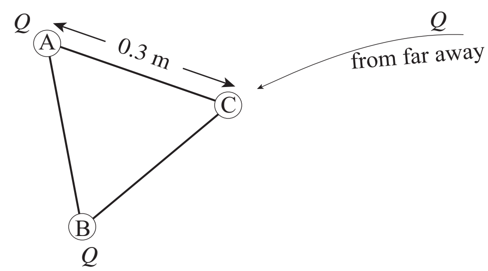
Physics 102 (F16)

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

1. Initially, two identical charges of Q are at A and B of an equilateral triangle ABC of edge length 0.3 m as illustrated below.
(1) You bring the thid charge Q to the corner C from infinity. You have to do a work of 12.0 J. What is the magnitude of the charge $|Q|$? [5]

superposition
pairwise potential kQQ'/r

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Work you do is 2kQ^2/r (- 0, which is the initial
energy according to our energy origin convention)
= 12, so kQ^2/r = 6.

That is Q = sqrt{6r/k} = sqrt{6 x 0.3/9x10^9}
     = sqrt{0.2x10^{-9}}= \sqrt{2}x10^{-5} = 14 microC.
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(2) Now, charge at vertex A is allowed to move freely. What is its speed far away from the triangle ABC, if the mass of the moving charge is 2.0 g? [5]

Energy conservation
(1/2) mv^2 + E_f = E_i

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Notice that (1) and (2) are basically the identical question.
(1/2)mv^2 = 12 -> v^2 = 24/m = 24/2x10^{-3} = 12x10^3
That is,
      v = \sqrt{1.2} x 10^2 = 1.1x10^2 = 110 m/s
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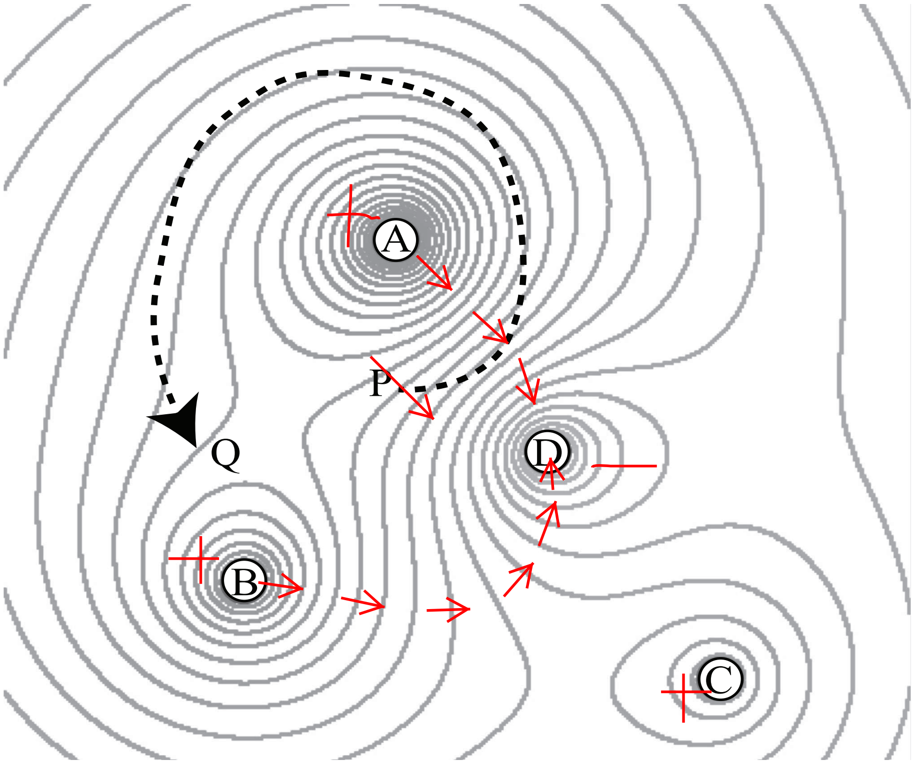
2. There are four charges A - D on the plane. The equipotential curves are described in the following figure.



(1) One charge has a different sign from other three. What is this unique charge? [3]

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D, because the gradient arrows directly go to A  or B from D.
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(2) Assume charge A is positive. Indicate the direction of the electric field at P in the figure. You must explain your choice succinctly.[3]

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E arrow must be + to -, and perpendicular to the contour there.
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(3) Assume charge A is positive as above. If the contours are equally spaced by 2 V, how much work do you have to do, if you wish to bring -2.0 C charge from P to Q along the dashed curve in the figure above? [4]

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VQ - VP = 2 V, because Q is on the higher voltage side.
Thus the energy difference of the charge is delta V x charge = - 4 J.
(That is, you would be dragged.)
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