

$$k = \frac{1}{4\pi\epsilon_0}$$

$$\Delta V = - \int \vec{E} \cdot d\vec{s}$$

$$V = k \frac{q}{r}$$

$$\Delta U = q \Delta V$$

$$I = dq/dt$$

$$P = I \Delta V$$

$$R = \frac{\Delta V}{I}$$

Series :

$$\frac{1}{C_{\text{eq}}} = \sum \frac{1}{C_i}$$

$$R_{\text{eq}} = \sum R_i$$

Parallel :

$$\frac{1}{R_{\text{eq}}} = \sum \frac{1}{R_i}$$

$$C_{\text{eq}} = \sum C_i$$

Fundamental Charge $e = 1.602 \times 10^{-19} \text{ C}$
 Coulomb constant $K = 8.988 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$
 Earth's gravitational field $g = 9.81 \text{ N/kg}$

Unless otherwise directed, friction, drag, and gravity should be neglected, and all batteries and wires are ideal.

All integrals in free-response problems must be evaluated.

$$\vec{E} = k \frac{q}{r^2} \hat{r}$$

$$\vec{F} = k \frac{q_1 q_2}{r^2} \hat{r}$$

$$\vec{F} = q \vec{E}$$

$$\vec{p} = q \vec{d}$$

$$\vec{\tau} = \vec{p} \times \vec{E}$$

$$U = -\vec{p} \cdot \vec{E}$$

$$|\vec{E}| \propto \frac{|\vec{p}|}{r^3}$$

$$\Phi_{\text{E}} = \int \vec{E} \cdot d\vec{A}$$

$$\epsilon_0 \oint \vec{E} \cdot d\vec{A} = q_{\text{enclosed}}$$

$$\oint \vec{E} \cdot d\vec{\ell} = -\frac{d\Phi_{\text{E}}}{dt}$$

$$C = \frac{Q}{\Delta V}$$

$$C = \epsilon_0 \frac{A}{d}$$

$$U = \frac{1}{2} C [\Delta V]^2$$

$$R = \rho \frac{\ell}{A}$$

$$\tau_{\text{C}} = RC$$

$$u_{\text{E}} = \frac{1}{2} \epsilon_0 E^2$$

$$q = q_{\text{max}} \left(1 - e^{-t/\tau_c} \right)$$

$$q = q_0 e^{-t/\tau_c}$$

$$I = I_{\text{max}} \left(1 - e^{-t/\tau_L} \right)$$

$$I = I_0 e^{-t/\tau_L}$$

$$I = \int \vec{J} \cdot d\vec{A}$$

$$\vec{J} = \sigma \vec{E}$$

$$\mathcal{E} = -N \frac{d\Phi_{\text{B}}}{dt}$$

$$I_d = \epsilon_0 \frac{d\Phi_{\text{E}}}{dt}$$

$$\mathcal{E} = -L \frac{dI}{dt}$$

$$c = f\lambda = \frac{|\vec{E}|}{|\vec{B}|}$$

$$\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$$

$$I = \frac{P}{4\pi r^2}$$

$$P_r = \frac{(2)I}{c}$$

$$I_{\text{trans}} = I_0 \cos^2 \theta$$

Mass of an Electron $m_e = 9.109 \times 10^{-31} \text{ kg}$
 Vacuum Permittivity $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$
 Vacuum Permeability $\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$

Unless otherwise directed, friction, drag, and gravity should be neglected, and all batteries and wires are ideal.

All integrals in free-response problems must be evaluated.

Please remove this sheet from your Quiz or Exam

Recitation Sections

STUDENT IDENTIFICATION

George P. Burdell

123 900987654

WRITTEN information for human benefit

Test Form Number from YOUR test

column 4 is blank

YOUR student number starts in column 5

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Version

Quiz #1 Form #211

Name: _____

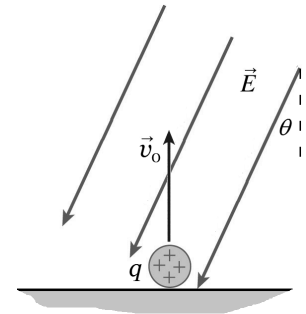
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Physics 2212 GJ Fall 2015

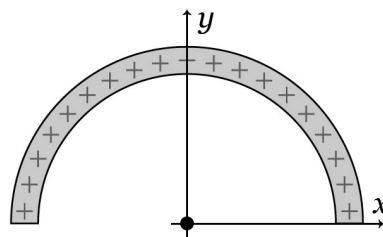
Recitation Section: _____

- 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–III. 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 use a calculator that cannot store letters, but no other aids or electronic devices.

I. (14 points) A $2.0\ \mu\text{g}$ dust particle, that has a charge of $q = +3.0\ \text{nC}$, leaves the ground with an upward initial speed of $v_0 = 1.0\ \text{m/s}$. It encounters a $E = 400.0\ \text{N/C}$ electric field which is slanted $\theta = 30.0^\circ$ from the vertical, as shown. What maximum height above the ground does the particle reach? (Neglect gravity and drag.)

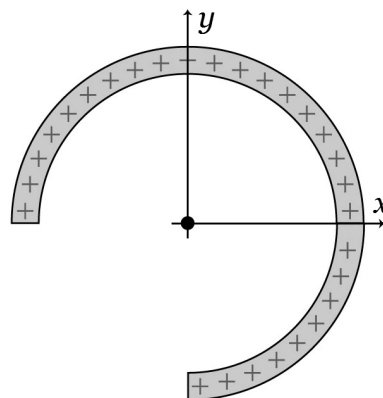


- II. (18 points) Positive charge Q is uniformly distributed along a thin, flexible rod of length L . The rod is then bent into the semicircle as shown in the figure. Find an expression for the electric field vector at the center of the semicircle. Express your answer in terms of parameters defined in the problem, and physical or mathematical constants.

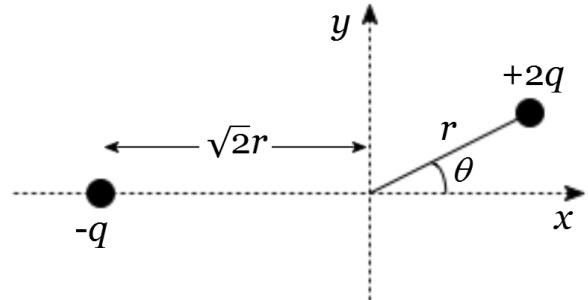


1. (5 points) Suppose we add another bent rod to that in the previous problem, with the same linear charge density, to make three-quarters of a circle as shown. If E_0 is the magnitude of the electric field at the origin for the semicircular rod above, what is the magnitude of the electric field at the origin now? *Hint:* You can answer this question without integration, and without having answered the problem above.

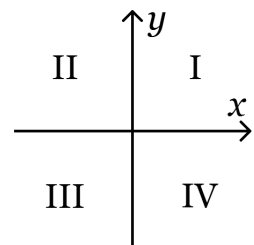
- (a) $E_0/2$
- (b) $2E_0$
- (c) $E_0/\sqrt{2}$
- (d) $\sqrt{2}E_0$
- (e) $\frac{3}{2}E_0$



- III. (18 points) A particle with positive charge $+2q$ can be positioned anywhere on a circle of radius r around the origin, making an angle θ with respect to the $+x$ axis. A particle with negative charge $-q$ is located on the x -axis at $x = -\sqrt{2}r$. In terms of q , r , θ and fundamental physical and mathematical constants as needed, what is the magnitude of the net electric field at the origin?

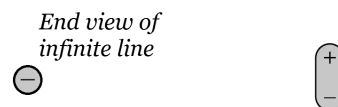


2. (5 points) If it is possible, in which quadrant should the particle with charge $+2q$ be positioned for the net electric field to be in the $+y$ direction?
- It is impossible for the field to be in the $+y$ direction.
 - In quadrant II .
 - In quadrant I .
 - In quadrant III .
 - In quadrant IV .

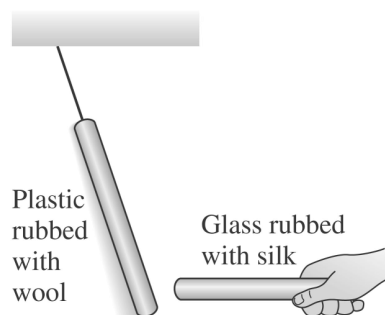


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3. (5 points) A dipole is held near a uniform infinite line of negative charge, oriented as shown. How, if at all, does the dipole move after it is released?

- (a) It does not move.
- (b) It rotates counter-clockwise and moves toward the line.
- (c) It just rotates clockwise.
- (d) It rotates clockwise and moves toward the line.
- (e) It just rotates counter-clockwise.

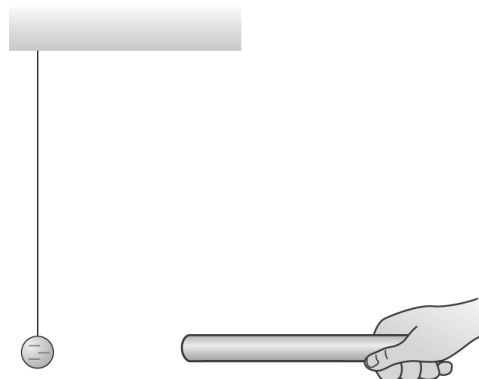


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4. (5 points) A plastic rod that has been rubbed with wool is attracted to a glass rod that has been rubbed with silk. What test would indicate that a third object has the same sign charge as the glass rod?
- (a) The object must have the same sign if it is repelled by the glass rod.
 - (b) The object must have the same sign if it is attracted to the glass rod.
 - (c) The object must have the same sign if it is attracted to the plastic rod.
 - (d) The object must have the same sign if it is repelled by the glass rod or if it is attracted to the plastic rod.
 - (e) The object must have the same sign if it is repelled by the plastic rod.



5. (5 points) A lightweight negatively charged ball hangs from a thin insulating thread. If a neutral insulating rod is brought nearby, the ball ...

- (a) remains stationary, as the rod is neutral.
- (b) moves away from the rod, as the rod becomes polarized.
- (c) moves toward the rod, as the rod becomes polarized.
- (d) moves toward the rod, as the rod becomes charged.
- (e) moves away from the rod, as the rod becomes charged.

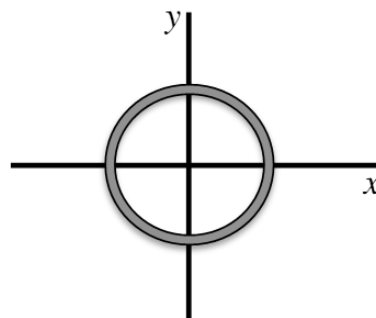


6. (5 points) A thin ring has a non-uniform linear charge density

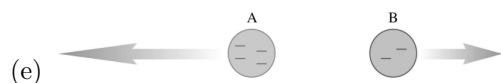
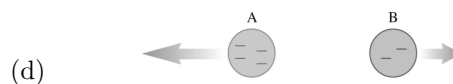
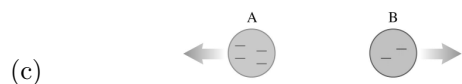
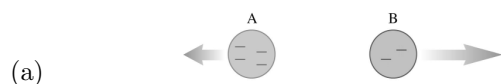
$$\lambda(\theta) = \lambda_0 \cos(\theta) \quad \text{for } 0 \leq \theta < 2\pi$$

where θ is an angle measured counter-clockwise from the positive x-axis, and λ_0 is a positive constant. What is the direction of the electric field at the center of the ring?

- (a) The field is in the $-y$ direction.
- (b) The field is in the $-x$ direction.
- (c) The field has no direction, as the magnitude is zero.
- (d) The field is in the $+x$ direction.
- (e) The field is in the $+y$ direction.



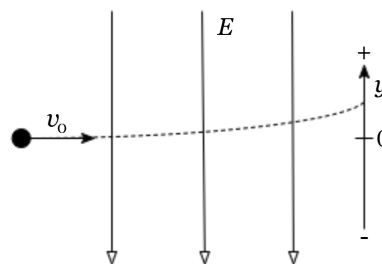
7. (5 points) Particles A and B have charges $-4q$ and $-2q$, respectively. In which diagram do the arrows best represent the force on each particle?



8. (5 points) Several particles, each with the same initial horizontal initial velocity, enter a region with uniform vertical electric field. While traveling some distance, the particles are deflected by a vertical amount y . The particles are

- an electron (charge $-e$, mass m_e)
- a proton (charge $+e$, mass $1000m_e$)
- a muon (charge $-e$, mass $200m_e$)
- a neutron (charge 0, mass $1000m_e$).

The trajectory of the electron is sketched in the figure. Rank the particles according to where they arrive on the y axis, from topmost (most positive y) to bottommost (most negative y). (Gravity may be neglected.)

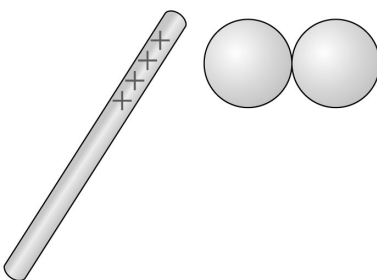


- (a) muon, electron, neutron, proton
 (b) electron, muon, neutron, proton
 (c) proton, muon, electron, neutron
 (d) electron, proton, muon, neutron
 (e) neutron, proton, muon, electron

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9. (5 points) How could two identical conducting spheres be given equal charges?

Start with the spheres touching. Bring a charged object nearby. Then ...

- (a) separate the spheres, briefly connect the further sphere to ground, and remove the charged object.
- (b) briefly connect the further sphere to ground, separate the spheres, and remove the charged object.
- (c) separate the spheres, and remove the charged object.
- (d) briefly connect the further sphere to ground, remove the charged object, and separate the spheres.



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10. (5 points) A dipole is held near a uniform infinite sheet of positive charge, oriented as shown. How, if at all, does the dipole move after it is released?

- (a) It rotates clockwise and moves toward the sheet.
- (b) It just rotates clockwise.
- (c) It does not move.
- (d) It rotates counter-clockwise and moves toward the sheet.
- (e) It just rotates counter-clockwise.

