Version

A

Quiz #1 Form #125

Physics 2212 G Spring 2018

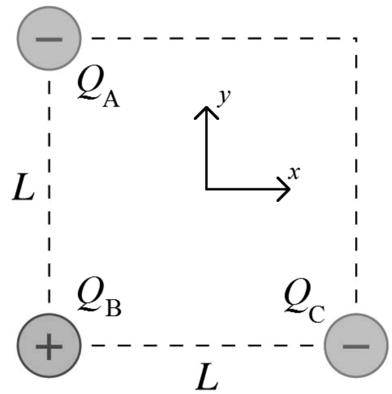
Name:______________________________

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) An electron is orbiting a charged dust speck, in a circular orbit of radius $880\,\mu\text{m}$. If the dust speck has a charge of $+2.2 \times 10^{-12}\,\text{C}$, what is the speed of the electron?

II. (16 points) Three particles are located on the vertexes of a square with sides having length $L = 12\,\text{cm}$, as shown. If $Q_A = -1.0\,\text{nC}$, $Q_B = +2.0\,\text{nC}$, and $Q_C = -3.0\,\text{nC}$, what is the magnitude of the force on particle B?

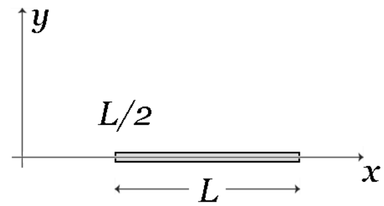


1. (6 points) What is the direction of the force on particle B?

   (a) 72°
   (b) 198°
   (c) 162°
   (d) 252°
   (e) 18°

III. (16 points) A thin rod of length L lies on the $+x$ axis, with one end at $+L/2$ and the other at $+3L/2$, as illustrated. The linear charge density, λ, of the rod depends on position, x, according to

$$\lambda = \lambda_0 \left(\frac{L}{x} \right)$$

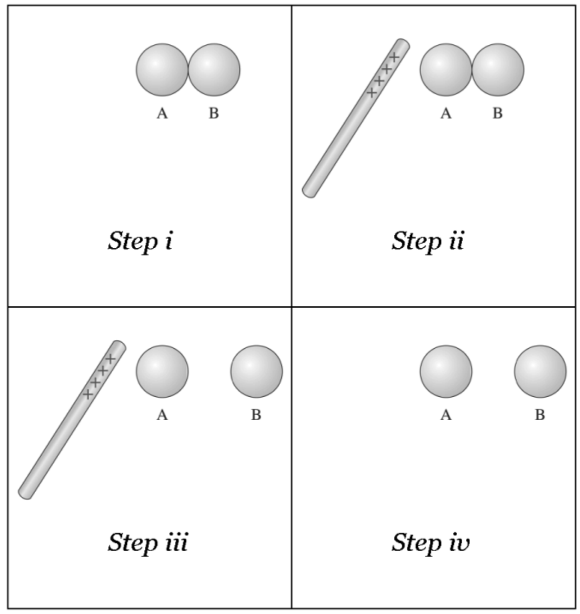


where λ_0 is a positive constant. What is the magnitude of the electric field at the origin? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants.

2. (6 points) In the problem above, what is the direction, if any, of the electric field at the origin?

   (a) In the $-x$ direction.
   (b) No direction, as the electric field magnitude is zero.
   (c) In the $-y$ direction.
   (d) In the $+y$ direction.
   (e) In the $+x$ direction.

3. (8 points) Two neutral conducting spheres, A and B, are in contact (*Step i*). A positively charged rod is brought near, but not touching, sphere A (*Step ii*). The spheres are separated (*Step iii*), and then the rod is removed (*Step iv*). Describe the charge of each sphere after *Step iv*.



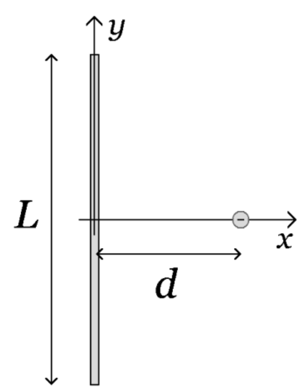
(a) A is neutral, B is neutral.
(b) A is negative, B is positive.
(c) A is positive, B is negative.
(d) A is negative, B is neutral.
(e) A is positive, B is neutral.

4. (8 points) A non-uniform line segment of charge with length L lies on the y axis. Its linear charge density, λ, depends on position, y, according to

$$\lambda = \lambda_0 y^5$$

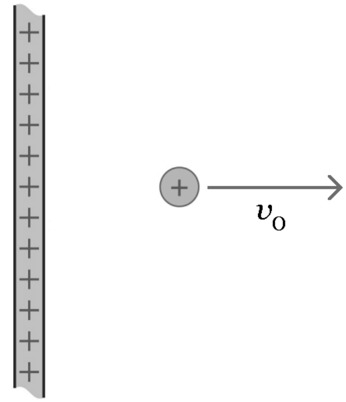
where λ_0 is a positive constant.

An electron is placed at a position $+d$ on the x axis. What is the direction of the electric field due to the line segment of charge at the location of the electron?



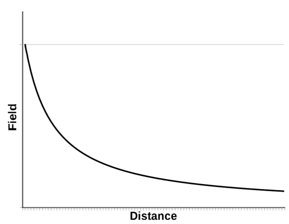
(a) The electric field at the electron is undefined.
(b) The electric field at the electron is in the $+x$ or $+\hat{\imath}$ direction.
(c) The electric field at the electron is in the $-y$ or $-\hat{\jmath}$ direction.
(d) The electric field at the electron is in the $+y$ or $+\hat{\jmath}$ direction.
(e) The electric field at the electron is in the $-x$ or $-\hat{\imath}$ direction.

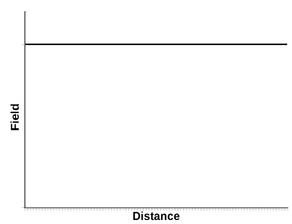
5. (8 points) A particle with positive charge q and mass m has initial velocity $\vec{v}_0$, moving away from the positively and uniformly charged infinite **rod** shown in the figure. Which statement best describes the subsequent motion of the particle?

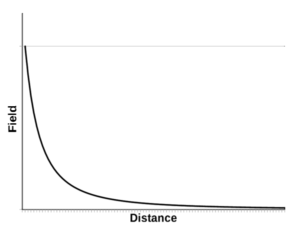


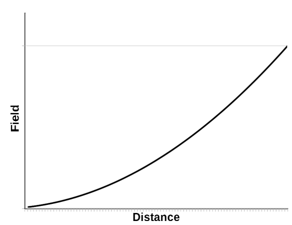
(a) It will keep moving away from the rod, with increasing speed.
(b) It moves away from the rod initially, but will eventually slow down, reverse direction, and move back towards the rod.
(c) It moves away from the rod initially, but it eventually comes to rest very far away from it.
(d) It will keep moving away from the rod, with constant speed.
(e) It will keep moving away from the rod, with decreasing speed.

6. (8 points) How does the electric field magnitude due to an infinite uniformly charged sheet depend on the distance from the sheet?

(a) 

(b) 

(c) 

(d) 

(e) 

7. (8 points) A dipole is released near a negatively-charged particle, as shown. What is the subsequent motion of the dipole?

   (a) It rotates clockwise and moves closer to the negative charge.
   (b) It just rotates clockwise.
   (c) It just rotates counter-clockwise.
   (d) It rotates counter-clockwise and moves farther from the negative charge.
   (e) It remains stationary.

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

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

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

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

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

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

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

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