Physics 208, Spring 2004 – Exam #1

A

Name (Last, First): _____

ID #: _____

Section #: _____

- You have 75 minutes to complete the exam.
- Formulae are provided on a separate colored sheet. You may NOT use any other formula sheet.
- You may use only a simple calculator: one without memory, or with a memory demonstrated to be cleared.
- When calculating numerical values, be sure to keep track of units. Results must include proper units.
- Be alert to the number of significant figures in the information given. Results must have the correct number of significant figures.
- If you are unable to solve a problem whose solution is needed in another problem, then assign a symbol for the solution of the first problem and use that symbol in solving the second problem.
- If you need additional space to answer a problem, use the back of the sheet it is written on.
- Show your work. Without supporting work, the answer alone is worth nothing.
- Mark your answers clearly by drawing boxes around them.
- Please write clearly. You may gain marks for a partially correct calculation if your work can be deciphered.

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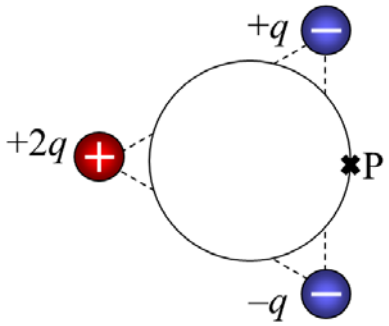
208 Mid-Term 1 POINTS TABLE	
Multiple Choice (out of 20)	
Problem 1 (out of 20)	
Problem 2 (out of 20)	
Problem 3 (out of 20)	
Problem 4 (out of 20)	
TOTAL SCORE (out of 100)	

For the following four multiple choice questions, more than one answer could be correct. Mark all possible correct answers by circling the letter in front of your choice(s).

MC 1. (5 points)
For the figure on the right, which of the following statements are true for the net flux through the spherical region and the E-field at point P which is on the spherical region. All three point charges are equidistant from the center of the sphere and are in the same plane.

A. The net flux is zero and the E-field is also zero.
B. The net flux is zero but the E-field is not zero.
C. The net flux is not zero and the E-field is not zero.
D. The net flux is not zero but the E-field is zero.
E. None of the above.



MC2. (5 points)
Three point charges are placed on the three vertices of an equilateral triangle and held in place.
Two of these charges form an electric dipole as shown in the figure. If the length of each side is 'a' and $k = 1/4\pi\varepsilon_0$, then the net torque on the dipole is

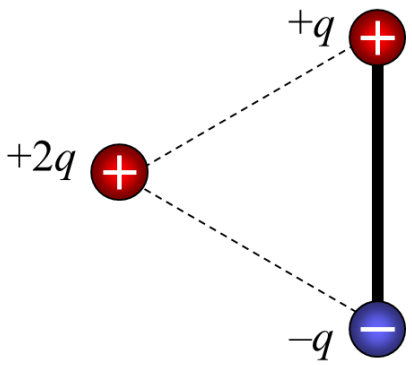
A. Zero because both the total charge and the net force on the dipole is zero.

B. $\frac{2.60\ kq^2}{a}$

C. $\frac{1.73\ kq^2}{a}$

D. $\frac{kq^2}{a/2}$

E. $\frac{0.87\ kq^2}{\left(\frac{a}{2}\right)^2}$



MC3. (5 points)

A positive point charge q is placed at the center of a hollow conducting spherical shell of radius 3.0m. The shell has a charge $-q$ on it. The electric potential at a distance 1.30 m from the point charge with respect to the potential at infinity of any point charge is – (Note: $k = 1/4\pi\varepsilon_0$)

A. 1.10 kq
B. 0.77 kq
C. 0.44 kq
D. 0.33 kq
E. Zero, because the net charge is zero!

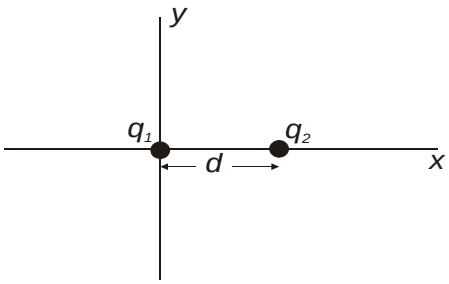
MC4. (5 points)
A positive point charge $+Q$ is released from rest in an electric field. For any later time, after the charge is released, which of the following statements are necessarily true. The velocity of the point charge

A. is in the same direction as the electric field at the position of the point charge.
B. is directly opposite to the direction of the electric field at the position of the point charge.
C. is perpendicular to the direction of the electric field at the position of the point charge.
D. is zero.
E. not enough information is given to decide.

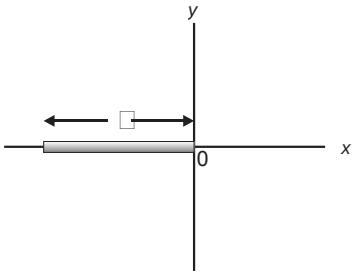
1. (20 marks) The two charges designated q_1 and q_2 in the figure have the values $q_1 = -Q$ and $q_2 = +3Q/2$.

a) At what value(s) of x on the x axis (either positive or negative) is the electric field zero? [Hint: draw the E vectors on the diagram first.]

b) At what value(s) of x on the x axis (either positive or negative) is the potential zero? Let $V = 0$ at $r = \infty$.

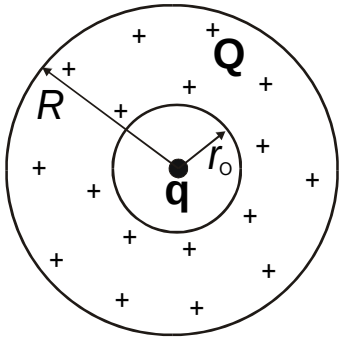


2. (20 marks) A thin rod of length *l* carries a total charge Q distributed uniformly along its length. Determine the electric field along the axis of the rod starting at one end — that is, find *E(x)* for $x \geq 0$ in the figure.



3. (20 marks) A non-conducting sphere of radius R has a spherical cavity of radius r_o centered at the sphere's center (see figure). There is a charge Q distributed uniformly in the non-conducting "shell" (between $r = r_o$ and $r = R$). In addition, there is a point charge q located at the center of the cavity. Determine the electric field for

a) $0 < r < r_o$;
b) $r_o < r < R$; and
c) $r > R$



4. **(20 marks)** Two identical +12.5-μC point charges are initially spaced 7.0 cm from each other. They have identical masses of 2.0 mg.

   a) If both are released at the same instant from rest, how fast will they be moving when they are very far away from each other?
   b) If only one is released, what will be its speed when it is very far away?