

13 Chapter 13: Electric Field

Q01:

Solution:

The relationship is that the force by an electric field on a particle of charge q is $\vec{F}_{\text{on particle due to } \vec{E}} = q\vec{E}$. The unit of force is newtons (N) and the unit of electric field is newtons per coulomb (N/C).

Q02:

Solution:

- (a) At location P, hold the charged object and release it from rest at one end of the meterstick. Watch the direction of motion and then align the meterstick along this direction. Again, release the object from rest from the end of the meterstick. Measure the time elapsed (on the stopwatch) as it travels a small distance along the meterstick. What is small? It depends on the average acceleration of the object. If its acceleration is small, then 1 m will be fine. If its acceleration is large, then perhaps 0.1 m should be used. The astronaut should measure the distance travelled d and the time interval Δt . A good experimentalist will make the measurement for multiple trials and calculate the average time elapsed.
- (b) The force on the particle may not be constant (because the electric field at the location of the object may be different as the object moves). However, for a small time interval, we will assume constant force. Define the $+x$ direction to be the direction of motion of the object. Use the following procedure to calculate the electric field:
 - (1) Use $v_{\text{avg},x} = d/\Delta t$ to calculate the average x-velocity of the object.
 - (2) Use $v_{\text{avg},x} = (v_i + v_f)/2$ to calculate the final x-velocity of the object.
 - (3) Use the Momentum Principle to calculate the net force on the object. $F_x = M\Delta v_x/\Delta t$.
 - (4) Use $\vec{F} = q\vec{E}$ to calculate the electric field.

Note that this procedure only works for small time interval because we are assuming a constant net force on the object.

Q03:

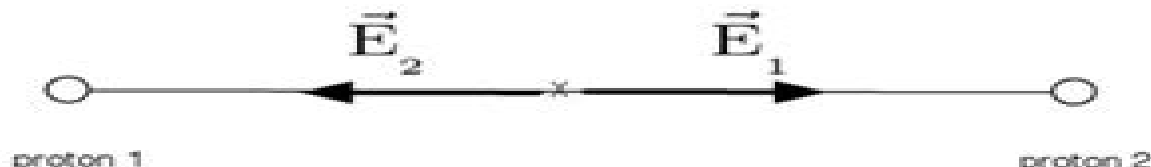
Solution:

A particle cannot exert a force on itself. In the equation $\vec{F} = q\vec{E}$, the electric field at the location of the particle q is due to *other* charges.

Q04:

Solution:

The simplest case is two equally charged particles in opposite directions and equidistant from the point where the net electric field is zero. See the figure below.



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