

Exam 1 – white version

Physics 2760

Fall 2012

Please identify your Lab section
Lab Section #
Name of TA:

Last Name _____

Solutions

First Name _____

ID # _____

This is a closed book exam. I understand, pursuant to University Regulations on academic honesty, that I am not to use any notes or consult with peers during the examination.

Signature _____

For multiple choice questions, please make sure that you circle the letter for the answer which you believe to be correct and only that answer. If more than one answer is circled for the same problem or there are any ambiguities, you will not receive credit for it. Don't get hung up on questions. They should take only one or two minutes each. If you find yourself spending more than a few minutes on a multiple choice question you are probably looking at it the wrong way. You should skip it for now and come back to it later.

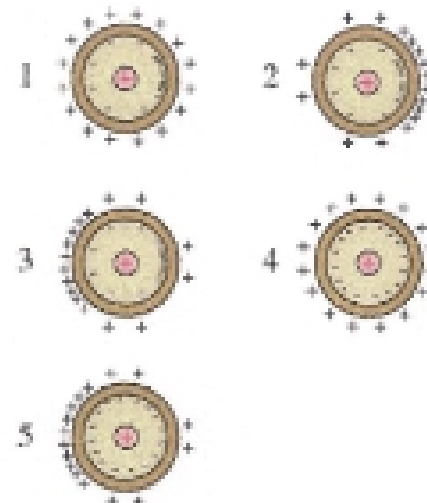
For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

Relax, read carefully, think – and then read everything again.

During the exam, if you have questions please raise your hand and the TA or the instructor will come to you and provide help.

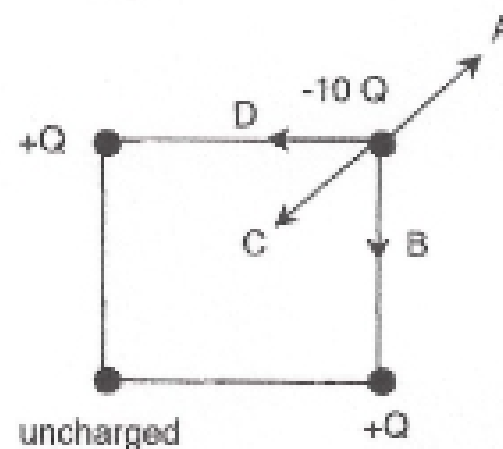
1. (5 points) The ^{central} positive charge is equal to roughly 16 of the smaller charges shown on the surfaces of the spherical shell. Which of the pictures best represents the charge distribution on the inner and outer walls of the shell?

- a) 2
- b) 3
- c) 1
- d) 4
- e) 5



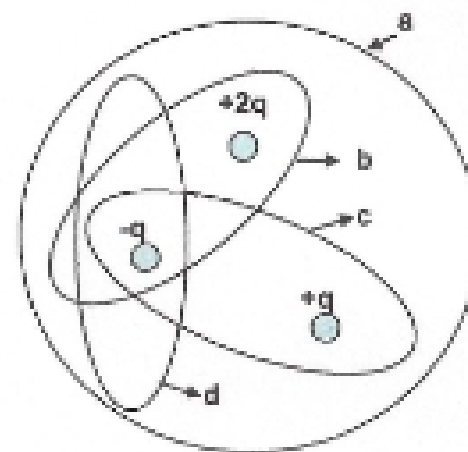
2 (5 points) Four point charges are arranged at the corners as shown. Which of the arrows labeled A, B, C, and D gives the correct direction of the net force that acts on the charge at the upper right corner?

- (a) A
- (b) B
- (c) C
- (d) D



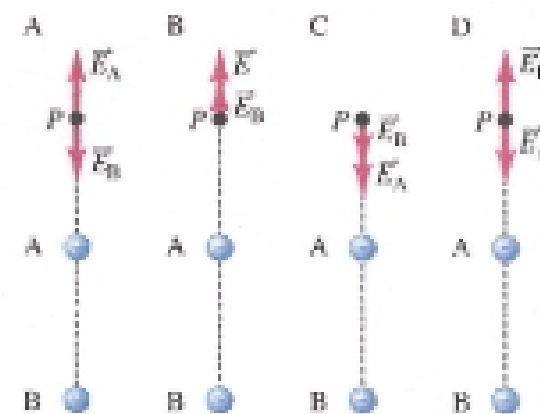
3. (5 points) The Figure on the right shows four Gaussian surfaces surrounding a distribution of charges. The Gaussian surface (surfaces) that has (have) no electric flux through it (them) is (are)

- a) surface a
- b) surface b
- c) surface d
- d) surface c



4. (5 points) Which of the following diagrams, where \vec{E}_A and \vec{E}_B are the electric fields produced by A and B, respectively, correctly represents the situation described in this problem?

- a) A
- b) B
- (c) C
- d) D

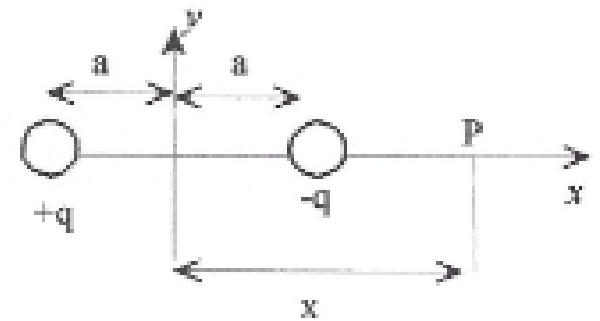


5. (5 points) The electric potential in a certain region of space is given by $V = Axy + Bx^2$. Here A and B are both positive constants. Which statement about the electric field at a point in the first quadrant ($x > 0; y > 0$) of the xy -plane is correct?

- a) $E_x < 0, E_y > 0$
- b) $E_x = 0, E_y > 0$
- (c) $E_x < 0, E_y < 0$
- d) $E_x > 0, E_y = 0$

Problem 6

An electric dipole consists of two equal and opposite charges separated by a distance "2a" as shown in the figure.



10 points A) Calculate the magnitude of the electric field at point P in terms of the charge, separation between the charges, and the distance from the point of observation.

$$\begin{aligned}
 E &= \frac{k(-q)}{(x-a)^2} + \frac{k(q)}{(x+a)^2} \\
 &= kq \left[\frac{-(x+a)^2 + (x-a)^2}{(x^2-a^2)^2} \right] \\
 &= kq \left[\frac{-x^2 - a^2 - 2xa + x^2 + a^2 - 2xa}{(x^2-a^2)^2} \right]
 \end{aligned}$$

$$\boxed{|\vec{E}| = \frac{4kqa}{(x^2-a^2)^2}}$$

7 points B) If the point P is located at a distance such that $x \gg a$, what is electrical potential at this point P, assuming that the electrical potential at infinity is zero? [hint: from part A, first determine the electric field at P when $x \gg a$.]

for $x \gg a$ $|\vec{E}| \sim \frac{4kqa}{x^3}$

$$V = -\int_0^x E dx = -4kqa \int_0^x \frac{dx}{x^3}$$

$$\boxed{V = \frac{2kqa}{x^2}}$$

8 points C) Sketch the electric field lines and the equipotential surfaces of the electric dipole of charges +q and -q shown below. (To distinguish, sketch the electric field lines by solid lines and the equipotential surfaces by dotted lines.)

