XtraWrk – Chapter 15: Electrostatics

Conceptual Questions

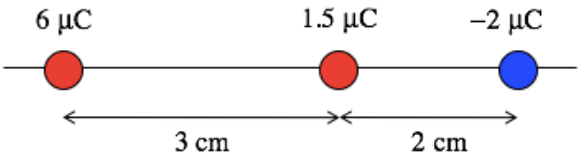
CQ1. A rubber balloon acquires a charge of + 5 nC by rubbing it against someone's hair. Were protons added to the balloon or electrons removed from the balloon? Explain.

CQ6. Consider balloon of unknown charge (object A) hanging from a string. If we bring a charged object B nearby and A is attracted, does this mean that A must be charged? Explain.

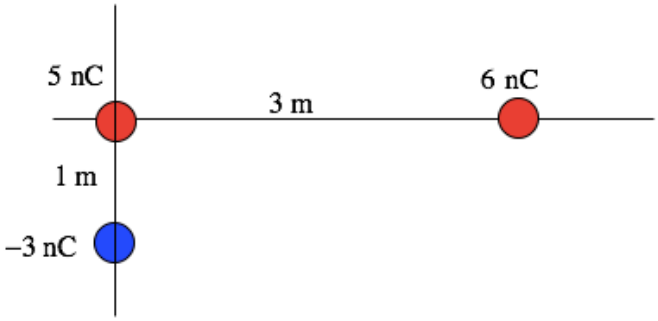
CQ13. If you run a comb through your hair, and then bring that comb close to confetti on a table, the confetti bits will attract to the comb but then fly away once they've actually touched the comb. Explain this behavior.

Problems

15.10) Given the three objects shown here, what are the forces between each pair of charges?

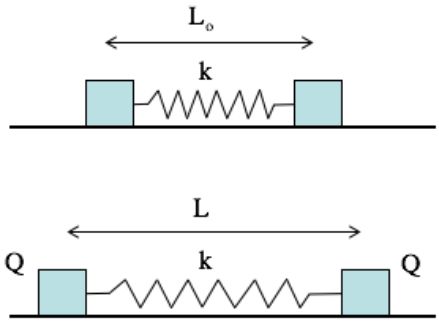


15.11) What is the force on the charge at the origin?

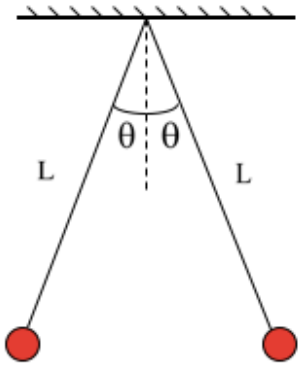


15.13) Two charges (q_1 = -5.80 nC and q_2 = -3.00 nC) are 50.0 cm apart. Where could you place a third charge q_3 = +7.50 nC such that the net electrostatic force on q_3 is zero?

15.14) Two identical blocks of mass M are on a frictionless surface, connected by a spring of k = 100 N/m and an unstretched length L_0 = 0.40 m. A charge Q is placed on each block causing the spring to stretch to a new equilibrium length of L = 0.50 m. What is the value of Q?



15.15) Two pith balls of equal mass are suspended by strings of length L as shown. An identical charge Q is placed on each pith ball, causing them to repel and make an angle θ with the vertical. Derive an expression for Q in terms of m, L, θ, and any relevant constants.

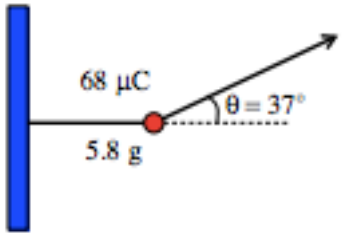


15.21) A charged block (mass *M* and charge *Q*) sits motionless on an insulated, frictionless inclined plane of angle θ. This requires an electric field to be present parallel to the incline.

a) What is the magnitude of the electric field required to keep the block motionless? Derive your expression in terms of known variables and constants.
b) If m = 5.40 g, Q = -7.00 μC, and θ=25.0º, calculate E using your expression from (a).

15.22) A balloon with a mass of 5.8 g and a charge of +68 μC is attached to a wall by a light string. In this area, an electric field $\vec{E}$ exists making an angle of 37º with the horizontal. With the electric field present, the balloon is in equilibrium when the string is horizontal as shown.

a) Draw an FBD for the balloon when in equilibrium
b) Derive an expression for the magnitude of the electric field (E), then use numbers to find a value.
c) Find the tension in the string.



15.30) The figure to the right shows two point charges and the field lines surrounding them.

a) What is the relative charge between them? That is, what is the ratio q_1/q_2?

b) Determine the sign of each charge.

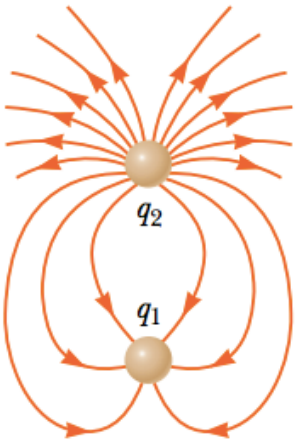


Figure P15.30

15.31) Consider an isolated positive point charge. Sketch the electric field lines around this point charge. Then sketch the field lines around a second isolate point charge with a magnitude that is -2 times that of q_1.

15.54) An electron moving through space has some kinetic energy *K*. You want to apply an electric field that will stop the electron in a distance *d*. How big should that electric field's magnitude be, in terms of *K, e,* and *d*? In what direction should the field be, relative to the motion of the electron?