CENGAGE | WEBASSIGN

tgillette@mail.fresnostate.edu
(sign out)

Home My Assignments
Grades Communication
Calendar
My eBooks

PHYS-2B, section 34945, Spring 2020

INSTRUCTOR
John Walkup
California State University Fresno

Coulomb's Law and E Fields (Homework)

Current Score

QUESTION	1	2	3	4	5	6	7	8	9	10	11	12
POINTS	1/1	0/2	2/2	2/2	3/3	2/4	1/1	2/2	3/3	2/2	1/3	2/4

TOTAL SCORE

21/29	72.4%

Due Date Past Due

TUE, JAN 28, 2020
11:59 PM PST

Request Extension

Assignment Submission & Scoring

Assignment Submission

For this assignment, you submit answers by question parts. The number of submissions remaining for each question part only changes if you submit or change the answer.

Assignment Scoring

Your last submission is used for your score.

The due date for this assignment has passed.

Your work can be viewed below, but no changes can be made.

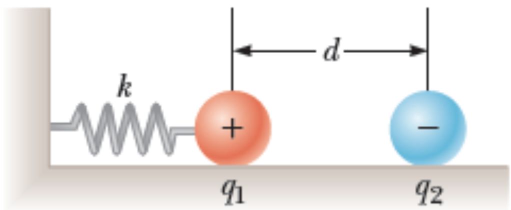
Important! Before you view the answer key, decide whether or not you plan to request an extension. Your Instructor may not grant you an extension if you have viewed the answer key. Automatic extensions are not granted if you have viewed the answer key.

Request Extension

1. 1/1 points Previous Answers **SERCP11 15.2.P.012.**

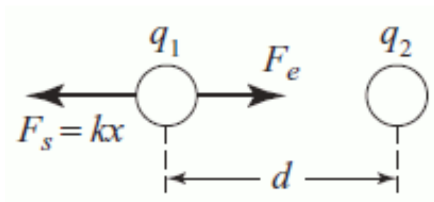
My Notes Ask Your Teacher

A positive charge q_1 = 2.65 μC on a frictionless horizontal surface is attached to a spring of force constant k as in the figure shown below. When a charge of q_2 = −8.500 μC is placed 9.50 cm away from the positive charge, the spring stretches by 5.00 mm, reducing the distance between charges to d = 9.00 cm. Find the value of k.



5E3 5000 N/m

Solution or Explanation



At equilibrium, $\sum F_x = F_e - F_s = 0$ or $F_s = F_e$.

Thus,

$$kx = \frac{k_e|q_1q_2|}{d^2}$$

and the force constant of the spring is

$$k = \frac{k_e|q_1q_2|}{xd^2} = \frac{(8.99 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(2.65 \times 10^{-6}\ \text{C})(-8.50 \times 10^{-6}\ \text{C})}{(5.00 \times 10^{-3}\ \text{m})(9.00 \times 10^{-2}\ \text{m})^2}$$

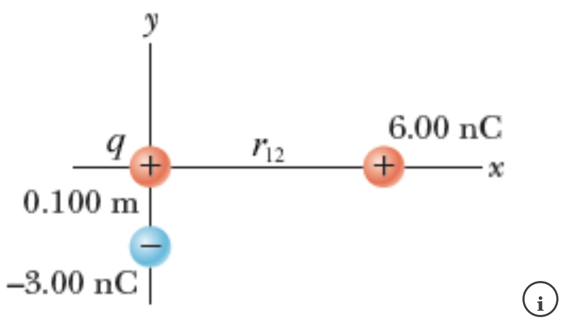
$$k = 5.00 \times 10^3\ \text{N/m}.$$

Need Help? Read It

2. 0/2 points Previous Answers **SERCP11 15.2.P.011.MI.**

My Notes Ask Your Teacher

Three charges are arranged as shown in the figure below. Find the magnitude and direction of the electrostatic force on the charge q = 5.04 nC at the origin. (Let r_{12} = 0.275 m.)



magnitude 1.3E-5 ✗ 1.41e-05
Your incorrect answer may have resulted from roundoff error. Make sure you keep extra significant figures in intermediate steps of your calculation. N

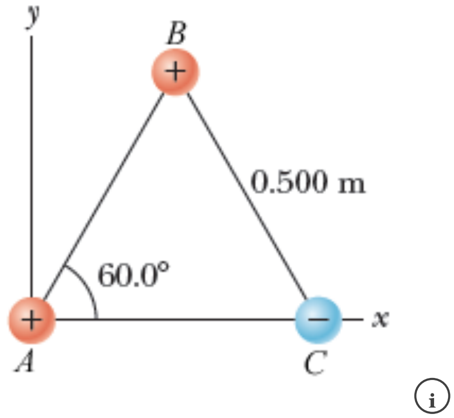
direction 95 ✗ -105
Examine the diagram and determine which quadrant contains the angle of the net force.° counterclockwise from the +x-axis

Need Help? Read It Master It

3. 2/2 points Previous Answers **SERCP11 15.2.OP.013.**

My Notes Ask Your Teacher

The figure below shows three small, charged spheres at the corners of an equilateral triangle. Sphere A has a charge of 1.40 μC; B has a charge of 5.50 μC; and C has a charge of −5.16 μC. Each side of the triangle is 0.500 m long. What are the magnitude and direction of the net electric force on A? (Enter the magnitude in N and the direction in degrees below the +x-axis.)

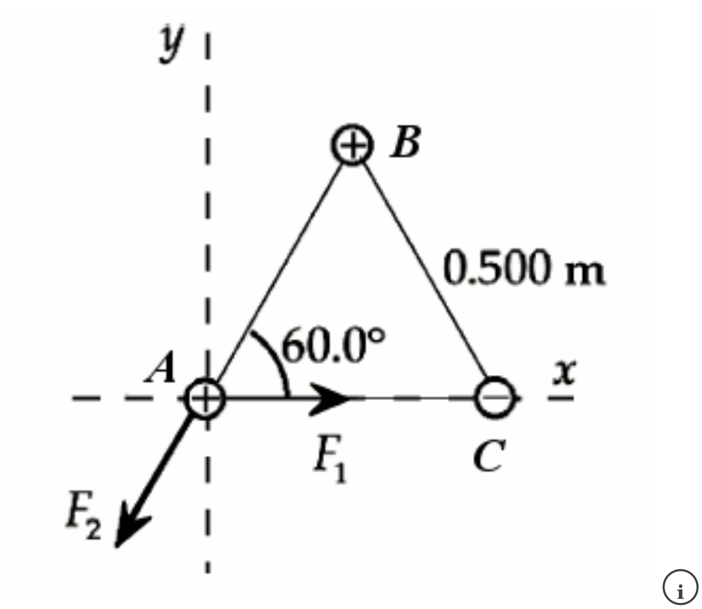


magnitude 2.69E-1 0.269 N

direction 63.1 63.2 ° below the +x-axis

Solution or Explanation

Please see the sketch below.



$$F_1 = \frac{(8.99 \times 10^9\ \text{N} \cdot \text{m}^2/\text{C}^2)(1.40 \times 10^{-6}\ \text{C})(5.16 \times 10^{-6}\ \text{C})}{(0.500\ \text{m})^2}$$

or

$$F_1 = 0.260\ \text{N}$$

$$F_2 = \frac{(8.99 \times 10^9\ \text{N} \cdot \text{m}^2/\text{C}^2)(1.40 \times 10^{-6}\ \text{C})(5.50 \times 10^{-6}\ \text{C})}{(0.500\ \text{m})^2}$$

or

$$F_2 = 0.277 \text{ N}.$$

The components of the resultant force acting on the 1.40 μC charge are

$$F_x = F_1 - F_2 \cos(60.0°) = 0.260 \text{ N} - (0.277 \text{ N}) \cos(60.0°) = 0.121 \text{ N}$$

and

$$F_y = -F_2 \sin(60.0°) = -(0.277 \text{ N}) \sin(60.0°) = -0.240 \text{ N}.$$

The magnitude and direction of this resultant force are

$$F = \sqrt{F_x^{\ 2} + F_y^{\ 2}} = \sqrt{(0.121 \text{ N})^2 + (-0.240 \text{ N})^2} = 0.269 \text{ N}$$

at

$$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = \tan^{-1}\left(\frac{-0.240 \text{ N}}{0.121 \text{ N}}\right) = -63.2°$$

or 63.2° below the +*x*-axis.

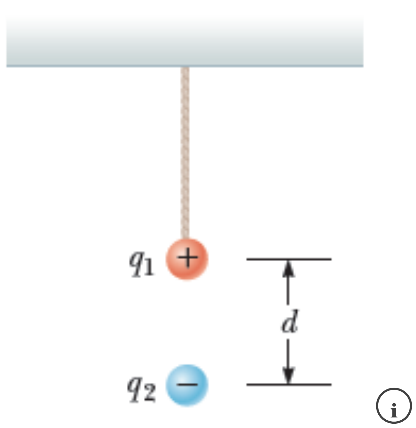
Need Help? Read It

---

4. 2/2 points Previous Answers **SERCP11 15.2.OP.004.**

My Notes Ask Your Teacher

The figure below shows a small, hollow, plastic sphere hanging vertically from a thin, lightweight string. The sphere has a mass of 6.40 g and a uniformly distributed charge of q_1 = 30.4 nC. Directly below it is a second sphere with the same mass, but a charge of q_2 = −58.0 nC. (Assume this second sphere is fixed in place.) The centers of the two plastic spheres are a distance *d* = 2.00 cm apart.



(a) What is the tension (in N) in the string?

1.02E-1 ✔ 0.102 N

(b) The string will break if the tension in it exceeds 0.180 N. What is the smallest possible value of *d* (in cm) before the string breaks?

1.16 ✔ 1.16 cm

Solution or Explanation

(a) The gravitational force exerted on the upper sphere by the lower one is negligible in comparison to the gravitational force exerted by the Earth and the downward electrical force exerted by the lower sphere. Therefore,

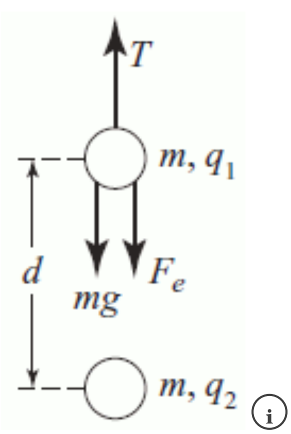
$$\sum F_y = 0 \Rightarrow T - mg - F_e = 0$$

or

$$T = mg + \frac{k_e|q_1||q_2|}{d^2}$$

$$T = (6.40 \times 10^{-3}\text{ kg})(9.80\text{ m/s}^2) + \frac{(8.99 \times 10^9\text{ N} \cdot \text{m}^2/\text{C}^2)(30.4 \times 10^{-9}\text{ C})(58.0 \times 10^{-9}\text{ C})}{(2.00 \times 10^{-2}\text{ m})^2}$$

giving $T = 0.102$ N.



(b) $\sum F_y = 0 \Rightarrow F_e = k_e \dfrac{q_1 q_2}{d^2} = T - mg$, and $d = \sqrt{\dfrac{k_e|q_1||q_2|}{T - mg}}$

Thus, if $T = 0.180$ N,

$$d = \sqrt{\frac{(8.99 \times 10^9\ \text{N} \cdot \text{m}^2/\text{C}^2)(30.4 \times 10^{-9}\ \text{C})(58.0 \times 10^{-9}\ \text{C})}{0.180\ \text{N} - (6.40 \times 10^{-3}\ \text{kg})(9.80\ \text{m/s}^2)}} = 1.16 \times 10^{-2}\ \text{m} = 1.16\ \text{cm}.$$

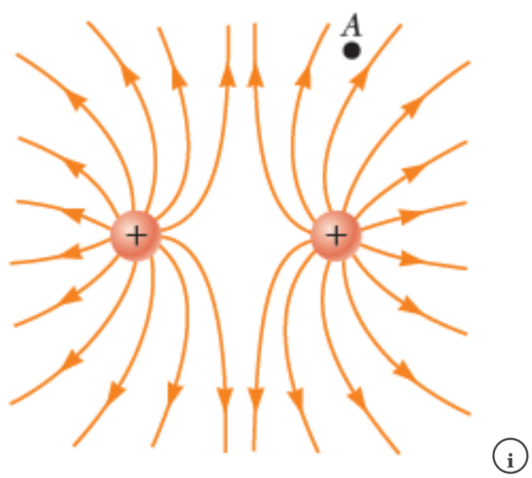
Need Help? Read It

---

5. 3/3 points Previous Answers **SERCP11 15.CQ.008.**

My Notes Ask Your Teacher

Consider point *A* in the figure below located an arbitrary distance from two point charges in otherwise empty space.



(a) Is it possible for an electric field to exist at point *A* in empty space?

- (●) Yes
- ( ) No

(b) Does charge exist at this point?

- Yes
- No ✓

(c) Does a force exist at this point?

- Yes
- No ✓

Need Help? Read It

---

6. 2/4 points Previous Answers **SERCP11 15.CQ.007.**

My Notes Ask Your Teacher

Positive charge Q is located at the center of a hollow, conducting spherical shell.

HINT

(a) Is the induced charge Q_{inner} on the inner surface of the shell positive or negative?

- positive
- negative ✓

(b) Is the induced charge Q_{outer} on the outer surface of the shell positive or negative?

- positive
- negative

✓

(c) Determine the ratio $\frac{Q_{\text{inner}}}{Q}$.

-Q ✖ -1

(d) Determine the ratio $\frac{Q_{\text{outer}}}{Q}$.

+Q ✖ 1

Solution or Explanation

(a) The positive charge at the center attracts an equal magnitude of negative charge to the inner surface, resulting in zero electric field inside the conductor. The correct answer is negative.

(b) By Gauss' law, the outer surface acquires a positive induced charge equal to the charge at the center. The correct answer is positive.

(c) Q_{inner} has the same magnitude and opposite sign as Q so that $\frac{Q_{\text{inner}}}{Q} = -1$.

(d) Q_{outer} has the same magnitude and sign as Q so that $\frac{Q_{\text{outer}}}{Q} = 1$.

Need Help? Read It

7. 1/1 points Previous Answers **SERCP11 15.CQ.015.**

My Notes Ask Your Teacher

If more electric field lines leave a Gaussian surface than enter it, what can you conclude about the net charge enclosed by that surface?

- ○ Not enough information is given to decide.
- ○ The surface must enclose a negative net charge.
- ● The surface must enclose a positive net charge. ✓

Need Help? Read It

8. 2/2 points Previous Answers **SERCP11 15.3.OP.017.**

My Notes Ask Your Teacher

A small piece of foam has a mass of 4.16 g and a charge of −16.6 μC. It levitates, motionless, when placed in a uniform electric field perpendicular to the ground.

What is the magnitude of the electric field (in N/C)?

2460 ✓ 2460 N/C

What is the direction of the electric field?

- ○ upward
- ● downward
- ○ east
- ○ west

✓

Solution or Explanation

In order to suspend the object in the electric field, the electric force exerted on the object by the field must be directed upward and have a magnitude equal to the weight of the object. Thus. $F_e = qE = mg$, and the magnitude of the electric field must be

$$E = \frac{mg}{|q|} = \frac{(4.16\ \cancel{\text{g}})(9.80\ \text{m/s}^2)}{16.6 \times 10^{-6}\ \text{C}}\left(\frac{1\ \text{kg}}{10^3\ \cancel{\text{g}}}\right) = 2460\ \text{N/C}.$$

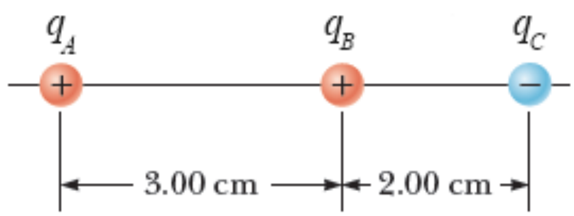
The electric force on a negatively charged object is in the direction opposite to that of the electric field. Since the electric force must be directed upward, the electric field must be directed downward.

Need Help? Read It

9. 3/3 points Previous Answers SERCP11 15.3.OP.018.

My Notes Ask Your Teacher

The figure below shows three small, charged beads, all lying along the horizontal axis. Bead *A*, at left, has a 6.65 nC charge. Bead *B* has a 1.00 nC charge and is 3.00 cm to the right of *A*. Bead *C* has a −2.35 nC charge and is 2.00 cm to the right of *B*.



(a) What is the magnitude (in N/C) of the electric field at a point 2.00 cm to the right of *A*?

83032.6 ✔ 83000 N/C

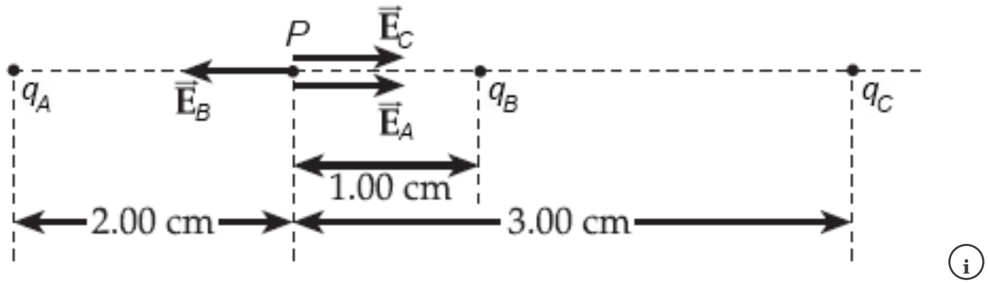
(b) A fourth bead with a charge of −5.00 nC is placed at this point. What are the magnitude (in N) and direction of the net electric force on it?

magnitude .000415 ✔ 0.000415 N

direction toward the left ✔ toward the left

Solution or Explanation

(a) Let's draw the electric field vectors due to each individual charge at point P, which is 2.00 cm to the right of A. The electric field of a charged particle points away from the particle if it is positively charged and toward it if it is negatively charged. We therefore have E_A pointing right, E_B pointing left, and E_C pointing right at P.



If the positive x-direction is to the right, the x-component of the net electric field is then given by

$$E_{\text{net}, x} = E_A - E_B + E_C$$

where E_A, E_B, and E_C are all positive magnitudes.

The magnitude of the electric field of a charged particle is given by

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

which we can substitute into the equation above, as shown below.

$$E_{\text{net}, x} = \frac{k_e|q_A|}{r_{AP}^{\ 2}} - \frac{k_e|q_B|}{r_{BP}^{\ 2}} + \frac{k_e|q_C|}{r_{CP}^{\ 2}}$$

$$E_{\text{net}, x} = k_e\left(\frac{|q_A|}{r_{AP}^{\ 2}} - \frac{|q_B|}{r_{BP}^{\ 2}} + \frac{|q_C|}{r_{CP}^{\ 2}}\right)$$

$$E_{\text{net}, x} = \left(8.99 \times 10^9 \ \frac{\text{N} \cdot \text{m}^2}{\text{C}^2}\right)\left(\frac{6.65 \times 10^{-9} \text{ C}}{(0.0200 \text{ m})^2} - \frac{1.00 \times 10^{-9} \text{ C}}{(0.0100 \text{ m})^2} + \frac{2.35 \times 10^{-9} \text{ C}}{(0.0300 \text{ m})^2}\right)$$

$$E_{\text{net}, x} = 8.30 \times 10^4 \text{ N/C}$$

The magnitude of the net electric field is then 8.30×10^4 N/C. Because the x-component is positive, the field points to the right.

(b) The *x*-component of the electric force is given by the following.

$$F_x = qE_{\text{net}, x}$$

Plugging in the values,

$$F_x = (-5.00 \times 10^{-9}\ \text{C})(8.30 \times 10^{4}\ \text{N/C}) = -4.15 \times 10^{-4}\ \text{N}.$$

The magnitude is then 4.15×10^{-4}. Because the *x*-component is negative, the force points to the left. Note the negative charge means the force points in the opposite direction of the electric field at that location.

Need Help? Read It

10. 2/2 points Previous Answers **SERCP11 15.3.OP.020.**

My Notes Ask Your Teacher

Inside a cathode ray tube, an electron is in the presence of a uniform electric field with a magnitude of 285 N/C.

(a) What is the magnitude of the acceleration of the electron (in m/s^2)?

5.00549e13 ✔ 5.01e+13 m/s^2

(b) The electron is initially at rest. What is its speed (in m/s) after 1.05×10^{-8} s?

5.26e5 ✔ 5.26e+05 m/s

Solution or Explanation

Note: We are displaying rounded intermediate values for practical purposes. However, the calculations are made using the unrounded values.

(a) The magnitude of the force on the electron is $F = |q|E = eE$, and the acceleration is computed as follows.

$$a = \frac{F}{m_e} = \frac{eE}{m_e} = \frac{(1.60 \times 10^{-19}\text{ C})(285\text{ N/C})}{(9.11 \times 10^{-31}\text{ kg})} = 5.01 \times 10^{13}\text{ m/s}^2$$

(b) We can then use the acceleration to find the electron's speed.

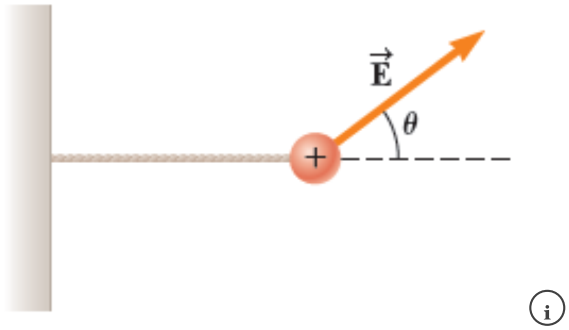
$$v = v_0 + at = 0 + (5.01 \times 10^{13}\text{ m/s}^2)(1.05 \times 10^{-8}\text{ s}) = 5.26 \times 10^{5}\text{ m/s}$$

Need Help? Read It

11. 1/3 points Previous Answers **SERCP11 15.3.P.022.**

My Notes Ask Your Teacher

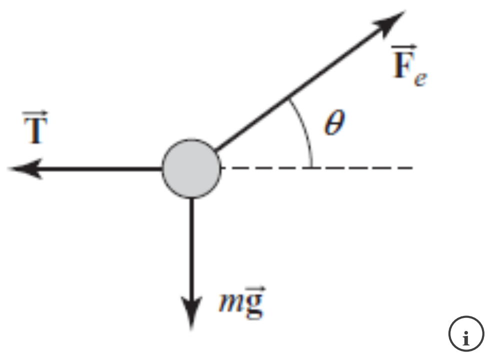
A small sphere of charge q = +66 μC and mass m = 5.3 g is attached to a light string and placed in a uniform electric field $\vec{\mathbf{E}}$ that makes an angle θ = 33° with the horizontal. The opposite end of the string is attached to a wall and the sphere is in static equilibrium when the string is horizontal as in the figure shown below.



(a) Construct a free body diagram for the sphere. (Submit a file with a maximum size of 1 MB.)

11.png

Key:



Score: 1 out of 1

Comment:

(b) Find the magnitude of the electric field.

1280 ✗ 1440

Your response differs from the correct answer by more than 10%. Double check your calculations. N/C

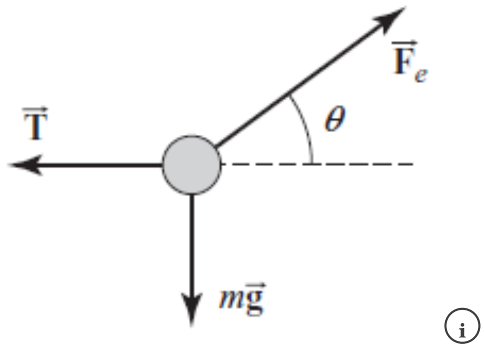
(c) Find the tension in the string. (Enter the magnitude of the tension in the string.)

.07 ✗ 0.08

Your response differs from the correct answer by more than 10%. Double check your calculations. N

Solution or Explanation

(a)



(b) $\sum F_y = 0 \Rightarrow F_e \sin(\theta) - mg = 0$ or $F_e = \dfrac{mg}{\sin(\theta)}$

Since $F_e = qE$, this gives

$$E = \frac{mg}{q\sin(\theta)} = \frac{(5.30 \times 10^{-3}\text{ kg})(9.8\text{ m/s}^2)}{(66.0 \times 10^{-6}\text{ C})\sin(33°)} = 1.44 \times 10^3\text{ N/C}$$

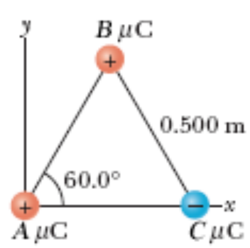
(c) $\sum F_x = 0 \Rightarrow F_e \cos(\theta) - T = 0$ or $T = F_e\cos(\theta) = \left(\dfrac{mg}{\sin(\theta)}\right)\cos(\theta) = \dfrac{mg}{\tan(\theta)}$

and $T = \dfrac{(5.30 \times 10^{-3}\text{ kg})(9.8\text{ m/s}^2)}{\tan(33°)} = 8.00 \times 10^{-2}\text{ N}$

Need Help? Read It

12. 2/4 points Previous Answers **SERCP11 15.3.P.024.**

My Notes Ask Your Teacher



(a) Three point charges, $A = 2.50$ μC, $B = 6.95$ μC, and $C = -4.75$ μC, are located at the corners of an equilateral triangle as in the figure above. Find the magnitude and direction of the electric field at the position of the 2.50 μC charge.

magnitude	*(No Response)*	2.21e+05	N/C
direction	*(No Response)*	78	° below the +x-axis

(b) How would the electric field at that point be affected if the charge there were doubled?

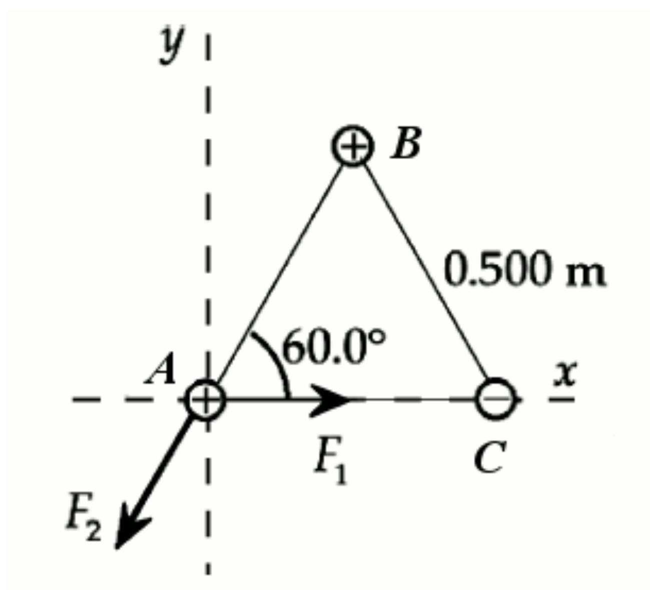
- The magnitude of the field would be halved.
- The field would be unchanged.
- The magnitude of the field would double.
- The magnitude of the field would quadruple.

Would the magnitude of the electric force be affected?

- Yes
- No

Solution or Explanation

(a) Please see the sketch below.



$$F_1 = \frac{(8.99 \times 10^9\ \text{N} \cdot \text{m}^2/\text{C}^2)(2.50 \times 10^{-6}\ \text{C})(4.75 \times 10^{-6}\ \text{C})}{(0.500\ \text{m})^2}$$

or

$F_1 = 0.427$ N

$$F_2 = \frac{(8.99 \times 10^9\ \text{N} \cdot \text{m}^2/\text{C}^2)(2.50 \times 10^{-6}\ \text{C})(6.95 \times 10^{-6}\ \text{C})}{(0.500\ \text{m})^2}$$

or

$F_2 = 0.625$ N

The components of the resultant force acting on the 2.50 μC charge are:

$$F_x = F_1 - F_2 \cos(60.0°) = 0.427\ \text{N} - (0.625\ \text{N}) \cos(60.0°) = 0.115\ \text{N}$$

and

$$F_y = -F_2 \sin(60.0°) = -(0.625\ \text{N}) \sin(60.0°) = -0.541\ \text{N}$$

The magnitude and direction of this resultant force are

$$F = \sqrt{F_x^{\ 2} + F_y^{\ 2}} = \sqrt{(0.115\ \text{N})^2 + (-0.541\ \text{N})^2} = 0.553\ \text{N}$$

$$\text{at } \theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = \tan^{-1}\left(\frac{-0.541\ \text{N}}{0.115\ \text{N}}\right) = -78.0°$$

or 78.0° below the +x-axis.

Since the electric field at a location is defined as the force per unit charge experienced by a test charge placed in that location, the electric field at the origin in the charge configuration is

$$\vec{\mathbf{E}} = \frac{\vec{\mathbf{F}}}{q_0} = \frac{0.553\ \text{N}}{2.50 \times 10^{-6}\ \text{C}} \text{ at } -78.0° = 2.21 \times 10^5\ \text{N/C at } 78.0° \text{ below the } +x\text{-axis}$$

(b) The electric force experienced by the charge at the origin is directly proportional to the magnitude of that charge. Thus, doubling the magnitude of this charge would double the magnitude of the electric force. However, the electric field is the force per unit charge and the field would be unchanged if the charge was doubled. This is easily seen in the calculation of part (a) above. Doubling the magnitude of the charge at the origin would double both the numerator and the denominator of the ratio $\vec{\mathbf{F}}/q_0$, but the value of the ratio (i.e., the electric field) would be unchanged.

Need Help? Read It

[Home](#) [My Assignments](#) Request Extension