Print Name: _____

Instructions

Time: 9:00 AM to 9:50 AM

- **PLEASE PRINT NAME LEGIBLY**
- Remove all materials from desktop except pencils, calculators.
- You are allowed to use your equation sheet (with a few notes of your own on the sheet).
- Show all your work!!!
- Evidence of cheating will result is a failing grade.
- Circle your final answer(s).
- Answer all questions.
- Organize your work in a logical fashion.

UNDERSTANDING CONCEPTS (Approx. 5 mins)

1.) (5 pts.)

List four properties that must be true for a charged conductor to be in electrostatic equilibrium:

2.) (10 pts.)

Vocabulary Mastery

Vocabulary List:

Coulomb's Law	Induction
Gauss' Law	Electric Flux
Conservative Force	Potential Difference
Insulators	Equipotential Surfaces
Volt	Electrostatic Equilibrium

1.) _____ is a law of physics describing the electrostatic force between unmoving electrically charged particles.
2.) Materials in which all electrons are bound to atoms and cannot move freely are called _____.
3.) SI unit of both electric potential and potential difference is a_____.
4.) When no net motion of charge occurs within a conductor, the conductor is said to be in _____.
5.) _____ is a law stating the net flux through any closed surface is $\Phi_E = \frac{Q\text{in}}{\epsilon\, o}$

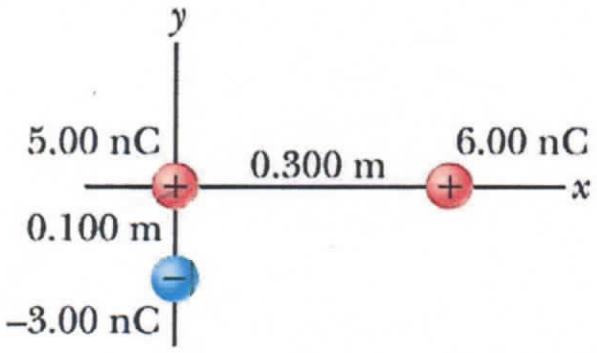
3.) (10 pts.)

Electric Field Lines

Draw the electric field lines for the case of two point charges where: **Charge 1** is positive and has a magnitude **3 times** as large as **Charge 2** which is negative.

4.) (20 pts.) (Approx. 10 mins)

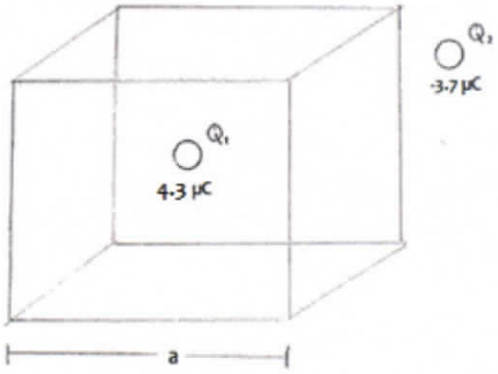
Three charges are arranged as shown in the figure. Find the **magnitude** and **direction** of the resultant electrostatic force on the charge at the origin. Sketch the resultant force vector.



5.) (15 pts.) (Approx. 5 mins)

A charged particle (**Q1**) of charge **4.3 μC** is at the center of a Gaussian cube with edges of **length a** (**a = 90 cm**). Another charged particle (**Q2**) of charge **-3.7 μC** is outside the cube.

a.) Find the **net electric flux** through the whole closed surface of the cube.
b.) Find the **electric flux** through one of the faces of the cube (*a cube has 6 faces*).
c.) Would your answers for (a) and/or (b) change if the charge **(Q1)** was not at the center of the cube?



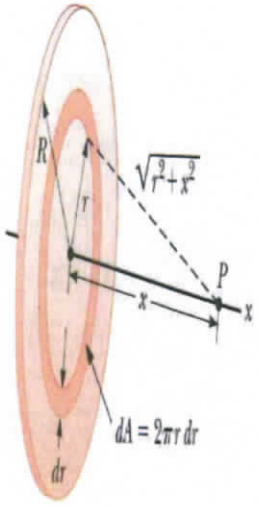
6.) (15 pts) (Approx. 10 mins)

A uniformly charged disk has a radius **R** and a surface charge density of **σ**. If **R = 7 cm** and **σ = 15 C/m²**, find

a.) The electric potential a **point P** (where **x = 30 cm**).
$V = 2\pi k_e \sigma [(R^2 + x^2)^{1/2} - x]$

b.) The x-component of the electric field **(E_x)** at **point P** (where **x = 30 cm**).
$E = 2\pi k_e \sigma \left[1 - \frac{x}{(R^2 + x^2)^{1/2}}\right]$

c.) If the electric field magnitude is **50×10^7 N/C, point P** is at **x= 16 cm** and **R = 11 cm**, what is the charge density **(σ)?**



7.) (15 pts.) (Approx. 10 mins)

An electron accelerates from rest in a uniform electric field of **420 N/C**. At one later moment, its speed is **7.0×10^{8} m/s**. An electron has a charge of **-1.60×10^{-19} C** and a mass of **9.11×10^{-31} kg.**

a.) Find the accleration of the electron.
b.) Over what time interval does the electron reach this speed?
c.) How far does the electron move in the time interval?

8.) (15 pts.) (Approx. 5 mins)

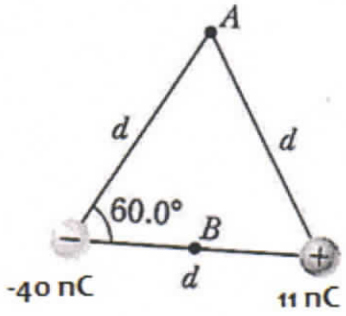
A spherical charged conductor has a radius of **27 cm** and a charge of **32 μC**. Calculate the **electric potential** and **electric field** at:

a.) 20 cm
b.) 40 cm
c.) 60 cm

9.) (5 pts) (Approx. 5 mins)

Two charges with magnitudes of **-40 nC** and **11 nC** are separated by **d = 12 cm**. Find,

a.) The **electric potential energy** of the pair of charges.



10.) (5 pts.) [redacted]

Over a certain region of space, the electric potential is $\mathbf{V = 4x - 11x^3y^2 + 9yz^3}$.

a.) Find the expression for the *x*, *y*, and *z* components of the electric field over this region.