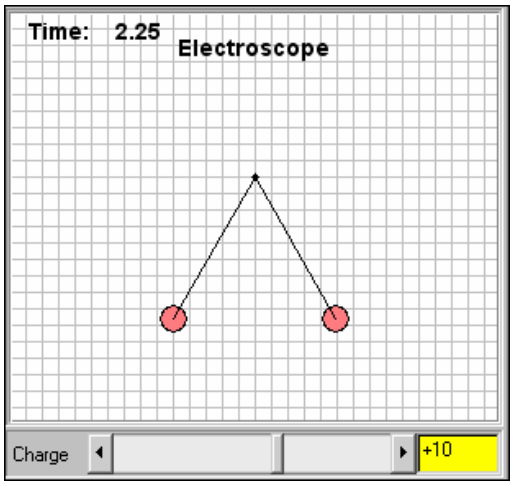
Worksheet for Exploration 22.5: Pendulum Electroscope



Two identical balls are hung pendulum-like in a laboratory as shown **(position is given in meters and time is given in seconds)**. The charge on each ball, in mC, can be varied by using the slider. Position can be measured by click-dragging.

a. Is there any difference in behavior if the charge on both balls is changed from negative to positive?

b. Notice that you can zero the velocity. Can you find a spot where the balls are in equilibrium? (You may need to set the velocity to zero several times to get the balls in equilibrium.)
   i. On the picture above, record the x,y positions of each ball after you have them in equilibrium. Select one of the balls and sketch vectors for each of the forces acting on it.
   ii. What is the distance between the balls for a given charge, when in equilibrium?
   iii. What is the electrical force between the balls?

c. What is the mass of each ball? (Assume that the charge on the two balls is uniformly distributed.)
   i. For your configuration you should determine the angle at which equilibrium occurs. Label on your sketch.
   ii. To determine this it may be useful to look back to Newton's second law and vector addition. You may want to use the following table to help you do this problem. (x refers to horizontal, y to vertical).

Forces	x Components of Forces	y Components of forces
Tension		
Electrical		
Gravitational		
NET		

d. How large a charge is required for the angle (as measured from the pivot) between the two balls in equilibrium to be 90 degrees? How large a charge for 180 degrees?

q_{90}=_____

q_{180}=_____