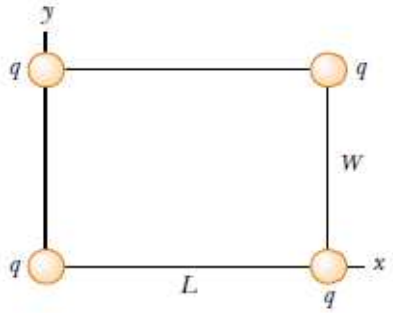
Applied Physics BS 101

The Electric Charge and Coulomb's Law

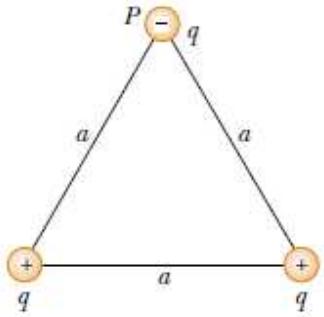
Problem 1: Two fixed charges, q_1 = +1.07μC and q_2 = -3.28μC, are 61.8cm apart. Where may a third charge be located so that no net force acts on it?
Ans.: 0.82m away from charge q_1

Problem 2: Two free point charges +q and +4q are a distance d apart. A third charge is placed so that the entire system is in equilibrium. (a) Find the sign, location and magnitude of the third charge (b) Show that the equilibrium is unstable.
Ans.: **(**a) d/3 from q or 2d/3 from 4q, q_3 = -4q/9

Problem 3: Four identical point charges (q=10.0 μC) are located on the corners of a rectangle as shown in Figure. The dimensions of the rectangle are L = 60.0 cm and W =15.0 cm. Calculate the magnitude and direction of the resultant electric force exerted on the charge at the lower left corner by the other three charges.
Ans.: $F = -4.78i - 40.6j$



Problem 4: Two positive charges, each of q = 4.18μC and a negative charge q = -6.36 μC, are fixed at the vertices of an equilateral triangle of side a = 13cm. Find the electric force on the negative charge.



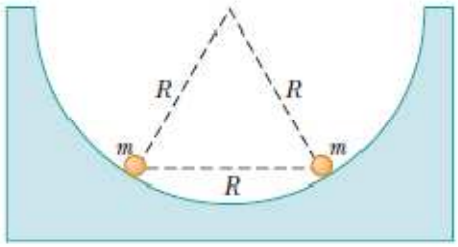
Ans.: $F = -24.4j$

Problem 5: Each of two small spheres is charged positively, the total charge being 52.6μC. Each sphere is repelled from the other with a force of 1.19N when the spheres are 1.94m apart. Calculate the charge on each sphere.
Ans.: $q_1 = 40.2\mu C, q_2 = 12.4\mu C$

Problem 6: A charge Q is fixed at each of two opposite corners of square. A charge q is placed at each of other two corners. If the resultant electrical force on one of Q is zero, how are Q and q related?
Ans.: $q = \sqrt{2}Q/4$

Problem 7: Two known charges, -12.0 μC and 45.0 μC, and an unknown charge are located on the *x* axis. The charge -12.0 μC is at the origin, and the charge 45.0 μC is at *x* =15.0 cm. The unknown charge is to be placed so that each charge is in equilibrium under the action of the electric forces exerted by the other two charges. Is this situation possible? Is it possible in more than one way? Find the required location, magnitude, and sign of the unknown charge.
Ans.: $x = -16cm, q = 51.3\mu C$

Problem 8: Two identical beads each have a mass *m* and charge *q*. When placed in a hemispherical bowl of radius *R* with frictionless, nonconducting walls, the beads move, and at equilibrium they are a distance *R* apart as shown. Determine the charge on each bead.



Ans.: $q = R\left(\frac{mg}{k\sqrt{3}}\right)^{1/2}$