

Version

Quiz #1 Form #125

Name: \_\_\_\_\_

A

Physics 2212 K Summer 2015

Recitation Section: \_\_\_\_\_

- Print your name, quiz form number (3 digits at the top of this form), and student number (9 digit Georgia Tech ID number) in the section of the answer card labeled "Student Identification."
- Bubble the Quiz Form Number in columns 1–3, skip column 4, then bubble your Student Number in columns 5–13.
- Free-response questions are numbered I–II. For each, make no marks and leave no space on your card. Show all your work clearly, including all steps and logic. Box your answer.
- Multiple-choice questions are numbered 1–10. For each, select the answer most nearly correct, circle this answer on your quiz, and bubble it on your answer card. Do not put any extra marks on the card.
- Turn in your quiz and answer card as you leave. Your score will be posted when your quiz has been graded. Quiz grades become final when the next quiz is given.
- You may not use a calculator or any other aids or electronic devices.

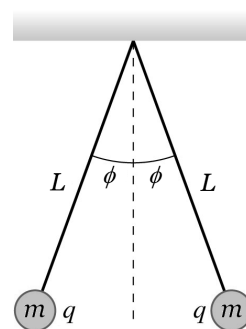
 $e$  Fundamental charge $m_e$  Mass of an electron $K$  Coulomb constant  $= 1/4\pi\epsilon_0$  $g$  Magnitude of Free Fall Acceleration*Unless otherwise directed, drag should be neglected.**Any integrals in free-response problems must be evaluated. Questions about magnitudes will state so explicitly.*

YOUR form number is 125

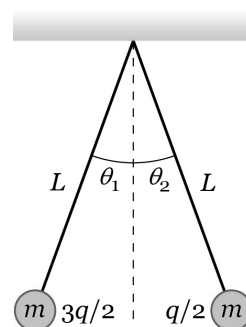
# Recitation Sections

|                  | Room 125             |
|------------------|----------------------|
| <b>TUESDAY</b>   |                      |
| 2:20–3:10 pm     | K04 Sharma, Kamal    |
| 3:20–4:10 pm     | K03 Sharma, Kamal    |
| 4:20–5:10 pm     | K01 Koh, Daegene     |
| <b>WEDNESDAY</b> |                      |
| 2:20–3:10 pm     | K06 Krygier, Michael |
| 3:20–4:10 pm     | K05 Krygier, Michael |
| 4:20–5:10 pm     | K02 Koh, Daegene     |
| <b>THURSDAY</b>  |                      |
| 2:20–3:10 pm     | K08 Nguyen, Khai     |
| 3:20–4:10 pm     |                      |
| 4:20–5:10 pm     | K09 Nguyen, Khai     |

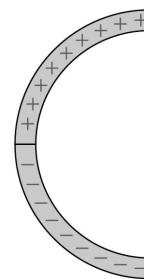
- I. (20 points) Two point particles, each of mass  $m$ , on threads of length  $L$  that make angles  $\phi$  with the vertical, repel each other after being *equally charged* as shown in the figure below. What is the magnitude of the charge  $q$  on each particle? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants. (*On Earth.*)



1. (6 points) In the problem above, charge  $q/2$  is transferred from the right particle to the left particle, so the threads now make angles  $\theta_1$  and  $\theta_2$  with the vertical, which (despite the figure) may or may not be equal to each other. How do the angles  $\theta_1$  and  $\theta_2$  compare to each other, and to the original angle  $\phi$ ?
- $\theta_1 > \phi > \theta_2$
  - $\theta_1 = \theta_2 > \phi$
  - $\theta_1 > \theta_2 > \phi$
  - $\theta_1 = \theta_2 < \phi$
  - $\theta_1 < \phi < \theta_2$



2. (6 points) A thin insulating rod forms a semicircle of radius  $R$ . Positive charge  $+Q$  is uniformly distributed on the upper half of the rod, and negative charge  $-Q$  is uniformly distributed on the bottom half, as shown. What is the direction, if any, of the electric field at the center of the semicircle?

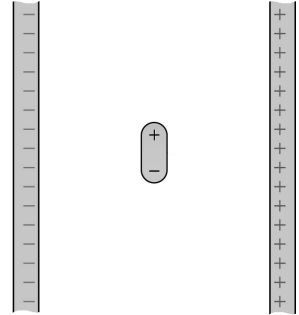


- (a) Down the page.
- (b) Up the page.
- (c) To the right.
- (d) No direction, as field must be zero.
- (e) To the left.

- II. (20 points) In the question above, what is the magnitude of the electric field at the center of the semicircle? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants. *Note: If you **start** with a memorized expression for the field at the center of a circular arc, you will be penalized for showing insufficient work.*

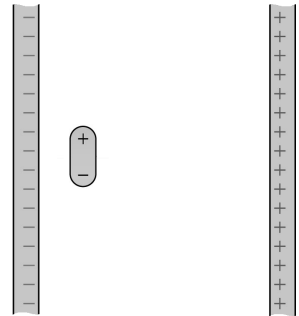
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3. (6 points) An electric dipole is centered in an ideal parallel-plate capacitor. How, if at all, does it move shortly after being released in the orientation shown?

- (a) It rotates counter-clockwise and moves right.
- (b) It just rotates clockwise.
- (c) It rotates counter-clockwise and moves left.
- (d) It rotates clockwise and moves left.
- (e) It just rotates counter-clockwise.



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4. (6 points) An electric dipole is in an ideal parallel-plate capacitor, much nearer the negative plate. How, if at all, does it move shortly after being released in the orientation shown?

- (a) It rotates counter-clockwise and moves left.
- (b) It rotates clockwise and moves left.
- (c) It just rotates counter-clockwise.
- (d) It rotates counter-clockwise and moves right.
- (e) It just rotates clockwise.

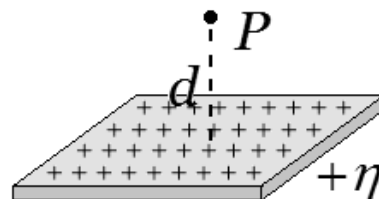


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5. (6 points) A thin insulating spherical shell has radius  $R$  and uniformly distributed charge  $Q$ . Let  $F_{\text{in}}$  be the force magnitude exerted by the shell on a particle with charge  $q$  placed at a distance  $R/2$  from the center. Let  $F_{\text{out}}$  be the force magnitude exerted by the shell on a particle with charge  $q$  placed at a distance  $2R$  from the center. What is the ratio of  $F_{\text{in}}$  to  $F_{\text{out}}$ ?

- (a)  $F_{\text{in}}/F_{\text{out}} = 0$
- (b)  $F_{\text{in}}/F_{\text{out}} = \sqrt{2}$
- (c)  $F_{\text{in}}/F_{\text{out}} = 2$
- (d)  $F_{\text{in}}/F_{\text{out}} = 1/\sqrt{2}$
- (e)  $F_{\text{in}}/F_{\text{out}} = 1/2$

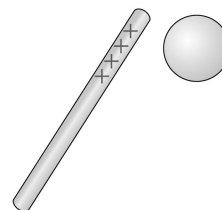
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6. (6 points) A thin infinite insulating sheet has positive uniform area charge density  $+\eta$ . The point  $P$  is a distance  $d$  from the sheet. Compare the sheet's electric field at point  $P$  when a positive charge  $+q$  is placed there, to the electric field at that point when a negative charge  $-2q$  is placed there.

- (a) The field at  $P$  with  $-2q$  has twice the magnitude, but the opposite direction, as the field at  $P$  with  $+q$ .
- (b) The field at  $P$  with  $-2q$  has the same magnitude, and the same direction, as the field at  $P$  with  $+q$ .
- (c) The field at  $P$  with  $-2q$  has the same magnitude, but the opposite direction, as the field at  $P$  with  $+q$ .
- (d) The field at  $P$  with  $-2q$  has twice the magnitude, but the same direction, as the field at  $P$  with  $+q$ .



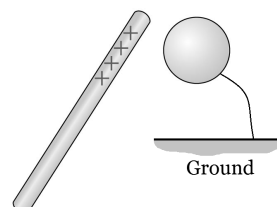
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7. (6 points) The conducting sphere is initially neutral. A positively charged rod is brought nearby, but not touching, as shown. What is the resulting charge on the sphere? What force does the rod exert on the sphere?

- (a) The sphere is neutral. The rod exerts no force on it.
- (b) The sphere is neutral. The rod exerts a repulsive force on it.
- (c) The sphere is neutral. The rod exerts an attractive force on it.
- (d) The sphere is negative. The rod exerts an attractive force on it.
- (e) The sphere is positive. The rod exerts a repulsive force on it.



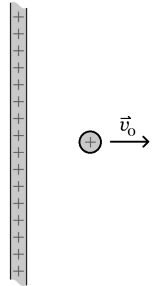
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8. (6 points) The conducting sphere is grounded. A positively charged rod is brought nearby, but not touching, as shown. What is the resulting charge on the sphere? What force does the rod exert on the sphere?

- (a) The sphere is negative. The rod exerts an attractive force on it.
- (b) The sphere is neutral. The rod exerts no force on it.
- (c) The sphere is neutral. The rod exerts an attractive force on it.
- (d) The sphere is neutral. The rod exerts a repulsive force on it.
- (e) The sphere is positive. The rod exerts a repulsive force on it.



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9. (6 points) A positively charged particle is held near a uniform infinite line of positive charge. The particle is then given an initial velocity  $\vec{v}_0$  away from the line. How does the magnitude of the particle's acceleration change, if at all, as it moves away from the line?

- (a) The magnitude of the acceleration decreases at first, then increases at greater distances.
- (b) The magnitude of the acceleration only decreases.
- (c) The magnitude of the acceleration increases at first, then decreases at greater distances.
- (d) The magnitude of the acceleration only increases.
- (e) The magnitude of the acceleration remains constant.



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10. (6 points) A positively charged particle is held near a uniform infinite line of positive charge. The particle is then given an initial velocity  $\vec{v}_0$  away from the line. How does the magnitude of the particle's velocity change, if at all, as it moves away from the line?

- (a) The magnitude of the velocity decreases at first, then increases at greater distances.
- (b) The magnitude of the velocity increases at first, then decreases at greater distances.
- (c) The magnitude of the velocity only increases.
- (d) The magnitude of the velocity remains constant.
- (e) The magnitude of the velocity only decreases.

