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Midterm

Answer 4 questions out of 6

1. Download a PDF version of this page on your computer.
2. Do not forget to include the questions page with your uploaded .zip file.
3. Keep an eye on the timer.

Question 1: Four Charges

10 points possible (graded, results hidden)

Use the following constants if necessary. Coulomb constant, $k = 8.987 \times 10^9\ N \cdot m^2/C^2$. Vacuum permitivity, $\epsilon_0 = 8.854 \times 10^{-12}\ F/m$. Magnitude of the Charge of one electron, $e = 1.60217662 \times 10^{-19}\ C$. Mass of one electron, $m_e = 9.10938356 \times 10^{-31}\ kg$. Unless specified otherwise, each symbol carries their usual meaning. For example, μC means $micro\,coulomb$.

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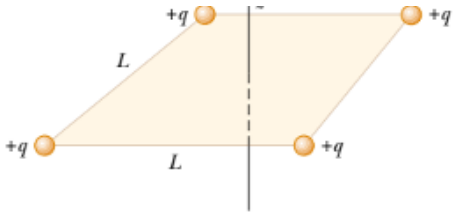

a) Four identical particles, each having charge $q = 28\,\mu C$, are fixed at the corners of a square of side $L = 25\,cm$. A fifth point charge $Q = -28\,\mu C$ lies a distance $z = 7\,cm$ along the line perpendicular to the plane of the square and passing through the center of the square as shown in Figure 3. Calculate the force exerted by the other four charges on $-Q$.

x component of the force
Give your answer to at least two significance digits.

0 **N**

0

y component of the force
Give your answer to at least two significance digits.

0 **N**

0

z component of the force
Give your answer to at least two significance digits.

-287.16 **N**

-287.16

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3.15*10^32 $\mathbf{m/s^2}$

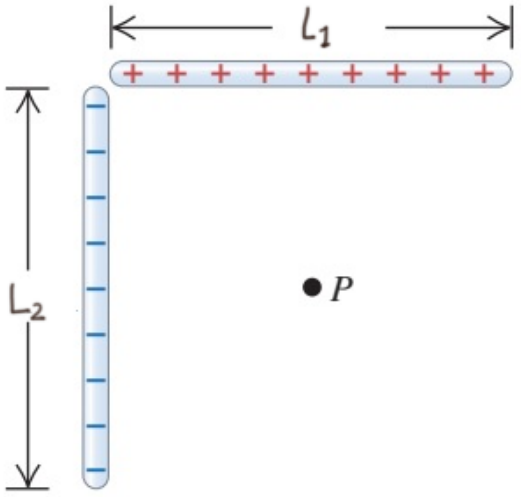
$3.15 \cdot 10^{32}$

Submit You have used 1 of 3 attempts

Answer submitted.

Question 2: Two Charged Rods Problem

10 points possible (graded, results hidden)



(a) Two nonconducting wires A and B meet at a right angle with length $L_1 = 10m$ and $L_2 = 6m$. (A is the Horizontal one and B is the Vertical one). One segment carries $q_1 = 11\mu C$ of charge distributed uniformly along its length, and the other carries -$q_2 = 11\mu C$ distributed uniformly along it, as shown in Figure. Find the magnitude and direction of the electric field these wires produce at point P. P is $6/2$ m away from A and $10/2$ m away from B.

Find the magnitude of the electric field

Give your answer to at least two significance digits.

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Find the angle of the electric field with the x axis
Answer in Degrees upto to significant digits

59.03 °

59.03

(b) If an electron is released at P,

what is the magnitude of the net force ?
Give your answer to at least two significance digits.

1.05*10^-15 N

$1.05 \cdot 10^{-15}$

what is the angle of the net force with x axis?
Answer in Degrees upto to significant digits

59.03 °

59.03

Submit You have used 2 of 3 attempts

Answer submitted.

Question 3: Gauss's Law and Infinite Sheet with a Disk

10.0 points possible (graded, results hidden)

Use the following constants if necessary. Coulomb constant, $k = 8.987 \times 10^9\ N \cdot m^2/C^2$. Vacuum permitivity, $\epsilon_0 = 8.854 \times 10^{-12}\ F/m$. Magnitude of the Charge of one electron, $e = 1.60217662 \times 10^{-19}\ C$. Mass of one electron, $m_e = 9.10938356 \times 10^{-31}\ kg$. Unless specified otherwise, each symbol carries their usual meaning. For example, μC means $micro\,coulomb$.

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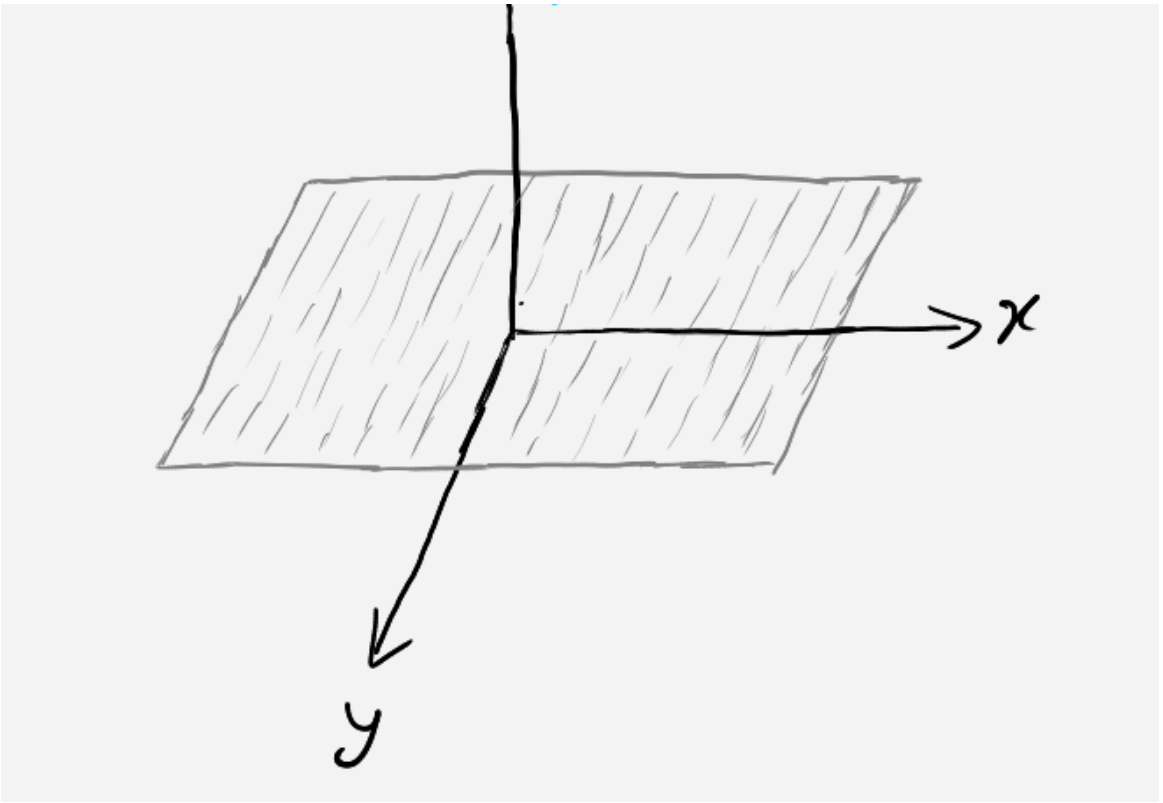

Suppose you have an infinite sheet lying in the xy plane. The charge density of the sheet is $\sigma_1 = 28\,\mu C/m^2$.(fig 1)

a) Calculate the electric field at point $p\,(0, 0, 9)$. These coordinates are in meters.

Electric Field

Give your answer to at least two significance digits.

N/C

b)

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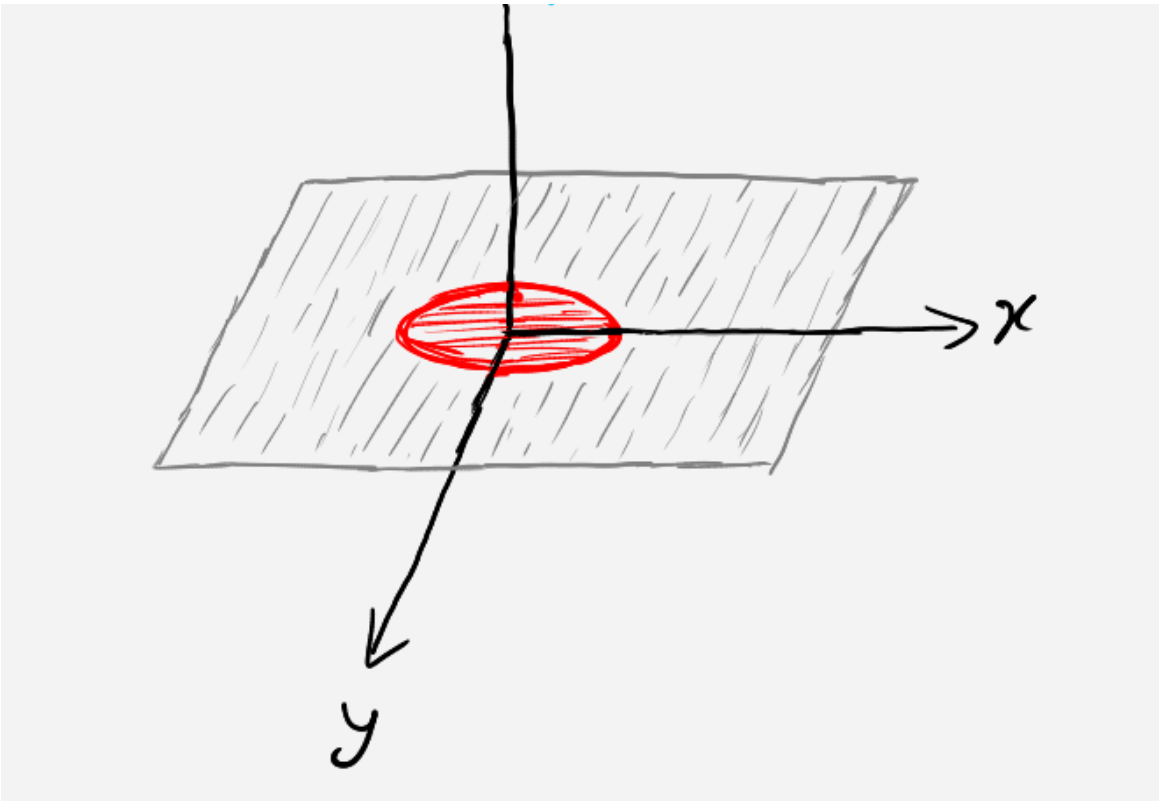

Say we place a charged circular disk on the xy plane such that the center of the disk coincides with the center of our coordinate system. Calculate the net electric field at p given the radius of the disk by $R = 3\,m$ and charge density $\sigma_2 = -\sigma_1$

Net Electric Field

Give your answer to at least two significance digits.

$\mathrm{N/C}$

c)

Calculate the potential at p for this system. Assume potential at infinity is 0, that is $V(\infty) = 0$

Potential at p

Give your answer to at least two significance digits.

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Question 4: Electron Gun Controller

10.0 points possible (graded, results hidden)

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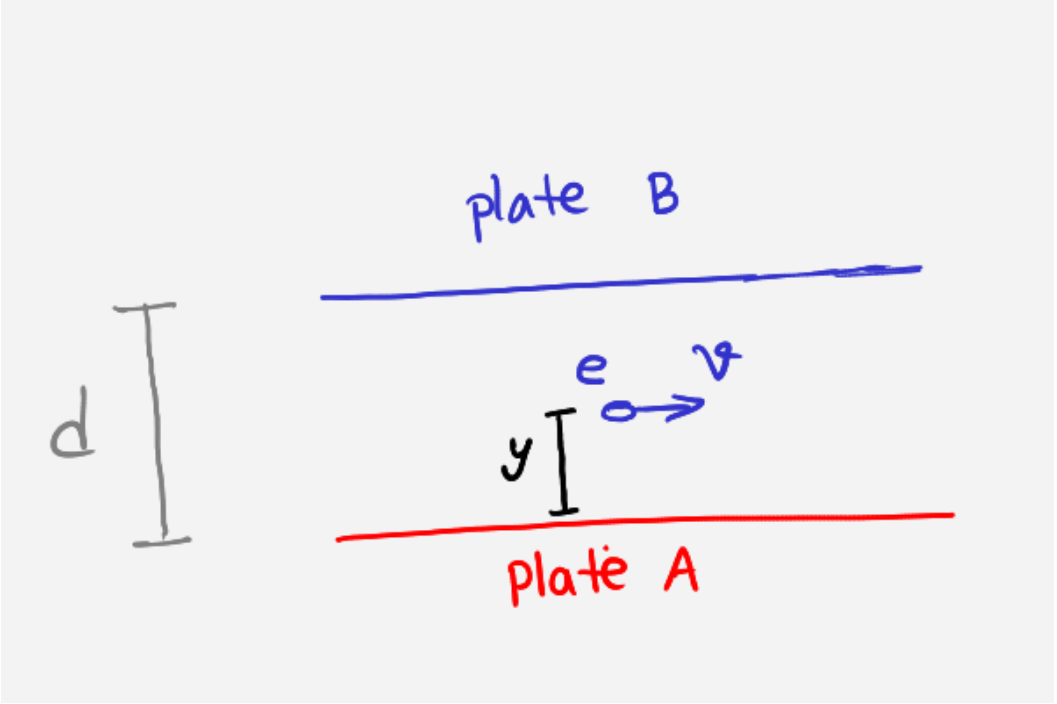

Two long conducting plates are placed in parallel which are labeled as plate A and B as shown in Figure. The distance between the plate is $d = 10\,cm$. The potentials of plate A and B are $V_A = +9\,volt$ and $V_B = -4\,volt$.

a) Calculate the magnitude of the net electric filed due to both plates at point P which is locate at a distance are $y = \frac{d}{2}$ from plate A.

Magnitude of the Net Electric Filed

Give your answer to at least two significance digits.

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b) Say an electron travelling with a speed $v = 3 \times 10^6\ m/s$ along the $+x$-axis, At point P calculate the force on the electron.

Force on the electron
Give your answer to at least two significance digits.

N

c) Calculate the instantaneous acceleration of the electron at point P.

Instantaneous acceleration
Give your answer to at least two significance digits.

m/s^2

Submit You have used 0 of 3 attempts

Question 5: Triangle

10.0 points possible (graded, results hidden)
Use the following constants if necessary. Coulomb constant, $k = 8.987 \times 10^9\ N \cdot m^2/C^2$. Vacuum permitivity, $\epsilon_0 = 8.854 \times 10^{-12}\ F/m$. Magnitude of the Charge of one electron, $e = 1.60217662 \times 10^{-19}\ C$. Mass of one electron, $m_e = 9.10938356 \times 10^{-31}\ kg$. Unless specified otherwise, each symbol carries their usual meaning. For example, μC means $micro\,coulomb$.

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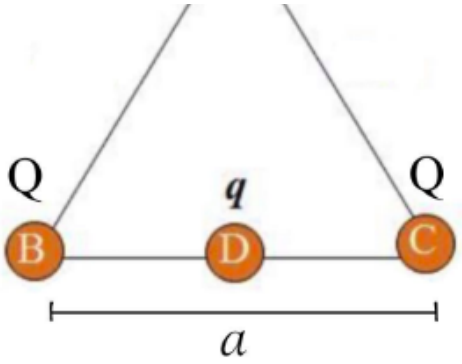

3 charges, each with magnitude $Q = 3\,coulombs$ are located on three vertices A, B, C of an equilateral triangle with sides $a = 7\,m$ each as shown in the figure. Another charge q is located at the mid point of the side BC.

a) Calculate the value of q so that the net force on the charge at A due to the charges at B, C and D is zero.

q charge
Give your answer to at least two significance digits.

C

b) Find out the magnitude of the net force on the charge at B due to the charges at A, C and D. Use the magnitude of charge q that you found out in the problem above.

Magnitude of the net Force
Give your answer to at least two significance digits.

N

Submit You have used 0 of 3 attempts

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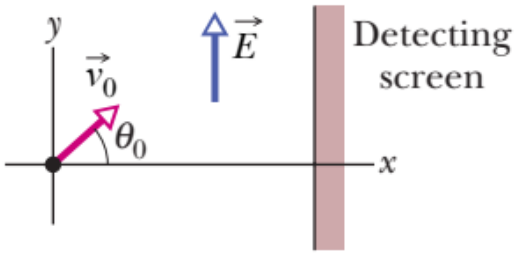

An electron is shot with an initial speed of $v_0 = 5 \times 10^6\ m/s$, at angle $\theta_0 = 53°$ from the x axis. It moves through a uniform electric field $\vec{E} = 17\ N/C\hat{j}$. A screen for detecting electrons is positioned parallel to the axis, at distance $x = 4\,m$.

a) How high does the electron can go in the vertical direction? (Note : distance is a positive quantity.)

Vertical distance
Give your answer to at least two significance digits.

m

b) In unit-vector notation, what is the velocity of the electron when it hits the screen?

x component of the velocity
Give your answer to at least two significance digits.

m/s

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$\mathrm{m/s}$

c) Calculate the coordinate of the electron when it hits the screen.

x coordinate
Give your answer to at least two significance digits.

m

y coordinnate
Give your answer to at least two significance digits.

m

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