Physics 102 (S15) **Q1B**

Name: _____ **Section:** _____ **Score:** _____**/20**

1. Very small and identical metal spheres A and B are with glass handles as in Fig. 1. Initially, A has no net charge and B has a net charge Q. After the metal spheres are connected, they are separated and placed as in the right-lower figure.

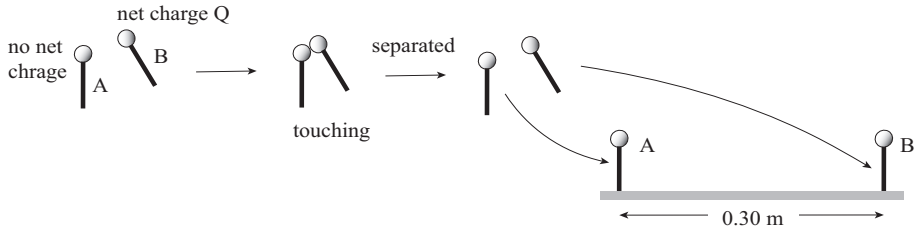

Figure 1:

(a) The magnitude of the force acting on charge at A is 10 N. What is the original net charge Q on B before touching with A? [5]

In terms of Q, the force between A and B satisfies

|F| = k(Q/2)^2/(0.3)^2 = (Q^2/4) x 10^{11} = 10.

Therefore, Q^2 = 4 x 10^{-10}, or Q = 2x 10^{-5} = 20 microC.

We cannot determine its sign.

(b) If the above experiment is repeated with a doubled Q, what is the magnitude of the force acting on A? [5]

F is proportional to the product of charges, F ,must be quadrupled, or 40 N.

3. Look at the configuration of three charges in the figure 2. A and C have -2 μC and B -3 μC.

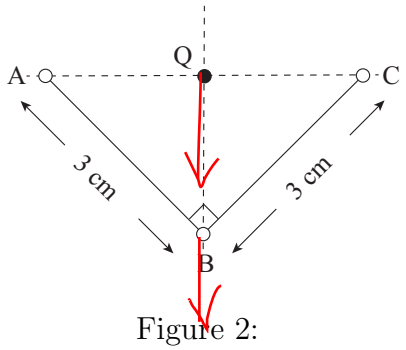

Figure 2:

(a) What is the total force acting on B from the other charges A and C? Compute its magnitude and indicate its direction in the figure 2. [5]

The x-components of the forces cancel each other, so we have only to consider the y-component. The forces are repulsive, so the resultant force must be in the -y-direction. The magnitude of the force between A and B is
|F| = (9x10^9) (2x10^{-6}) (3x10^{-6})/(0.03)^2 = 6x 10^{9-12+4) = 60 N.
Therefore, 60 x 2 cos(45deg) = 60 x 1.414 = 84.9 N (downward).

(b) Q is the point equidistant from all three points A-C and on the line connecting A and C. What is the total force acting on a 2 μC charge placed at Q? Compute its magnitude and indicate its direction in the figure 2. [5]

By symmetry forces due to A and C cancel each other, so we have only to consider the effect of B on Q. These charges have opposite signs, ao the force is attractive and Q is sucked downward. Its magnitude is
|F| = (9x10^9) (2x10^{-6}) (3x10^{-6})/(0.03cos(45deg))^2 = 12 x10^{9-12+4} = 120 N.