Physics 102 (F16) Q2A

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

1. As shown in Figure 1 multiple point charges are fixed in space, making an electric field $\boldsymbol{E}$. At the origin O the electric field is given by $\boldsymbol{E} = (-1.2, 3.2) \times 10^3$ N/C.

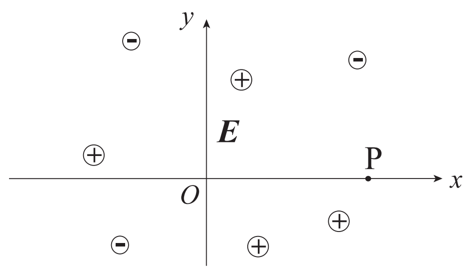

Figure 1:

(a) Now, a charge $q = 6.5\ \mu$C is placed at P $= (2.0, 0)$ m anew. What is the electric field (vector!) at the origin now? [5]

Superposition

E by a single charge, magnitude = kQ/r^2

The electric field at the origin due to the charge q at P is, pushing outward from P and with magnitude kq/r^2 = 9x10^9 x 6.5x10^{-6}/2^2 = 14.625 x 10^{9-6} = 14.625x10^3 N/C.
Thus, (-14.625,0)x10^3 N/C is the field at O due to q at P.
Now, the total field at O is (-14.625,0)x10^3 + (-1.2, 3.2)x10^3 = (-15.825, 3.2)x10^3 N/C.
Its magnitude is sqrt(15.825^2 + 3.2^2)x10^3 = 16.15x10^3 N/C.

(b) Now, the charge q in (a) is moved from P to the origin. What is the force (vector) acting on q? [5]

F = qE

There is no self interaction, so the field acting on the charge at the origin is the original E = (-1.2, 3.2)x10^3.
Therefore, F = 6.5x10^{-6}x (-1.2, 3.2)x10^3 = (-7.8, 20.8)x10^{-3} N

2. Electric field lines due to multiple charges (and other charges outside the figure window) on a plane are depicted in Fig. 2.

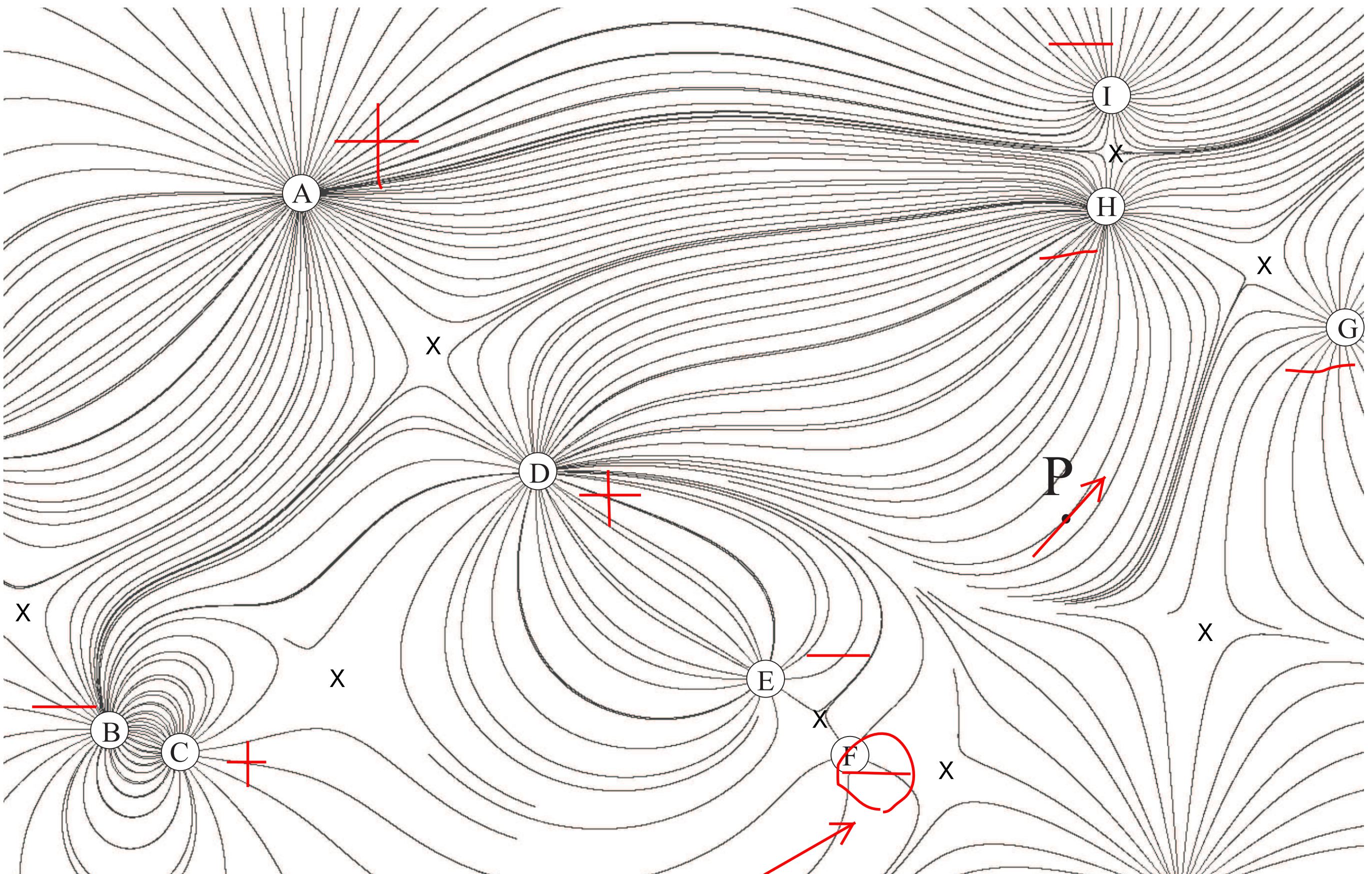

Figure 2:

(a) Suppose charge F is negative. Tell all the positive charges. [5]

A, C, D

(b) There are locations where the electric field is zero. Mark at least four (4) such locations with X. [3]

(c) Indicate the direction of the electric field at point P. You must briefly justify your choice. [2]

E is + to -, tangential to the force lines.