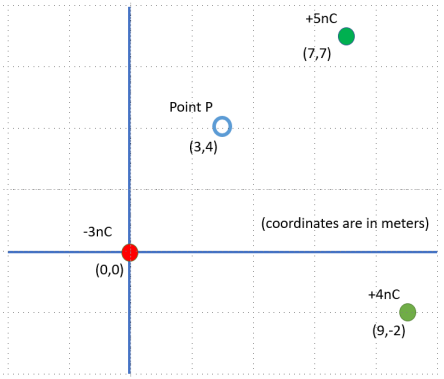
Physics 1320 - Calculus-based Physics II
Summer 2022
Midterm Exam I

Question 1

Consider the following configuration (all distances are in meters):



A Draw the electric field lines that result from the three charges.

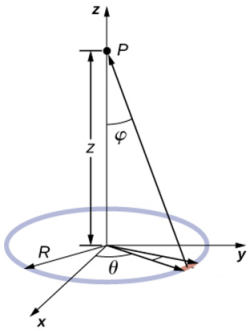
B What is the total Electric Field at point P expressed in vector notation (i.e., $\vec{E} = E_x\hat{i} + E_y\hat{j}$)?

C What is the magnitude (E) and direction (θ) of the Electric Field $\vec{E}$?

D If an electron is placed at point P, what Force ($\vec{F}$) will it experience?

Question 2

Consider a ring of charge on the xy-plane with a radius $R = 10cm$.



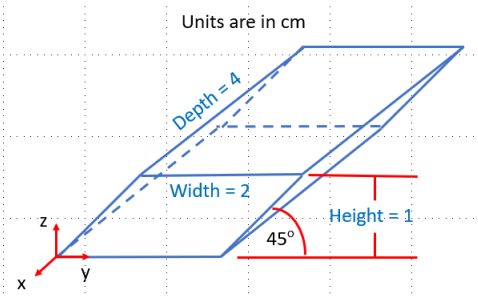
If the total charge on the ring is $-31.5\mu C$.

A What is the charge density on the ring?

B From the charge density, calculate the electric field ($\vec{E}$) at point P.

Question 3

Consider the following surface (dimensions are in cm).



Assume that there is a uniform electric field of $\vec{E} = E_x(-\hat{i}) + E_y\hat{j}$, where $E_x = 3\frac{N}{C}$ and $E_y = 8\frac{N}{C}$. Calculate the Flux through:

A Front surface?

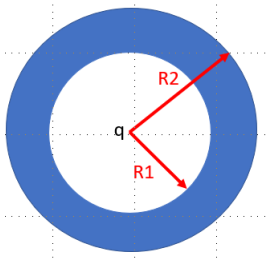
B Top surface?

C Right surface?

D Net flux through all surfaces combined?

Question 4

Consider the following hallow, spherical, conducting shell.



Assume the total charge on the sphere is $Q_o = xxxxnC$, and that there is a charge of $Q_{center} = yyyynC$ at the center. For the case where $R1 = 0.25m$ and $R2 = 0.42m$. Using Gauss's Law, find:

A The electric field ($\vec{E}$) at a point in the hallow cavity at a distance 0.20m from the center.

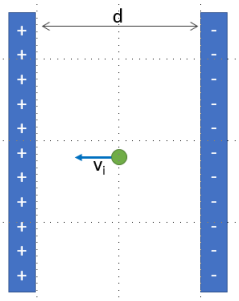
B The electric field inside the sphere at a point 0.40m from the center.

C The electric field outside the sphere at a point 0.55m from the center.

D The charge density (σ_i) on the inner surface ($r = R1$) of the sphere.

Question 5

Consider two equally (but opposite) charged parallel plates as show below.



Assume the distance (d) between the plates is $20mm$ and the charge on each plate has a magnitude of $150\frac{N}{C}$.

A If a proton is at the midpoint between the two plates with initial speed of xxxx in the direction shown, then at what location will the proton change direction due to the electric field?

B If the proton is replaced with an electron, how does that change the location where the particle changes direction?

Note: the mass of a proton is $m_p = 1.637 \cdot 10^{-27}kg$ *and the mass of a electron is* $9.11 \cdot 10^{-31}kg$. The charge on an electron is $1.602 \cdot 10^{-19}C$.

Question 6

Consider a $475\mu F$ parallel plate capacitor filled with air. The magnitude of the charge on the plates is $xxxC$ and the separation between the plates is $xxxm$.

A What is the Potential difference between the two plates?

B What is the area of the plates?

C What is the Electric Field between the plates?

D What is the charge density on the plates?

Question 7 - Extra Credit (5pts)

A Name one of the two individuals credited with inventing the lightning rod.

B Draw a lightning rod on top of a building (quality of drawing isn't graded).

C Describe how and why a lightning rod works.