Physics 102 (S15) **Q3A**

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

1. A 12 μC positive point charge **A** is fixed in the space.
(1) You bring another positive charge **B** of 8 μC from infinity to a point P which is 0.3 m away from charge **A**. What is the work you have to do? (Assume there are only these two charges.) [5]

The final potential energy is

kQAQB/r = (9 x 10^9) (12 x 10^{-6}) (8 x 10^{-6})/0.3

= 2880 x 10^{9 - 6 - 6} = 2.88 J

This is +, so you must do this much of work to the charge system.

(2) Now, charge **B** is gently released from P and moves to a point 1.2 m away from the fixed **A**. Its speed is 5.2 m/s. What is the mass of the charged particle **B**? (Assume there are only these two charges.) [5]

The initial potential energy is 2.88 J as computed in (1).

The final electrical potential energy is

kQAQB/r' = (9 x 10^9) (12 x 10{-6}) (8 x 10^{-6})/1.2 = 0.72 J

This is 2.88 x (0.3/1.2).

Energy conservation tells us the difference must be the kinetic energy:

initial pot energy + 0 kinetic energy = final pot energy + (1/2)mv^2

so

(1/2) m v^2 = 2.88 - 0.72 = 2.16.

Hence.

m = 2 x 2.16/(5.2^2) = 0.1598   0.16 kg.

2. There are four charges A - D on the plane. The equipotential curves are described in the following figure.

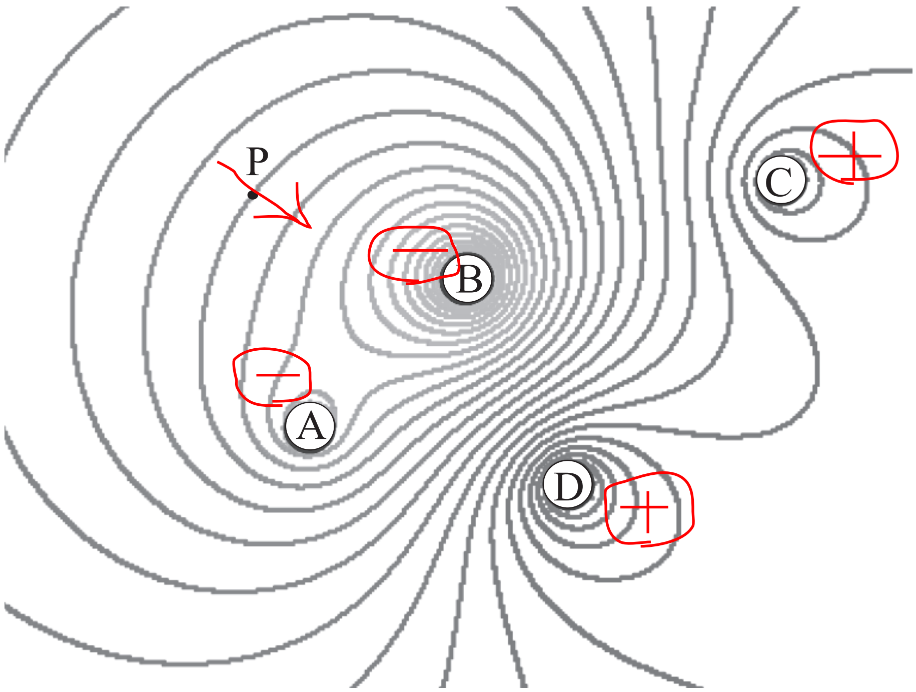

Figure 1:

(1) Suppose A is negatively charged. State the signs of all the remaining charges B - D.

(2) Which charge has the largest magnitude?

B

(3) Indicate the direction of the electric field at P. You must explain your choice succinctly.

Since A and B are negative, te right side of P should be with lower electrical potential.