Physics 102 (S15) **Q1A**

Name: ____________________ **Section:** __________ **Score:** __________/20

1. Very small metal spheres A and B are on glass stands placed 0.3 m apart as in Fig. 1.

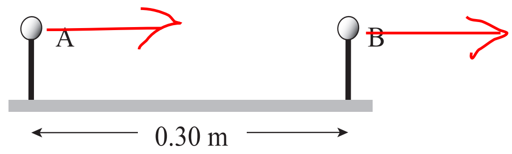

Figure 1:

(a) Initially, A has 5 μC and B has -1 μC charges. What is the force acting on A due to B? Compute its magnitude and indicate its direction in the figure with an arrow [5].

The charges have opposite signs, so the Coulomb force between A and B is attractive,and its magnitude is kq_Aq_B/L^2, where k= 9 x 10^9, L = 0.3, etc:

|F|= (9 x 10^9) (5 x 10^{-6}) (1 x 10^{-6})/(0.3)^2 = 5 x 10^{9-12+2} = 0.5 N.

(b) After A and B are connected with a conducting wire, they are again isolated and 0.3 m apart as before. What is the force acting on B due to A? Compute its magnitude and indicate its direction in the figure with an arrow. [5]

The total charge is 4 microC, so they are evenly distributed to A and B (because charges wish to be as evenly apart as possible), 2 microC each. Now, the Coulomb force is repulsive and its magnitude is

|F|= (9 x 10^9) (2 x 10^{-6}) (2 x 10^{-6})/(0.3)^2 = 4 x 10^{9-12+2} = 0.4 N.

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

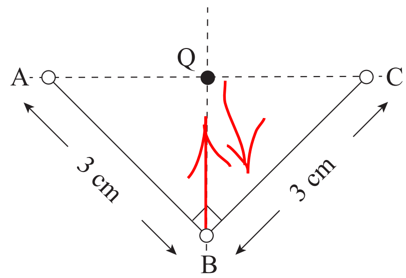

Figure 2:

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

Recall the superposition principle. The x-components of the forces cancel each other, so you have only to consider the y-components. The forces are attractive, so the total force must be in the +y direction. The magnitude of the force due to A on B is
|F| = (9 x 10^9) (2 x 10^{-6}) (2 x 10^{-6})/(0.03)^2 = 4 x 10^(9-12+4) = 40 N,
Therefore, 2 x 40 cos(45deg) = 40 x 1.414 = 56.6 N

(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 the magnitude and indicate its direction in the figure 2 [5].

The forces due to A and C kill each other, so we have only to consider B. The force is attractive, and its magnitude is
|F| = (9 x 10^9) (2 x 10^{-6}) (2 x 10^{-6})/(0.03 cos(45deg))^2 = 8 x 10^(9-12+4) = 80 N.