Quiz and Exam Formulæ & Constants

$$k = \frac{1}{4\pi\epsilon_0}$$
$$\Delta V = -\int \vec{E}\cdot d\vec{s}$$
$$V = k\frac{q}{r}$$
$$\Delta U = q\,\Delta V$$
$$I = dq/dt$$
$$P = I\,\Delta V$$
$$R = \frac{\Delta V}{I}$$

Series :
$$\frac{1}{C_{\text{eq}}} = \sum \frac{1}{C_i}$$
$$R_{\text{eq}} = \sum R_i$$

Parallel :
$$\frac{1}{R_{\text{eq}}} = \sum \frac{1}{R_i}$$
$$C_{\text{eq}} = \sum C_i$$

$$\vec{E} = k\frac{q}{r^2}\hat{r}$$
$$\vec{F} = k\frac{q_1 q_2}{r^2}\hat{r}$$
$$\vec{F} = q\vec{E}$$
$$\vec{p} = q\vec{d}$$
$$\vec{\tau} = \vec{p}\times\vec{E}$$
$$U = -\vec{p}\cdot\vec{E}$$
$$|\vec{E}| \propto \frac{|\vec{p}|}{r^3}$$
$$\Phi_{\text{E}} = \int \vec{E}\cdot d\vec{A}$$
$$\epsilon_0 \oint \vec{E}\cdot d\vec{A} = q_{\text{enclosed}}$$
$$\oint \vec{E}\cdot d\vec{\ell} = -\frac{d\Phi_{\text{B}}}{dt}$$
$$C = \frac{Q}{\Delta V}$$
$$C = \epsilon_0 \frac{A}{d}$$
$$U = \tfrac{1}{2}C\,[\Delta V]^2$$
$$R = \rho\frac{\ell}{A}$$
$$\tau_{\text{C}} = RC$$
$$u_{\text{E}} = \tfrac{1}{2}\epsilon_0 E^2$$

$$\vec{B} = \frac{\mu_0 q}{4\pi}\frac{\vec{v}\times\hat{r}}{r^2}$$
$$d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{\ell}\times\hat{r}}{r^2}$$
$$\vec{F} = q\vec{v}\times\vec{B}$$
$$\vec{F} = I\vec{\ell}\times\vec{B}$$
$$\vec{\mu} = NI\vec{A}$$
$$\vec{\tau} = \vec{\mu}\times\vec{B}$$
$$U = -\vec{\mu}\cdot\vec{B}$$
$$\Phi_{\text{B}} = \int \vec{B}\cdot d\vec{A}$$
$$\oint \vec{B}\cdot d\vec{A} = 0$$
$$\oint \vec{B}\cdot d\vec{\ell} = \mu_0(I_{\text{c}} + I_{\text{d}})$$
$$L = \frac{\Phi_{\text{B}}}{I}$$
$$L = \mu_0 N^2 \frac{A}{\ell}$$
$$U = \tfrac{1}{2}LI^2$$
$$B = \mu_0 n I$$
$$\tau_{\text{L}} = L/R$$
$$u_{\text{B}} = \frac{1}{2\mu_0}B^2$$

$$q = q_{\max}\left(1 - e^{-t/\tau_{\text{C}}}\right)$$
$$q = q_0 e^{-t/\tau_{\text{C}}}$$
$$I = I_{\max}\left(1 - e^{-t/\tau_{\text{L}}}\right)$$
$$I = I_0 e^{-t/\tau_{\text{L}}}$$
$$I = \int \vec{J}\cdot d\vec{A}$$
$$\vec{J} = \sigma\vec{E}$$
$$\mathcal{E} = -N\frac{d\Phi_{\text{B}}}{dt}$$
$$I_d = \epsilon_0 \frac{d\Phi_{\text{E}}}{dt}$$
$$\mathcal{E} = -L\frac{dI}{dt}$$
$$c = f\lambda = \frac{|\vec{E}|}{|\vec{B}|}$$
$$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B}$$

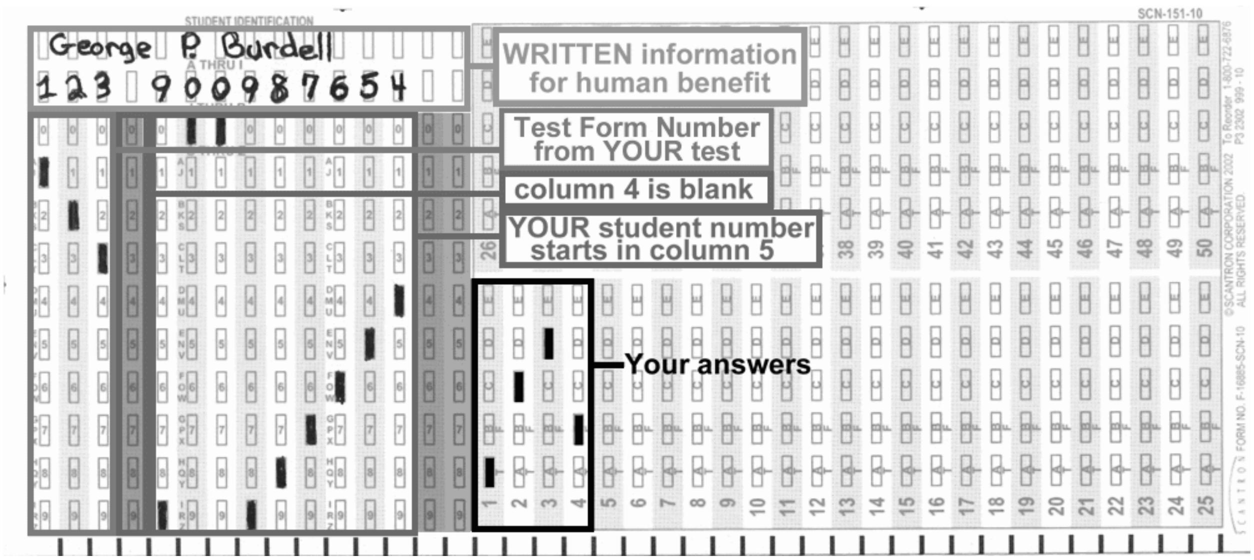
Fundamental Charge $e = 1.602\times10^{-19}\,\text{C}$
Earth's gravitational field $g = 9.81\,\text{N/kg}$
Coulomb constant $K = 8.988\times10^{9}\,\text{N}\cdot\text{m}^2/\text{C}^2$
Speed of Light $c = 2.998\times10^{8}\,\text{m/s}$

Mass of an Electron $m_{\text{e}} = 9.109\times10^{-31}\,\text{kg}$
Mass of a Proton $m_{\text{p}} = 1.673\times10^{-27}\,\text{kg}$
Vacuum Permittivity $\epsilon_0 = 8.854\times10^{-12}\,\text{C}^2/\text{N}\cdot\text{m}^2$
Vacuum Permeability $\mu_0 = 4\pi\times10^{-7}\,\text{T}\cdot\text{m/A}$

Unless otherwise directed, friction, drag, and gravity should be neglected, and all batteries and wires are ideal.
All derivatives and integrals in free-response problems must be evaluated.

Please remove this sheet from your Quiz or Exam

Version: A



YOUR form number is **128**

Recitation Sections

	Clough 127	Clough 131
Monday		
1:55 – 2:45 pm		J05 Girdhar, Anant
3:00 – 3:50 pm	G05 Girdhar, Anant	
4:30 – 5:20 pm	G06 Girdhar, Anant	J06 Bapat, Chaitanya
6:00 – 6:50 pm	G07 & J07 Bernardes, Sarah	
Tuesday		
12:00 – 12:50 pm	G08 Huang, Shengnan	J08 Daum, Marcus
3:00 – 3:50 pm	G09 Huang, Shengnan	J09 Daum, Marcus
4:30 – 5:20 pm	G10 Huang, Shengnan	J10 Daum, Marcus
Wednesday		
3:00 – 3:50 pm	G01 Bapat, Chaitanya	J01 Bernardes, Sarah
4:30 – 5:20 pm	G02 Bapat, Chaitanya	J02 Bernardes, Sarah
Thursday		
12:00 – 12:50 pm	G03 Huang, Shengnan	J03 Daum, Marcus
3:00 – 3:50 pm	G04 Huang, Shengnan	J04 Daum, Marcus

Version
A

Quiz #1 Form #125

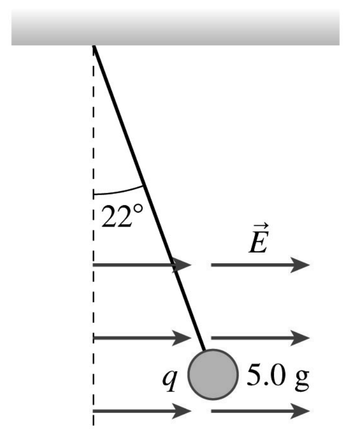
Physics 2212 G&J Fall 2017

Name:________________________

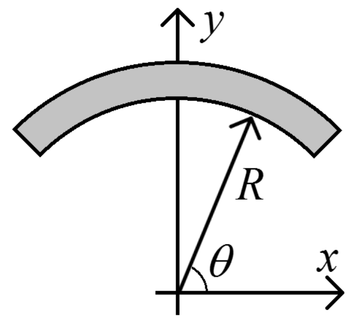
Recitation Section:__________________

- 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 1–7. 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. (16 points) The small sphere has a mass of 5.0 g, and a charge $q = +13\,\text{nC}$. It hangs by an ideal cord at an angle of 22° from the vertical, as shown. What is the magnitude of the horizontal electric field? (*On Earth, do NOT neglect gravity.*)



1. (6 points) A non-uniform thin rod of charge is bent into an arc of radius R. It extends from $\theta = \pi/4$ to $\theta = 3\pi/4$, as shown. The linear charge density λ of the rod depends on θ according to



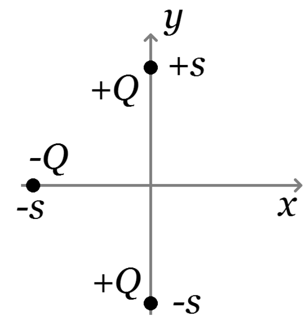
$$\lambda = \frac{\lambda_0}{\sin\theta}$$

where λ_0 is a positive constant. In what direction is the electric field at the origin?

(a) In the $+x$ direction.
(b) In the $-y$ direction.
(c) In the $+y$ direction.
(d) In the $-x$ direction.

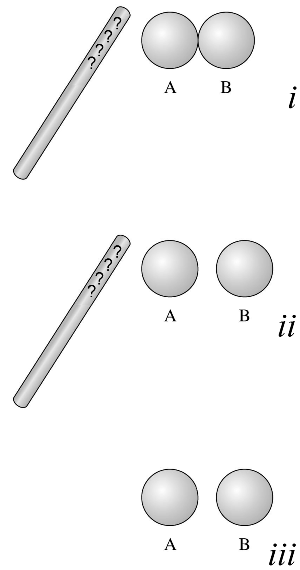
II. (16 points) In the problem above, what is the magnitude of the electric field at the origin? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants.

III. (16 points) Two small insulating spheres are centered at $y = \pm s$, as shown. These spheres have a uniformly distributed positive charge $+Q$. A test charge is centered at $x = -s$ with negative charge $-Q$. What is the electric **field** at the center of the test charge, in terms of parameters defined in the problem and physical or mathematical constants?



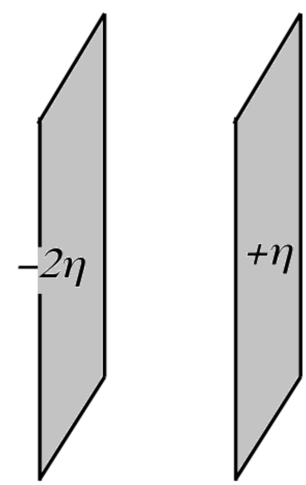
2. (6 points) In the problem above, what happens to the electric field at the point $x = -s$ if the sphere of charge $-Q$ is replaced with a positive test charge $+Q$?
   (a) It remains the same in magnitude and direction.
   (b) It increases in magnitude but maintains the same direction.
   (c) It has the same magnitude but opposite direction.
   (d) It decreases and has opposite direction.
   (e) It increases in magnitude and has opposite direction.

3. (8 points) Two identical neutral conducting spheres are in contact when a rod with non-zero charge is brought nearby (*i*). The spheres are then separated (*ii*), and the rod is taken away (*iii*). Compare the resulting charge of each sphere to that of the rod.



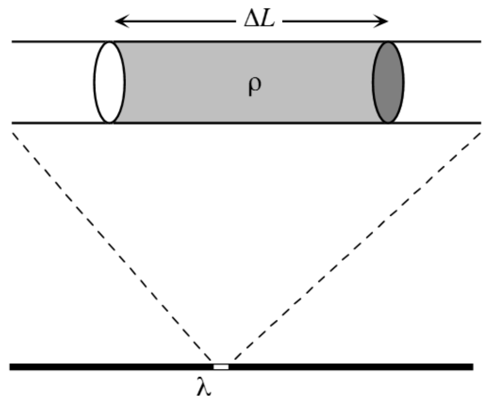
(a) Both Sphere A and Sphere B are neutral.
(b) Sphere A has charge of the same sign as the rod, while Sphere B has charge opposite the sign of the rod.
(c) Both Sphere A and Sphere B have charge opposite the sign of the rod.
(d) Both Sphere A and Sphere B have charge of the same sign as the rod.
(e) Sphere A has charge opposite the sign of the rod, while Sphere B has charge of the same sign as the rod.

4. (8 points) A pair of charged infinite sheets aligned parallel to one another, as shown in the diagram below. What will be the magnitude and direction of the electric field at a point to the left of both sheets?



(a) $\eta/2\epsilon_0$ to the right
(b) $\eta/2\epsilon_0$ to the left
(c) η/ϵ_0 to the right
(d) No direction, as the field magnitude is exactly zero.
(e) η/ϵ_0 to the left

5. (8 points) An insulating rod of radius R has some charge *uniformly* distributed throughout its volume, as a density ρ. At large distances from the rod, the cross-sectional area will not be noticeable, and the charge will seem to be a linear density λ. How is this effective λ related to the actual ρ for the rod?



(a) $\lambda = \rho / \left(\pi R^2\right)$
(b) $\lambda = \rho \, 2\pi R$
(c) $\lambda = \rho / \left(4\pi R^2\right)$
(d) $\lambda = \rho \, \pi R^2$
(e) $\lambda = \rho / (2\pi R)$

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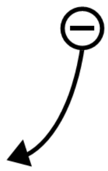
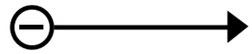
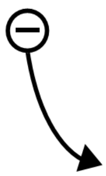
6. (8 points) Charged particle q_1 exerts a force magnitude $F_{1\text{on}2}$ on charged particle q_2. If the charge of each particle is tripled (increased by a factor of 3), and the distance between the particles is doubled (increased by a factor of 2), what is the new force magnitude $F'_{1\text{on}2}$?

(a) $F'_{1\text{on}2} = 3F_{1\text{on}2}/2$
(b) $F'_{1\text{on}2} = 9F_{1\text{on}2}/4$
(c) $F'_{1\text{on}2} = 2F_{1\text{on}2}/3$
(d) $F'_{1\text{on}2} = 9F_{1\text{on}2}/2$
(e) $F'_{1\text{on}2} = 3F_{1\text{on}2}/4$

7. (8 points) An electron moves through a uniform electric field which points directly to the right. Which of the following diagrams could **NOT** represent a possible trajectory for the electron at any time? Assume each straight-line path is perfectly straight, and that each curved path is parabolic in shape. Do **NOT** assume the electron is simply released from rest in every case.

(a) 

(b) 

(c) 

(d) 

(e)