r_i is the distance from the *i* th source charge q_i to the point *P* and $\hat{\mathbf{r}}_i$ is a unit vector directed from q_i toward *P*.

Example 23.5 **Electric Field Due to Two Charges**

A charge $q_1 = 7.0\ \mu C$ is located at the origin, and a second charge $q_2 = -5.0\ \mu C$ is located on the x axis, 0.30 m from the origin (Fig. 23.14). Find the electric field at the point P, which has coordinates (0, 0.40) m.



Example 1

- Calculate the magnitude and direction of an electric field at a point 30 cm from a source charge of $Q = -3.0 \times 10^{-6}$ C.

Example 2

- Two point charges are separated by a distance of 10.0 cm. What is the magnitude and direction of the electric field at point P, 2.0 cm from the negative charge?