Physics 2049 Test 2 Name:_____
Dr. Jeff Saul Group:_____
March 14, 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.

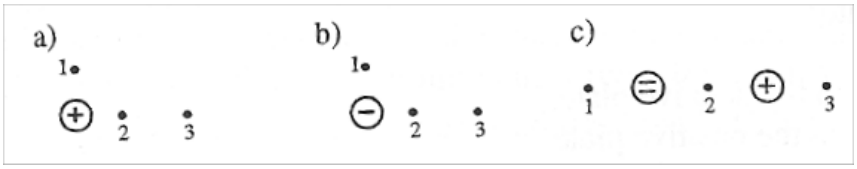
- If on a multistep problem you can't do a particular part, don't give up. Go on to the next part anyway. If necessary, define a variable name for the quantity you couldn't find and express your answer in terms of it.

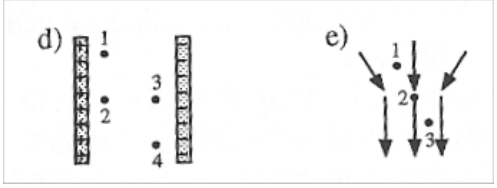
Problem	Points Possible	Score
Group Problem	25	
1	15	
2	15	
3	10	
4	18	
5	17	
Total	100	

Name:_____

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

Rank the electric potentials in the following situations from most positive to most negative.





Name:_____

Problem 2 (Estimation Problem: 15 points)

For a science fair, your kid brother wants to levitate a penny between two square metal plates where each side of the square is 40 cm long. If the penny is given an excess charge of 1 nC and the plates are given equal, but opposite charges, what is the magnitude of the charge on each plate. The plates are parallel and placed 3 cm apart.

Name:_____

Problem 3 (Essay 10 points)

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

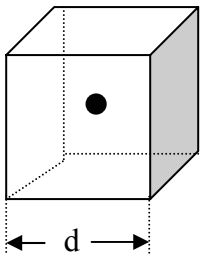
Consider the Gaussian cubes A and B shown below. Each cube has sides of length *d* and a shaded face. Two point charges, q_1 and q_2, each with charge q_0, are placed as follows: point charge q_1 is placed in the center of cube A. Point charge q_2 is placed at a distance $d/2$ to the left of the shaded face of cube B.

A. Which shaded face has the greater magnitude flux?

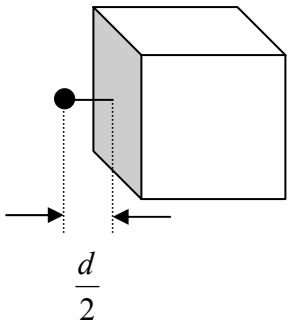
B. Which Gaussian cube has the larger Φ_{Total}?

Explain your reasoning and defend your answers without using calculations.

Cube A



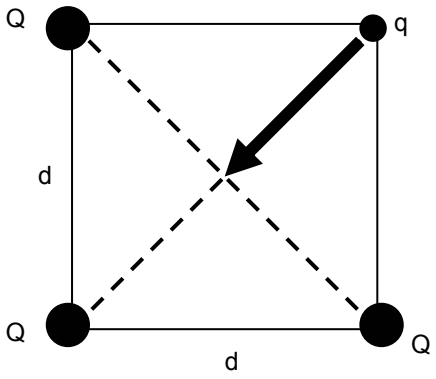
Cube B.



Name:_____

Problem 4 (18 points)

Three point charges, each with charge Q, are located at the three corners of a square as shown in the diagram on the right. Each side of the square is of length d. A forth charge q is then located at the fourth corner. You may use $k=1/4\pi\varepsilon_0$. Write carefully so your work can be followed



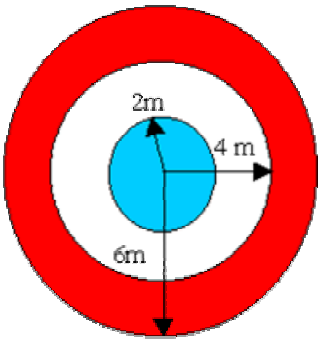
(a) Derive the potential for the point charge in the upper left corner.

(b) How much energy was required to assemble the initial 3 Q charges?

(c) How much work is required to move a charge q from the fourth corner to a point where the diagonals of the square intersect?

Name:_____

Problem 5 (17 points)



A solid spherical conductor with radius $R_1 = 2$ m is given a net charge of $+ Q_0$ and placed inside a spherical conducting shell (with inner radius $R_2 = 4$ m and outer radius $R_3 = 6$ m) with net charge + q.

(a) Use Gauss' Law to find a symbolic expression for magnitude of the electric field (if the electric field is zero state that explicitly and show your reasoning) at the following points:

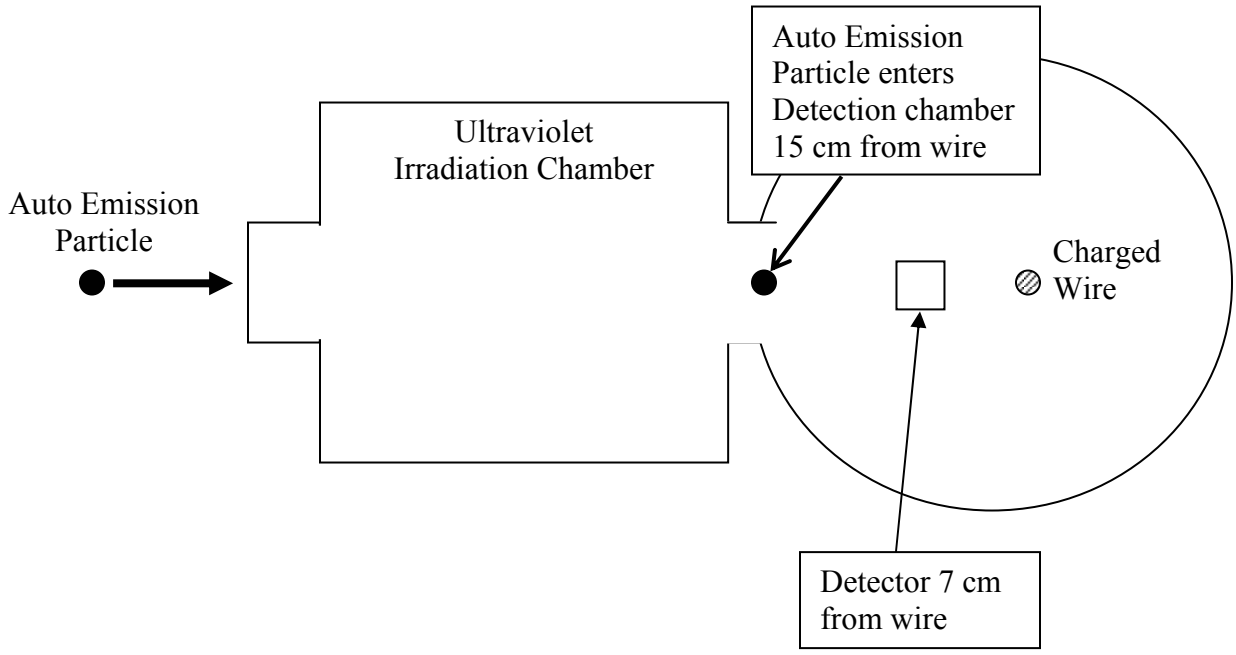
1. $r_1 = 1$ m
2. $r_2 = 3$ m
3. $r_3 = 5$ m
4. $r_4 = 9$ m

(b) Where and how much charge is on each surface of the two conductors?

(c) Using your expression for the electric field in part a, find the electric potential difference between the two spheres.

Group Test 2 (25 points) Physics 2049 Spring 2003

You are working in cooperation with the Public Health department to design an electrostatic trap for particles from auto emissions. The average particle enters the device and is exposed to ultraviolet radiation that knocks off electrons so that it has a charge of $+3.0 \times 10^{-8}$ C. This average particle is then moving at a speed of 900 m/s and is 15 cm from a very long negatively charged wire with a linear charge density of -8.0×10^{-6} C/m. The detector for the particle is located 7.0 cm from the wire. In order to design the proper kind of detector, your colleagues need to know the speed that an average emission particle will have if it hits the detector. They tell you that an average emission particle has a mass of 6.0×10^{-9} kg.



- USE THE GOAL PROTOCOL AND GROUP ROLES TO SOLVE THIS PROBLEM
- Make sure everyone's name and their group role on the GOAL Answer sheets. Do not staple.
- YOU MAY USE 1 WHITE BOARD PER GROUP
- Work only with your group members
- NO BOOKS OR NOTES OR SCRATCH PAPER ALLOWED
- You will be graded on your reasoning and how well you used the Goal protocol in addition to the correctness of your answer.
- YOU MUST START FROM GENERAL PHYSICS PRINCIPLES, DEFINITIONS, AND MODELS, I.E. CONSTANT ACCELERATION MODEL, MOTION DEFINITIONS, ETC.
- Your group manager may buy an equation, if you need it, at a cost of 2 points.