Physics 102 (S15) **Q3B**

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

1. Charge **A** with $+8\ \mu$C and charge **B** with $-12\ \mu$C are 7 cm apart.
(1) To assemble this charge configuration what work do you have to supply? [5]

The potential energy stored in this charge system is

Ui = kQAQB/r = (9 x 10^9) (8 x 10^{-6}) (-12 x 10^{-6})/0.07

= - 12342 x 10^{9 - 6 -6} = - 12.3 J

This you must `supply.' That is, you are `done' 12.3 J of work (you are dragged to the charge A).

(2) Now, charge **B** is gently released and moves to a point P which is 3 cm away from the fixed charge **A**. Its speed is 122 m/s at P. What is the mass of the charged particle **B**? [5]

The initial potential energy is Ui = -12.3 J as computed in (1).

The final potential energy is

Uf = (9 x 10^9) (8 x 10^{-6}) (-12 x 10^{-6})/0.03

= - 28.8 J (which is = -12.3 x (0.07/0.03).

Energy conservation tells us that

Ui + 0 = Uf + (1/2)m v^2

or

(1/2) mv^2 = 28.8 - 12.3 = 16.5.

Therefore,

m = 2 x 16.5/122^2= 0.0225 that is, 22.5g

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

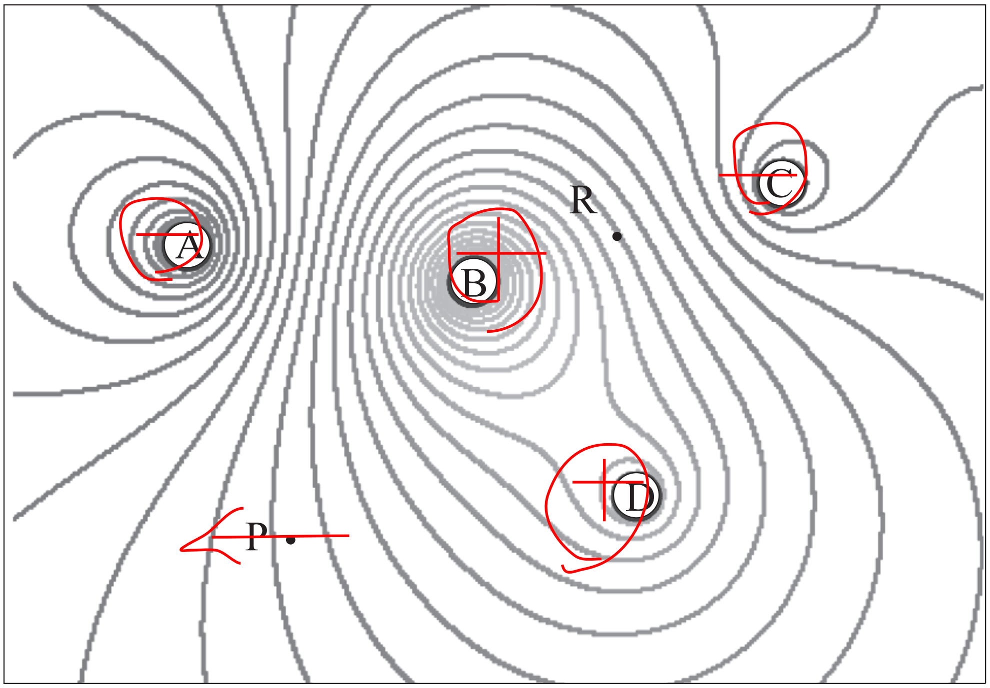

Figure 1:

(1) Suppose A is negatively charged. State the signs of all the remaining charges B-D [3].

(2) Indicate the direction of the electric field at P. [3]

To the left and must be perpendicular to the equipotential curve.

(3) If A negative charge is moved from P to R by you, do you have to do positive work? You must explain your answer. [4]

Since B is positive, R is with higher electric potential than P, so a negative charge `tumbles down' the potential energy slop to R. You are done a positive work. You do a negative work.