Physics 2049 Test 1 Name:_____
Dr. Jeff Saul Group:_____
Spring 2003 Date:_____

READ THESE INSTRUCTIONS BEFORE YOU BEGIN

- Before you start the test, **WRITE YOUR NAME ON EVERY PAGE OF THE EXAM.**

- Basic scientific calculators (no programmable or graphing calculators) are permitted, but no notes or books are allowed

- If you have ANY questions while taking the test, please be sure to ask me. The purpose of the test is not to give you trick problems to catch you in an error. The purpose is to give you an opportunity to "show what you know!"

- On problems 2, 4, & 5 your answers will be evaluated on how you got them. Remember that to get full credit on a problem you will need to
  - Make a list of given information and indicate what you are trying to find
  - Start from general principles
  - Solve for the unknown quantity in symbols before plugging in numbers
  - Substitute numbers with units
  - Include units with all numeric quantities

  Partial credit will be given for correct steps shown, even if the final answer is wrong.

- Write clearly and logically so that I can understand what you are doing and can give you as much partial credit as you deserve. I cannot give credit for what you are thinking, only for what you show on your paper.

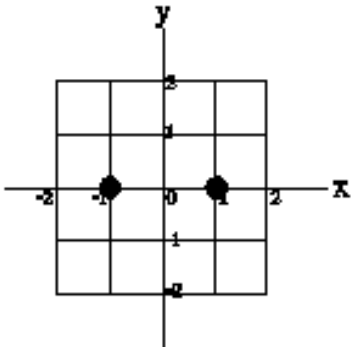
- If on a multistep problem you can't do a particular part, don't give up. Go on to the next part anyway. If necessary, define a variable name for the quantity you couldn't find and express your answer in terms of it.

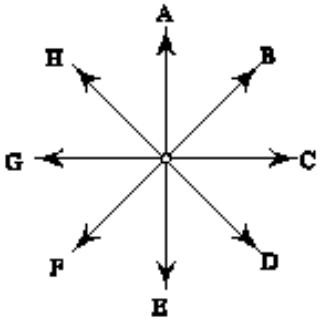
Problem	Points Possible	Score
Group Problem	25	
1	15	
2	15	
3	10	
4	20	
5	15	
Total	100	

Name:_____

Problem 1 (Short Answer: 15 points) no explanation required, but no partial credit either.

In the figure on the left below is displayed a grid with coordinates measured in meters. On the grid two charges are placed with their positions indicated as black circles. We call the charge at the position (1,0) q_1, and the charge at the position (-1,0) q_2. In the middle figure below is displayed a set of possible vector directions. On the right is a list of the components of possible E fields. For each of the three cases described below specify: an arrow corresponding to the directions of the E field from the middle figure, and a set of components from the list on the right. Each of your answers should consist of a capital letter and a small letter.





a. $\sqrt{8}(1,0)$

b. $\sqrt{8}(0,-1)$

c. $2(-1,0)$

d. $2(0,1)$

e. $\frac{1}{2}(1,\sqrt{5})$

f. $\frac{1}{2}(1,-\sqrt{5})$

g. *none of the above*

(a) $q_1 = 0$, $q_2 = 8\,\pi\,\varepsilon_0$ E-field at the point (x,y) = (-1,1)

(b) $q_1 = 0$, $q_2 = -8\,\pi\,\varepsilon_0$ E-field at the point (x,y) = (-1,-1)

(c) $q_1 = -q_2 = -16\,\pi\,\varepsilon_0$ E-field at the point (x,y) = (0,-1)

Name:_____

Problem 2 (Estimation Problem: 15 points)

A. Consider a situation where you have two pennies, the bottom one on a table and the top one held 1 m above the table. Estimate how many electrons would need to be added to both pennies so that you can let go of the top penny and it would stay suspended in midair. Be sure to list all assumptions and explain all approximations.

Name:_____

Problem 3 (Essay 10 points)

You may use diagrams and equations but no calculations in your response for this problem.

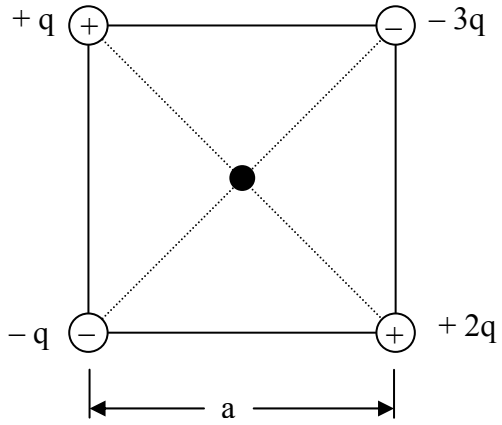
Explain how you could charge two metal spheres to have opposite charges without rubbing them or touching them. Explain how you would test them to make sure they are oppositely charged. You may touch either or both spheres with a neutral object.

Name:_____

Problem 4 (20 points)

Four point charges are at the corners of a square with sides of length a as shown below.

A. Using graphical vector addition, find the E-field at the center of the square.



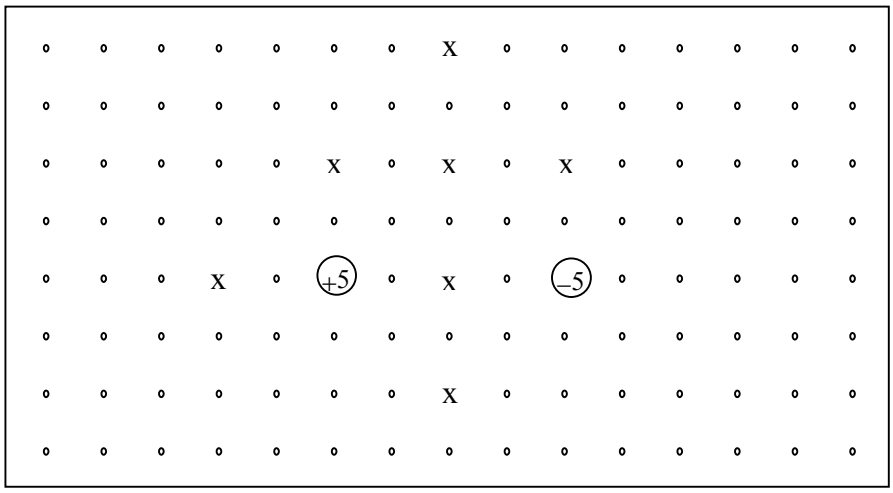
B. Using vector components, algebraically find the E-field at the center of the square.

C. If q = 0.5 μC and a = 25 cm, what would be the magnitude and direction of the force on an electron placed at the center of the square.

Name:_____

Problem 5 (15 points)

A) Sketch electric field vectors at the points marked x for the two equal and opposite point charges shown below.



(B) An electron (mass = 9.11 x 10^{-31} kg) is released from rest in a uniform electric field of magnitude 5000 N/C. Compute the magnitude of the electron's acceleration.

(C) Compute the distance the electron travels before reaching a speed of 2.0 x 10^{6} m/s.