AMERICAN UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER AND COMMUNICATIONS ENGINEERING

CCE 200: ENGINEERING PHYSICS

Fall Term 2019-2020

Exam No. 1

November 29, 2019

Student Name: _____ ID Number: _____

The **CHEATING** penalty will result in an **F** in the course.
This exam consists of **6 pages. Make sure that you have the correct number of pages.**

YOU NEED TO SHOW ALL OF YOUR WORK TO GET COMPLETE CREDIT.

Good Luck!

PROBLEM	POINTS
1	: 10
2	: 10
3	: 10
4	: 10
5	: 10
6	: 10
7	: 10
8	: 10
9	: 10
10	: 10

SCORE: /100

Given:

$k = 9\times10^{9}$ N.m^2/kg^2

$\varepsilon_0 = 8.8\times10^{-12}$

g = 9.81 m/s^2

Mass of proton: 1.67×10^{-27} kg

Mass of electron: 9.1×10^{-31} kg

Charge of electron: -1.6×10^{-19} C

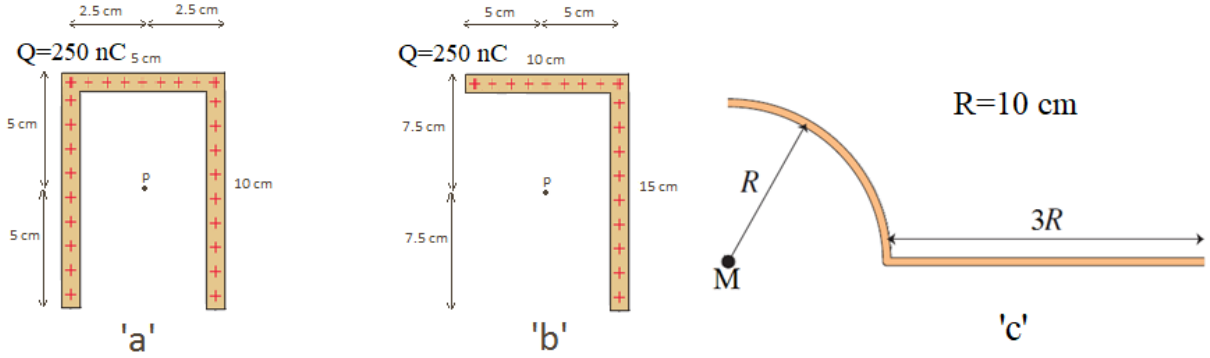
Charge of proton: 1.6×10^{-19} C

$$\int \frac{dx}{(a^2+x^2)^{3/2}} = \frac{x}{a^2(a^2+x^2)^{1/2}} \quad and \quad \int \frac{xdx}{(a^2+x^2)^{3/2}} = -\frac{1}{\sqrt{(a^2+x^2)}}$$

$$\int \frac{dx}{(a^2+x^2)^{1/2}} = \ln\left[(a^2+x^2)^{1/2}+x\right]$$

$$\int \frac{xdx}{(a^2+x^2)^{1/2}} = (a^2+x^2)^{1/2}$$

Question #1



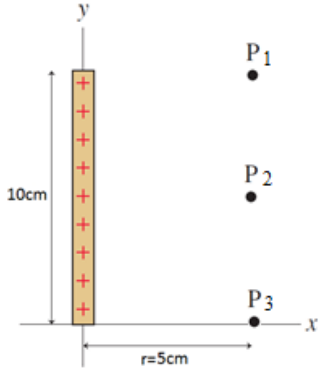
a. Find the electric field $\vec{E}$ at point 'P' in figure 'a', give your answer in component form.

b. Find the electric field $\vec{E}$ at point 'P' in figure 'b', give your answer in component form.

c. The wire shown in figure 'c' has linear charge distribution $\rho_L = 1\times10^{-6}\ C/m$. What is the electric field at point M?

Question #2

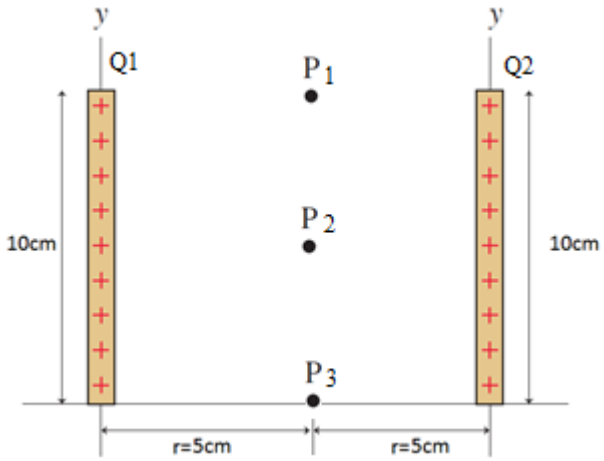
The following figure shows a thin rod of length L=10cm with total charge Q=100nC. Find the electric field $\vec{E}$ at points P1(5cm, 10cm), P2(5cm, 10cm), and P3(5cm, 0cm). Give your answer in component form.



Question #3

The following figure shows two thin rods of length L=10cm with total charge Q1=200nC and Q2=250nC.

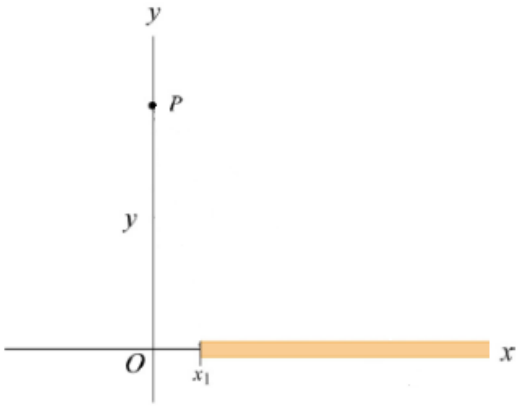
Find the electric field $\vec{E}$ at points P1(5cm, 10cm), P2(5cm, 5cm), and P3(5cm, 0cm). Give your answer in component form.



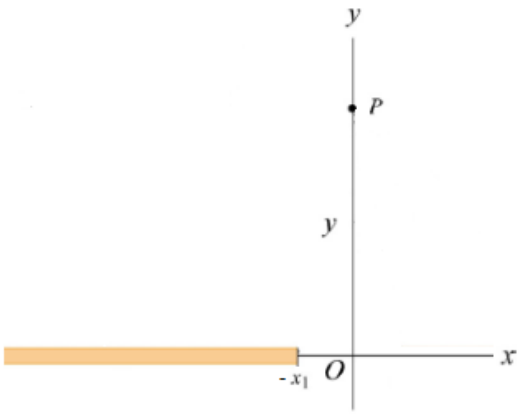
Question #4

For the following parts, take y = 10.0 cm, and x_1 = 1.00 cm

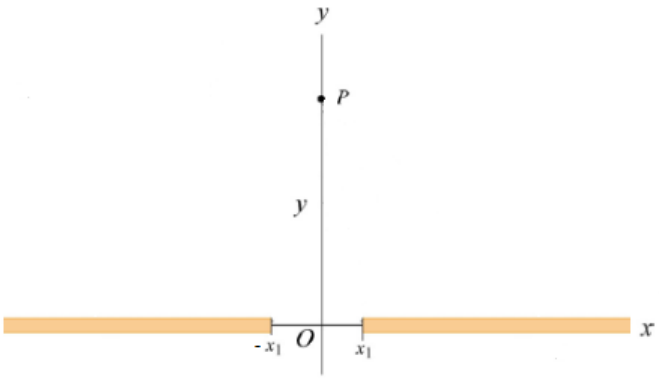
a. Consider the following semi-infinite line starting at x_1 and extending towards +∞ with a uniform line charge distribution of +20.0 nC/m. Calculate the electric field at *P*.



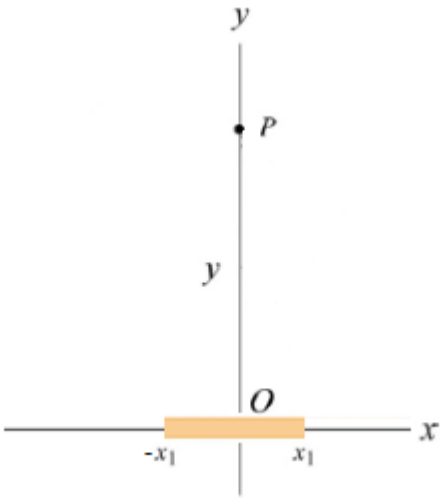
b. Now, consider the following semi-infinite line starting at -x_1 and extending towards -∞ with a uniform line charge distribution of +20.0 nC/m. Calculate the electric field at *P*.



c. Now, calculate the electric field at *P* where both semi-infinite rods from parts (a) and (b) are present.

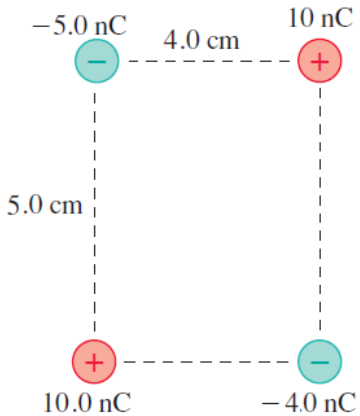


d. Now, deduce the electric field at *P* for a finite rod between $-x_1$ and x_1.



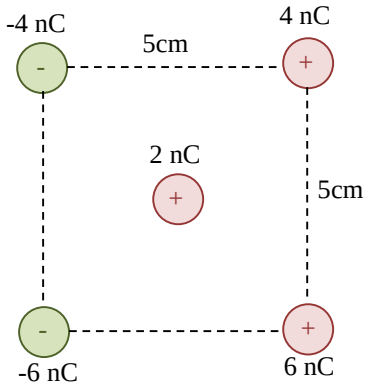
Question #5

What is the force $\vec{F}$ on the -5.0 nC charge in the following figure?
Give your answer as a magnitude and an angle measured cw or ccw (specify which) from the positive *x*-axis.



Question #6

What is the force $\vec{F}$ on the 2 nC charge in the middle of the square due to the four other charges? Give your answer in component form.



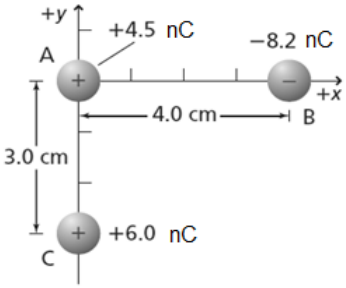
Question #7

Three charged spheres are located at the positions shown in the figure to the right.

Find the total force on sphere C.

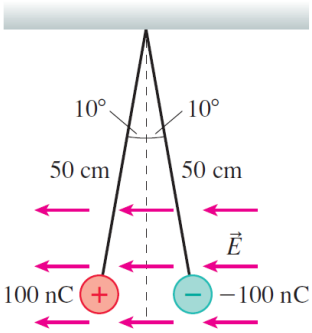
- In component form (vector).
- In magnitude and angle form.

In your answer, include a diagram showing the force vectors $\boldsymbol{F}_{\text{A on C}}$, $\boldsymbol{F}_{\text{B on C}}$, and $\boldsymbol{F}_{\text{net}}$.



Question #8

The identical small spheres shown in the following figure are charged to +100 nC and -100 nC. They hang as shown in a 100,000 N/C electric field.



a. Find the magnitude of the electric force exerted by the electric field on each of the spheres.

b. Find the magnitude of the electric force exerted by each of the spheres on the other one.

c. What is the mass of each sphere?

Question #9

A 15-cm-long thin glass rod uniformly charged to +5 nC and a 15-cm-long thin plastic rod uniformly charged to -5 nC are placed side by side, 5.0 cm apart. What are the electric field strengths E_1 and E_2 at distances 1.0 cm and 4.0 cm from the glass rod along the line connecting the midpoints of the two rods?

Question #10

What is the strength and direction of the electric field at the position indicated by the dot in the following figure? Specify your answer in component form, and as a magnitude and an angle measured cw or ccw (specify which) from the positive *x*-axis.