

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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Table of Contents Matter And Interactions 2 Instructor Solutions Manual

1. Understanding the eBook Matter And Interactions 2 Instructor Solutions Manual
 - The Rise of Digital Reading Matter And Interactions 2 Instructor Solutions Manual
 - Advantages of eBooks Over Traditional Books
2. Identifying Matter And Interactions 2 Instructor Solutions Manual
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Matter And Interactions 2 Instructor Solutions Manual
 - User-Friendly Interface
4. Exploring eBook Recommendations from Matter And Interactions 2 Instructor Solutions Manual
 - Personalized Recommendations
 - Matter And Interactions 2 Instructor Solutions Manual User Reviews and Ratings
 - Matter And Interactions 2 Instructor Solutions Manual and Bestseller Lists
5. Accessing Matter And Interactions 2 Instructor Solutions Manual Free and Paid eBooks
 - Matter And Interactions 2 Instructor Solutions Manual Public Domain eBooks
 - Matter And Interactions 2 Instructor Solutions Manual eBook Subscription Services
 - Matter And Interactions 2 Instructor Solutions Manual Budget-Friendly Options

6. Navigating Matter And Interactions 2 Instructor Solutions Manual eBook Formats
 - ePub, PDF, MOBI, and More
 - Matter And Interactions 2 Instructor Solutions Manual Compatibility with Devices
 - Matter And Interactions 2 Instructor Solutions Manual Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Matter And Interactions 2 Instructor Solutions Manual
 - Highlighting and Note-Taking Matter And Interactions 2 Instructor Solutions Manual
 - Interactive Elements Matter And Interactions 2 Instructor Solutions Manual
8. Staying Engaged with Matter And Interactions 2 Instructor Solutions Manual
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Matter And Interactions 2 Instructor Solutions Manual
9. Balancing eBooks and Physical Books Matter And Interactions 2 Instructor Solutions Manual
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Matter And Interactions 2 Instructor Solutions Manual
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Matter And Interactions 2 Instructor Solutions Manual
 - Setting Reading Goals Matter And Interactions 2 Instructor Solutions Manual
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Matter And Interactions 2 Instructor Solutions Manual
 - Fact-Checking eBook Content of Matter And Interactions 2 Instructor Solutions Manual
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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