Physics 2212G/J Test form **411** Name _____
Fall 2016
Test 1 Recitation Section (see back of test):_____

A

1) Print your name, test form number (above), and nine-digit student number in the section of the answer card labeled "STUDENT IDENTIFICATION".

2) Bubble your test form number (**ABOVE**) in columns 1-3, skip column 4, then bubble in your student number in columns 5-13.

3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer.** "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.

4) For each multiple-choice question, select the answer most nearly correct, **circle this answer on your test**, and bubble it in on your answer card. **Show all relevant work on your quiz.**

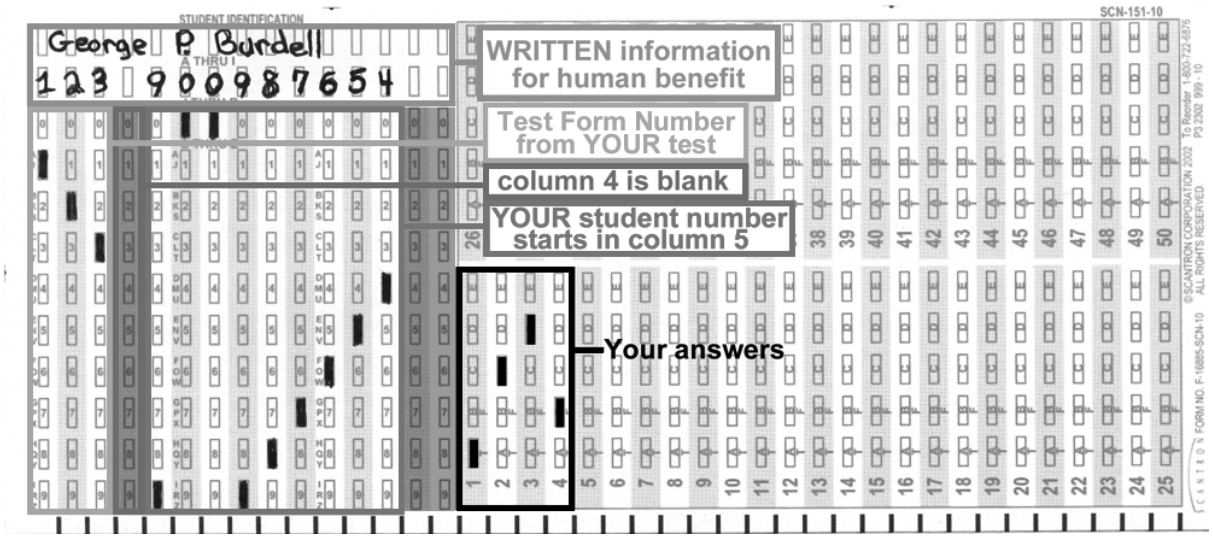
5) Be prepared to present your Buzzcard as you turn in your test. Scores will be posted to WebAssign after they have been been graded. **Quiz grades become final when the next quiz is given.**

6) You may use a simple scientific calculator capable of logarithms, exponentials, and trigonometric functions. **Programmable engineering calculators with text or graphical capabilities are not allowed. Wireless devices are prohibited.**

Numerical Constants:

$k = 8.99\times10^{9}$ N·m^2/C^2	$e = 1.60\times10^{-19}$ C	$m_e = 9.11\times10^{-31}$ kg
$\varepsilon_o = 8.85\times10^{-12}$ C^2/N·m^2	$g = 9.81$ m/s^2	$m_p = 1.67\times10^{-27}$ kg

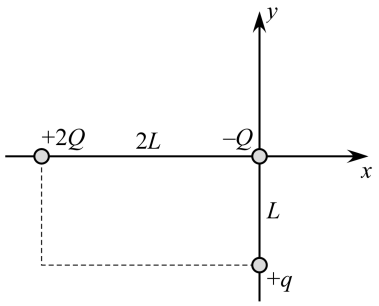
Your test form is: 411



Our next test will be on Tuesday, October 4

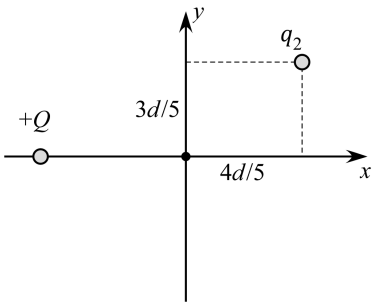
The following problem will be hand-graded. <u>*Show all your work for this problem*</u>*. Make no marks and leave no space on your answer card for it.*

[I] *(20 points)* The figure at right displays point charges placed at three corners of a $2L \times L$ rectangle. Determine the direction of the net electric force on charge $+q$. Express your answer as a numerical direction angle measured relative to one of the coordinate axes.



The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

[II] *(20 points)* A positive source charge $+Q$ is placed on the negative x-axis, a distance d from the origin. A second source charge q_2 having unknown sign and magnitude is placed at $\langle x, y\rangle = \langle 4d/5\ , 3d/5\rangle$. It is found that the net electric field at the origin has no x-component, i.e. $\vec{E}_{\text{net},x} \equiv 0$.

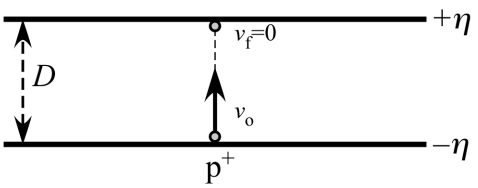


(i) Determine the magnitude and sign of charge q_2. Express your answer as a multiple of Q.

(ii) Find the net electric field at the origin. Express your answer as a Cartesian vector (i.e. $\hat{\imath}$ and $\hat{\jmath}$ terms) involving the symbols k, Q, and d.

The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

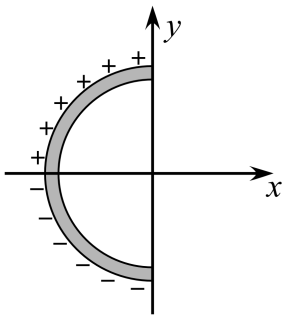
[III] *(20 points)* A capacitor consists of two large parallel plates separated by a distance D, carrying equal and opposite surface charge densities, $\pm\eta$. From the negative plate, a proton (mass m, charge $+e$) is fired directly toward the positive plate with a speed v_o. It is observed to stop momentarily just as it reaches the plate, after which it falls back toward the negative plate. (Assume that gravity is negligible.)



Find an expression for the magnitude of the surface charge density η on either plate. Express your answer in terms of the other parameters given in this problem, along with any necessary fundamental constants.

The next two questions both involve the following situation:

A thin plastic rod is bent in to a semicircle of radius *R* as shown at right. The upper-left portion (in Quadrant II) has uniform charge per unit length +λ, and the lower-left portion (in Quadrant III) has uniform charge per unit length –λ.



Question value 4 points

(1) What is the direction of the net electric field at the origin?

(a) $+\hat{\imath}$

(b) $+\hat{\jmath}$

(c) The field is zero so there is no direction.

(d) $-\hat{\jmath}$

(e) $-\hat{\imath}$

Question value 4 points

(2) Let E_o be the magnitude of the electric field at the origin due to the semicircular rod. If the positively charged half is removed, what is the (new) magnitude of the electric field at the origin? *Hint: You can answer this question without doing an integral.*

(a) $2E_o$

(b) $E_o/2$

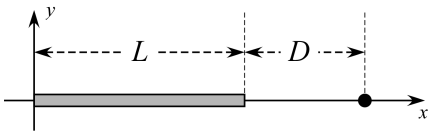
(c) $E_o/\sqrt{2}$

(d) E_o

(e) $\sqrt{2}\,E_o$

Question value 8 points

(3) A uniformly charged thin plastic rod of length L lies on the positive x-axis with one end at the origin. The rod has total charge $+Q$. Which of the following expressions gives the correct magnitude for the electric field, at a point on the x-axis that is a distance D from the right end of the rod?



(a) $E = \int_{x=0}^{L+D} \frac{k\,Q\,dx}{L\,x^2}$

(b) $E = \int_{x=0}^{L} \frac{k\,Q\,dx}{L\,(L+D-x)^2}$

(c) $E = \frac{k\,Q}{(D+L/2)^2}$

(d) $E = \int_{x=0}^{L} \frac{k\,Q\,dx}{L\,(D-x)^2}$

(e) $E = \int_{x=0}^{D} \frac{k\,Q\,dx}{L\,(L+x)^2}$

Question value 8 points

(4) The electric field strength 2.0 cm from the surface of an 11 cm-diameter metal sphere is 54,000 N/C. What is the magnitude of the charge on the ball?

(a) 18.2 nC

(b) 450 nC

(c) 2.40 nC

(d) 33.8 nC

(e) 101 nC

Question value 8 points

(5) A positive charge $+q$ is used as a test charge to detect the electric field created by a set of unknown source charges, $\{Q_i\}$. When placed at a particular point *P*, the charge experiences a force $\vec{F}_1$, which allows us to determine an electric field value $\vec{E}_1$. If, instead we were to use a larger, *negative* test charge, $-2q$, to probe the field, what would we measure for the force and field when the new test charge is placed at the same point *P*?

(a) $\vec{F}_2 = -2\vec{F}_1$ and $\vec{E}_2 = \vec{E}_1$

(b) $\vec{F}_2 = 2\vec{F}_1$ and $\vec{E}_2 = -\vec{E}_1$

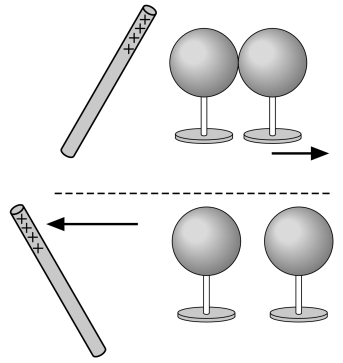
(c) $\vec{F}_2 = -\vec{F}_1$ and $\vec{E}_2 = 2\vec{E}_1$

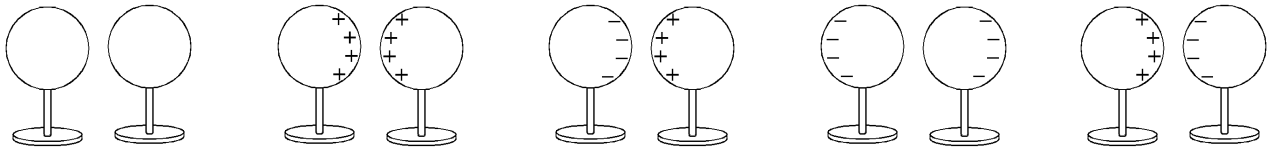
(d) $\vec{F}_2 = \vec{F}_1$ and $\vec{E}_2 = \vec{E}_1$

(e) $\vec{F}_2 = 2\vec{F}_1$ and $\vec{E}_2 = -2\vec{E}_1$

Question value 8 points

(6) Two solid uncharged conducting spheres are supported on insulating stands. With the spheres in direct contact, a positively-charged rod is brought close to the left-hand sphere, and *then* the right-hand sphere is pulled away (top figure). *After* separating the spheres, the rod is taken away (bottom figure). Which of the diagrams below best depicts the final distribution of electrical charge on the two spheres, after the rod has been removed?





(a) (b) (c) (d) (e)

PHYS 2212 G/J Recitation TA and Room Assignments

	Howey S-104	Howey S-106	Howey S-107
WEDNESDAY			
1:05 pm		J01 Zhou, Boli	
2:05 pm		G01 Zhou, Boli	G02 Daum, Marcus
3:05 pm		G06 Zhou, Boli	J02/J05 Daum, Marcus
4:05 pm		G08 Kim, Sirwoo	
5:05 pm	J09 Daum, Marcus	G03/J06 Kim, Sirwoo	
THURSDAY			
12:05 pm			G04 Daum, Marcus
1:05 pm			J10 Daum, Marcus
2:05 pm		G09 Zhou, Boli	J03/J08 Daum, Marcus
3:05 pm		G10/J07 Zhou, Boli	
4:05 pm		J04 Thoreson, Megan	
5:05 pm		G05 Zhou, Boli	G07 Bernardes, Sarah

Tests will be returned in recitation, in the week *after* the test. In order to ensure that you receive your test back as soon as possible, please enter your recitation section from the table above (G01–G10) on the front of this test.