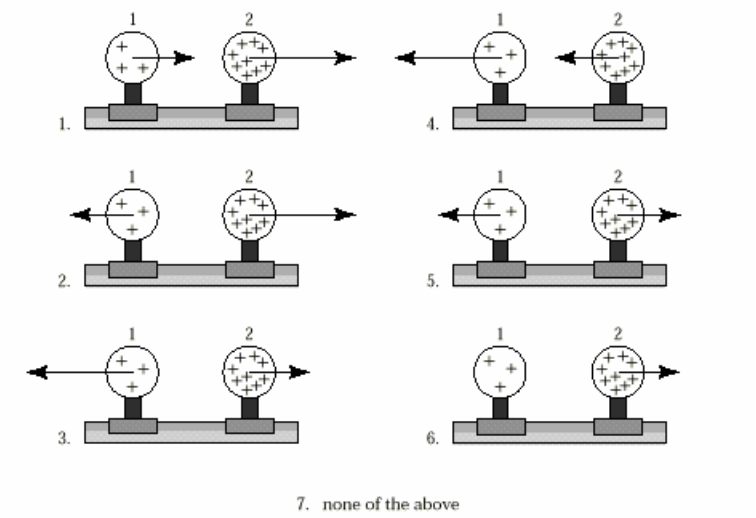
Physics 2049 Test 1 Name _____

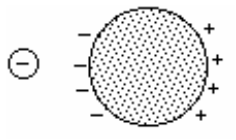
Part I. Multiple Choice/Short Answer (4 points each / 20 points total)
no explanation required, but no partial credit either

1. Two uniformly charged spheres are firmly fastened to and electrically insulated from frictionless pucks on an air table. The charge on sphere 2 is three times the charge on sphere 1. which force diagram correctly shows the magnitude and direction of the electrostatic forces?

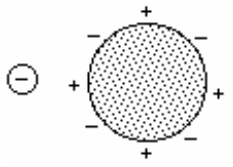


2. A negative point charge is brought near an isolated, neutral, conducting sphere. The sketch best representing the charge distribution on the sphere is

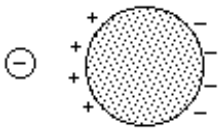
(A)



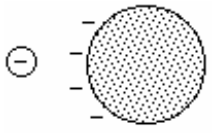
(B)



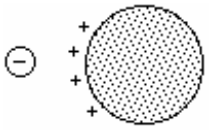
(C)



(D)



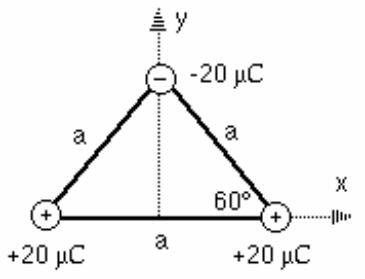
(E)



3. Two point charges a distance R apart repel one another with a force of magnitude 50 N. If the distance between charges is changed to R/2 the magnitude of the repulsive force will be

(A) 100 N
(B) 12.5 N
(C) 200 N
(D) 25 N
(E) 50 N

Questions 4 & 5 refer to the figure below



4. Three point charges of equal magnitude are fixed at the corners of an equilateral triangle. The two on the x axis are positive and the one at the apex, on the +y axis, is negative, as shown. If a = 0.030 m, what is the magnitude of the net force on the negative charge ?

(A) 6900
(B) 4000
(C) 240
(D) 120
(E) 210

5. Three point charges of equal magnitude are fixed at the corners of an equilateral triangle. The two on the x axis are positive and the one at the apex, on the +y axis, is negative, as shown. What is the direction of the net force on the negative charge ?

(A) +x
(B) -x
(C) +y
(D) -y
(E) none (zero)

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6. (15 points) A cathode ray tube uses an electron accelerator to create the electron beam that scans the screen. The accelerator consists of two parallel charged plates, one positively charged and one negatively charged, separated by 3 cm. There is a uniform electric field E = 2.00 x 10^4 N/C between and only between the two plates. Electrons are pulled off the negative plate and accelerated towards the positive plate which has a small hole in the middle of the plate. The beam is formed by the electrons passing through the plate. What is the velocity of the electrons as they pass through the hole?

7. (10 points) During the tape labs, you made top and bottom tapes. Assuming the top tapes have a net positive charge, can you use top and/or bottom tapes to tell if another object is negatively charged, positively charged, or neutral? Explain why or why not. (Hint: For full credit you will need to consider all three cases.)

8. (GOAL Problem: 15 points) The first round of tests is almost over so you decide to have a party. To add atmosphere to your otherwise drab apartment, you decide to decorate with balloons. You buy about fifty and blow them up so that they are all sitting on your carpet. After putting most of them up, you decide to play with the few balloons left on the floor. You rub one on your sweater and find that it will "stick" to a wall. Ah ha, you know immediately that you are observing the electric force in action. Since it will be some time before you guests arrive and you have already made the onion dip, you decide to calculate the minimum electric force of the wall on the balloon. You know that the air exerts a net upward force (the "buoyant" force) on the balloon, which makes it almost float. You measure that the weight of the balloon minus the buoyant force of the air on the balloon is 0.05 lb. By reading your physics book, you estimate that the coefficient of static friction between the wall and the balloon (rubber and concrete) is 0.80. (Hint: 2.2 lb. = 1 kg)

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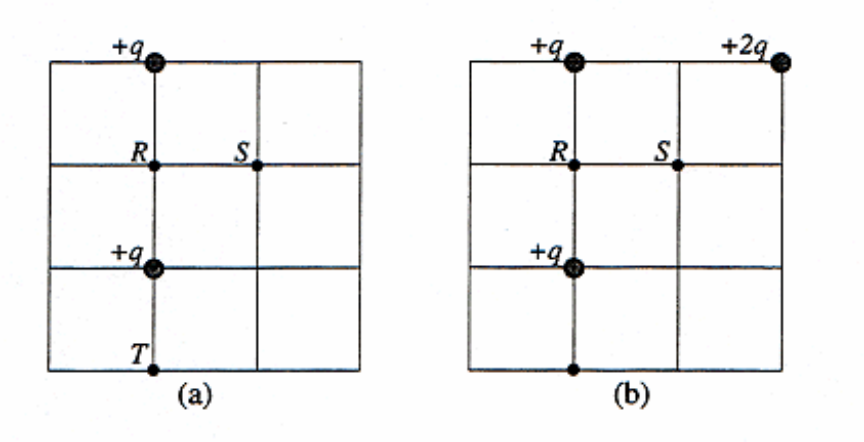
9. (15 points) Two point charges with charge $+q$ are arranged on a square grid as shown in figure (a) below.

   a. Draw arrows on figure (a) to represent the magnitude and direction of the electric field at points *R*, *S*, and *T*.



   b. Suppose a third point charge with charge +2q is added as shown in figure (b).

   Will the magnitude of the electric field at point *R* *increase*, *decrease*, or *remain the same*? Explain.

   Will the magnitude of the electric field at point *S* *increase*, *decrease*, or *remain the same*? Explain.

   c. If q = 30 μC and each grid square has sides 5 cm long, what is the magnitude of the electric field at point *S* in figure (b)?

   If all the positive charges were replaced with negative charges, how would the electric field at point S in figure (b) change?