Physics 102 (S15) **Q1C**

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

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

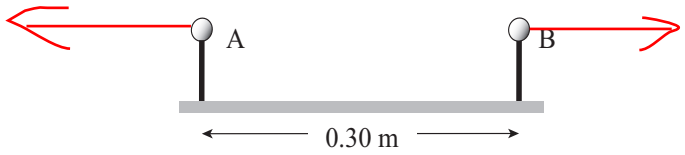

Figure 1:

(a) Initially, A has -3 μC and B has -1 μC. What is the force acting on A due to B? Compute its magnitude and draw its direction in the figure with an arrow. [5]

The force is repulsive, and its magnitude is
|F| = (9x10^9) (3x10^{-6}) (1x10^{-6})/(0.3)^2 = 3x10^{9-12+2} = 0.3 N

(b) After A and B are connected with a conducting wire, they are again isolated as before without moving them. What is the force acting on B due to A? Compute its magnitude and draw its direction in the figure with an arrow. [5]

The total charge - 4 microC is evenly distributed between A and b, so they have -2 microC each. The force is repulsive and its magnitude is
|F| = (9x10^9) (2x10^{-6}) (2x10^{-6})/(0.3)^2 = 4x10^{9-12+2} = 0.4 N

2. On a line are two points A and B as shown in Fig. 2. At A is charge -3 μC, and at Q and B are unknown charges.

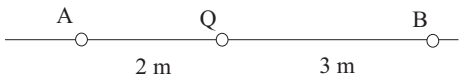

Figure 2:

(a) The force on the charge at A due to that at Q is 25 N to the left. Compute the charge at Q. [5]

Let the unknown charge be q. The force between A and Q is repulsive, so we must conclude that q < 0.

|F| = k|q_Aq|/r^2 = (9x10^9) (3x10^{-6}) |q|/2^2 = (27/4)10^{3}|q| = 25.

Therefore, q = -25 x4/(27x10^3) = -1/270 = -3.7 mC.

(b) There is no net force on the charge at Q. What is the charge at B? [5]

Since the forces from A and from B must cancel, the charge at B must have the same sign as that at A.

kq_Aq/2^2 = kq_Bq/3^2 or q_A/4 = q_B/9

Therefore,

q_B = 9q_A/4 = -27/4 = -6.75 microC.