Exercise 21.14 - Enhanced - with Feedback

A positive point charge q_1 = 1.5 μC is located at x = 0, y = 0.30 m, a negative point charge q_2 = -1.5 μC is located at x = 0, y = -0.30 m. A third point charge Q = 4.0 μC is located at x = 0.40 m, y = 0.

Review | Constants

Part A

What is the magnitude of the total electric force that charges q_1 and q_2 exert on charge Q?

Express your answer in newtons.

$|F|$ = N

Submit Request Answer

Part B

What is the direction of the total electric force that charges q_1 and q_2 exert on charge Q?

Express your answer in degrees.

θ = ° clockwise from the $+x$ direction

Exercise 21.27 - Enhanced - with Solution

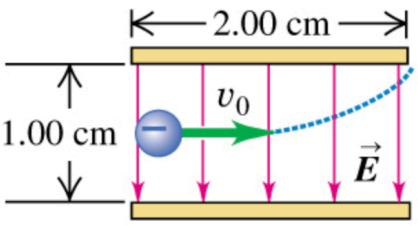
An electron is projected with an initial speed v_0 = $1.10\times10^6\ \mathrm{m/s}$ into the uniform field between the parallel plates in the figure (Figure 1). Assume that the field between the plates is uniform and directed vertically downward, and that the field outside the plates is zero. The electron enters the field at a point midway between the plates.

You may want to review (Page) .

For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of Electron in a uniform field.

Figure

1 of 1



Review | Constants

Part A

If the electron just misses the upper plate as it emerges from the field, find the magnitude of the electric field.

Express your answer in newtons per coulomb.

E = N/C

Submit Request Answer

Part B

Suppose that in the figure the electron is replaced by a proton with the same initial speed v_0. Would the proton hit one of the plates?

- yes
- no

Review | Constants

Part C

If the proton would not hit one of the plates, what would be the magnitude of its vertical displacement as it exits the region between the plates?

Express your answer in meters.

$|\Delta y| = 2.73 \times 10^{-6}$ m

Submit Previous Answers

Part D

What would be the direction of proton's displacement?

- ○ displacement is upward
- ◉ displacement is downward

Submit

Previous Answers

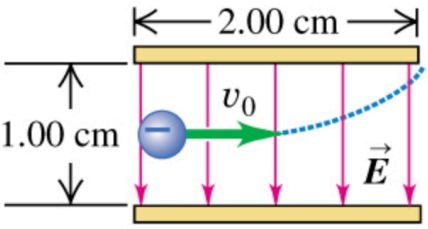
An electron is projected with an initial speed $1.00\times10^6\ \mathrm{m/s}$ into the uniform field between the parallel plates in the figure (Figure 1). Assume that the field between the plates is uniform and directed vertically downward, and that the field outside the plates is zero. The electron enters the field at a point midway between the plates.

You may want to review (Page) .

For related problem-solving tips and strategies, you may

Figure

1 of 1



Review | Constants

Part A

If the electron just misses the upper plate as it emerges from the field, find the speed of the electron as it emerges from the field?

Express your answer in meters per second.

$v =$ $1.12\times10^6\ \mathrm{m/s}$

Submit Previous Answers

Correct

IDENTIFY: Apply constant acceleration equations to the motion of the electron.

SET UP: Let $+x$ be to the right and let $+y$ be downward. The electron moves $2.00\ \mathrm{cm}$ to the right and $0.50\ \mathrm{cm}$ upward.

EXECUTE: Use the horizontal motion to find the time when the electron emerges from the field.

$x - x_0 = 0.0200\ \mathrm{m}$, $a_x = 0$, $v_{0x} = 1.00\times10^6\ \mathrm{m/s}$. $x - x_0 = v_{0x}t + \frac{1}{2}a_x t^2$ gives $t = 2.00\times10^{-8}\ \mathrm{s}$. Since $a_x = 0$, $v_x = 1.00\times10^6\ \mathrm{m/s}$. $y - y_0 = 0.0050\ \mathrm{m}$, $v_{0y} = 0$, $t = 2.00\times10^{-8}\ \mathrm{s}$. $y - y_0 = \left(\frac{v_{0y} + v_y}{2}\right)t$ gives

Exercise 21.33

✔ Complete

A very long line of charge with charge per unit length +8.00 $\mu\mathrm{C/m}$ is on the x-axis and its midpoint is at x = 0. A second very long line of charge with charge per unit length -4.00 $\mu\mathrm{C/m}$ is parallel to the x-axis at y = 15.0 cm and its midpoint is also at x = 0.

Review | Constants

Part A ✔

At what point on the y-axis is the resultant electric field of the two lines of charge equal to zero?

Enter the y-coordinate of the point and include the appropriate units.

y_0 = 30.0 cm

Submit Previous Answers

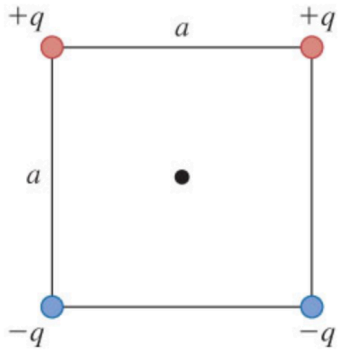
Exercise 21.38 - Enhanced - with Feedback

5 of 10

A point charge is placed at each corner of a square with side length a. The charges all have the same magnitude q. Two of the charges are positive and two are negative, as shown in the following figure. (Figure 1)

Figure

1 of 1



Review | Constants

Part A

What is the direction of the net electric field at the center of the square?

- upward direction
- leftward direction
- downward direction
- rightward direction

Submit | Request Answer

Part B

What is the magnitude of the net electric field at the center of the square due to the four charges in terms of q and a?

Express your answer in terms of the variables q, a, and constant k.

$E =$

Exercise 21.50 - Enhanced - with Feedback

A straight, nonconducting plastic wire 9.50 cm long carries a charge density of 175 $\mathrm{nC/m}$ distributed uniformly along its length. It is lying on a horizontal tabletop.

Review | Constants

Part A

Find the magnitude of the electric field this wire produces at a point 5.50 cm directly above its midpoint.

Express your answer in newtons per coulomb.

$E =$ 3.74×10^4 $\mathrm{N/C}$

Submit | Previous Answers

✔ **Correct**

Part B

Find the direction of this electric field.

- ○ electric field is directed upward
- ○ electric field is directed downward

Submit | Request Answer

Part C

If the wire is now bent into a circle lying flat on the table, find the magnitude and direction of the electric field it produces at a point 5.50 cm directly above its center.

Express your answer in newtons per coulomb.

$E =$ N/C

Submit Request Answer

Part D

Find the direction of this electric field.

- electric field is directed upward
- electric field is directed downward

Problem 21.69

A charge $+Q$ is located at the origin and a second charge, $+4Q$, is at distance d on the x-axis.

Review | Constants

Part A

Where should a third charge, q, be placed, so that all three charges will be in equilibrium?

Express your answer in terms of d.

$x =$

Submit Request Answer

Part B

What should be its sign, so that all three charges will be in equilibrium?

- negative
- positive

Submit Request Answer

Part C

What should be its magnitude, so that all three charges will be in equilibrium?

Express your answer in terms of Q.

$|q| = \frac{4Q}{9}$

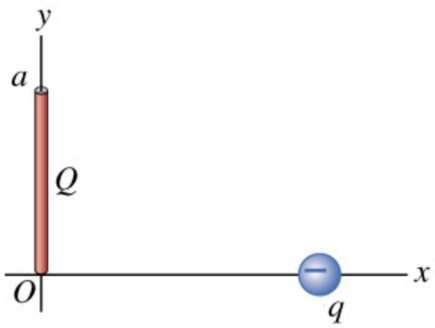
Submit

Previous Answers

Problem 21.80 - Enhanced - with Feedback

Positive charge Q is distributed uniformly along the positive y-axis between $y = 0$ and $y = a$. A negative point charge $-q$ lies on the positive x-axis, a distance x from the origin (the figure (Figure 1)).

Figure



Review | Constants

Part A

Calculate the x-component of the electric field produced by the charge distribution Q at points on the positive x-axis.

Express your answer in terms of some or all of the variables Q, x, y, a, and constant k.

E_x =

Submit | Request Answer

Part B

Calculate the y-component of the electric field produced by the charge distribution Q at points on the positive x-axis.

Express your answer in terms of some or all of the variables Q, x, y, a, and constant k.

E_y =

Part C

Calculate the *x*-component of the force that the charge distribution Q exerts on q.

Express your answer in terms of some or all of the variables Q, x, y, a, and constant k.

$F_x = \dfrac{-qQk}{x\sqrt{x^2+a^2}}$

Submit Previous Answers

✔ **Correct**

Part D

Calculate the *y*-component of the force that the charge distribution Q exerts on q.

Express your answer in terms of some or all of the variables Q, x, y, a, and constant k.

$F_y =$

Problem 21.87

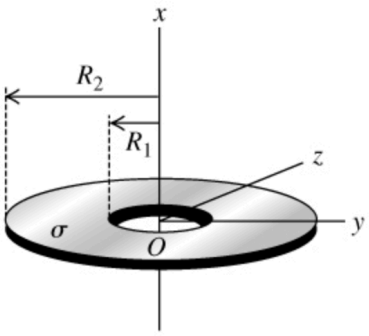
10 of 10

✔ Complete

A thin disk with a circular hole at its center, called an *annulus*, has inner radius R_1 and outer radius R_2. The disk has a uniform positive surface charge density σ on its surface. (Figure 1)

Figure

1 of 1



Review | Constants

Part A

Determine the total electric charge on the annulus.

Express your answer in terms of the variables R_1, R_2, and σ.

$$Q = \pi\sigma\left(R_2{}^2 - R_1{}^2\right)$$

Submit Previous Answers

✔ Correct

Part B

The annulus lies in the *yz*-plane, with its center at the origin. For an arbitrary point on the *x*-axis (the axis of the annulus), find the magnitude of the electric field $\vec{E}$. Consider points above the annulus in the figure.

Express your answer in terms of the variables R_1, R_2, σ, x and constant k.

$$E(x) = 2\pi\sigma k x\left(\frac{1}{\sqrt{x^2+R_1{}^2}} - \frac{1}{\sqrt{x^2+R_2{}^2}}\right)$$

Submit Previous Answers

Part C

Find the direction of the electric field $\vec{E}$. Consider points above the annulus in the figure.

- (•) $+$ *x*-direction
- ( ) $-$ *x*-direction

Submit Previous Answers

✔ **Correct**

Part D

A point particle with mass m and negative charge $-q$ is free to move along the *x*-axis (but cannot move off the axis). The particle is originally placed at rest at $x = 0.01R_1$ and released. Find the frequency of oscillation of the particle.

Express your answer in terms of the variables R_1, R_2, σ, m, q, and constant k.

$$\sqrt{\frac{kq\sigma}{2\pi m}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)}$$