PHYS 2102

Exam 1

Spring 2000

Dr. Aktash

Name :_____

SS # : _____

You have five questions, 20 points each.

This is a closed book exam. I understand I am not to use any notes or information other than on this exam sheet. I may use a pocket calculator but only for the purpose of numerical calculation. I accept the responsibility to know and observe the requirements of the UNC-Charlotte Code of Student Academic Integrity.

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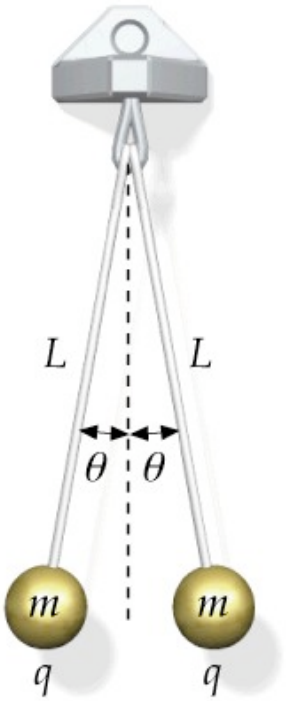
Signature

Good luck

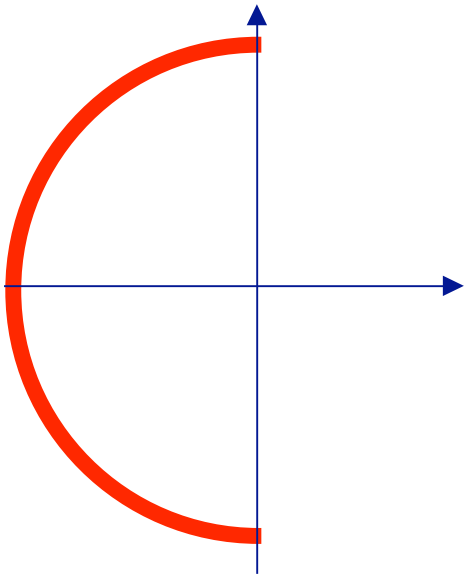
Show all of your work. Do not skip steps. First write down the relevant equations then substitute the numbers if necessary.



1. Two small spheres of mass m are suspended from a common point by threads of length L. When each sphere carries a charge q, each thread makes an angle θ with the vertical as shown in figure. Show that the charge q is given by

$$q = 2L\sin\theta\sqrt{\frac{mg\tan\theta}{k}}$$

Where k is Coulomb constant.



2. A semicircular ring of radius R carries a uniform line charge of λ. Find the electric field at the center of the semicircle.

3. A sphere of radius 6 cm carries a uniform volume charge density $\rho = 450\ \text{nC/m}^3$. (a) What is the total charge of the sphere? Find the electric field at (b) r = 2 cm, (c) r = 5.9 cm, (d) r = 6.1 cm, and (e) r = 10 cm.

4. A disk of radius 6.25 cm carries a uniform surface charge density $\sigma = 7.5\ \text{nC/m}^2$. Find the potential on the axis of the disk at a distance from the disk of (a) 0.5 cm, (b) 3.0 cm, and (c) 6.25 cm.

5. A spherical capacitor consists of two thin concentric spherical shells of radii R_1 and R_2. (a) Show that the capacitance is given by,

$$C = 4\pi\varepsilon_0 \frac{R_1 R_2}{(R_2 - R_1)}$$

(b) Show that when the radii of the shells are nearly equal, the capacitance is given approximately by the expression for the capacitance of a parallel-plate capacitor, $C = \varepsilon_0 A/d$, where A is the area of the sphere and $d = R_2 - R_1$.