Name: ID:

General Physics II (152)

Discussion Questions #3

Electric Force and Field

1. Varying q_1 while Keeping $q_1 + q_2$ Constant

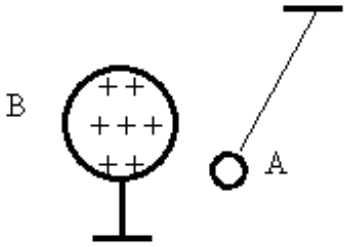
Case I: Distribute two positive charges q_1 and q_2, with $q_1 > q_2$, on two identical conducting spheres. Each sphere has a radius R. The separation between centers of the two spheres is r, where $r >> R$. Denote the magnitude of the Case I repulsive force between the two spheres by F_I.

Case II: Now, let the same two charged spheres from Case I touch each other. While they are in contact, there is a charge flow. After an electric equilibrium is established, separate the two centers again by the same distance r. The magnitude of the force is now F_{II}. How do F_I and F_{II} compare to each other?

Hint: Express the magnitude of the force between the two charges as $F = \frac{kq_1(q_0 - q_1)}{r^2}$, where $q_0 = q_1 + q_2 = \text{constant}$. Then, inspect how F varies as a function of q_1.

2. Electrostatic Attraction

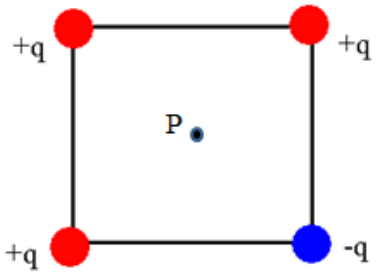
a) Two conducting spheres A and B are shown. Sphere B is positively charged. Sphere A, suspended by a string from above, is attracted to B. The setup is in equilibrium. What is the sign of the net charge on A?



b) Consider a new situation: where q_A is *negative* and $q_B >> |q_A|$. Now A swings upward and touches B. Do you expect that A will remain in contact with B?

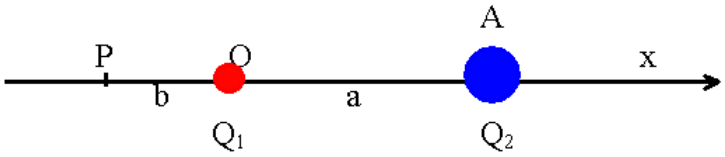
3. Electric Field at Square Center Due to Corner Charges

The diagram shows a square with charges as marked located at the vertices. What is the direction of the electric field at P, the center of the square? Assume magnitudes of all charges are the same.



4. Electric Field Due to Two Unequal Point Charges

Consider the setup below, where Q_1 = 1 μC and Q_2 = 4 μC are located at O and A respectively, with OA = a = 1 m. Consider an arbitrary point P, to the left of O where OP = b. Denote the magnitudes of fields at P contributed by Q_1 and Q_2 as E_1 and E_2 respectively. Which is greater between E_1 and E_2? Could they be equal?



5. Electric Field Due to Point Charges in a Square

a) What is the direction of the electric field at A due to the positive charges at the three corners? Assume the magnitudes of all charges are q.

b) Show the magnitude of the electric field at A due to the three positive charges is $E = \left(\sqrt{2} + \frac{1}{2}\right)\frac{kq}{c^2}$, where c is the side of the square.