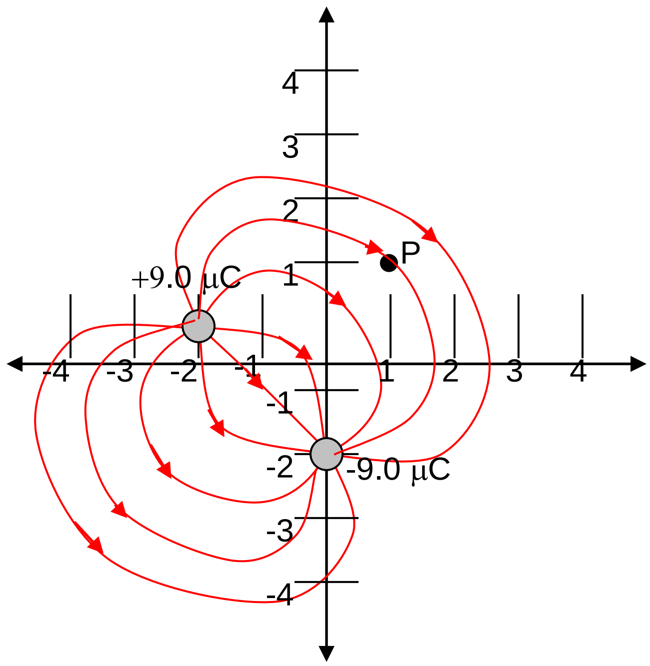
PHYS 2120 Quiz 1 Name ________________________

1. What is the magnitude and angle of the electric field at location (1,1) due to the presence of the +9.0 μC and –9.0 μC charges? (The units for distance on the graph is in meters.) (8 pts)



The electric field is the sum of the field from both charges. Therefore,

$$\vec{E} = \vec{E}_1 + \vec{E}_2 = k\frac{q_1}{r_1^3}\vec{r}_1 + k\frac{q_2}{r_2^3}\vec{r}_2$$

$$\vec{r}_1 = 3\hat{i} + 1\hat{j}\, m \qquad \vec{r}_2 = 1\hat{i} + 3\hat{j}\, m$$

$$r_1 = \sqrt{(3)^2 + (1)^2} = \sqrt{10}\text{ m}$$

$$r_2 = \sqrt{(1)^2 + (3)^2} = \sqrt{10}\text{ m}$$

$$q_1 = +9.0\times10^{-6}C \qquad q_2 = -9.0\times10^{-6}C$$

Substituting in the appropriate values gives

$$\vec{E} = (8.99\times10^9\, Nm^2/C^2)\left[\frac{9.0\times10^{-6}C}{(10m)^{\frac{3}{2}}}\left\{3\hat{i}+1\hat{j}\right\}m + \frac{-9.0\times10^{-6}C}{(10m)^{\frac{3}{2}}}\left\{1\hat{i}+3\hat{j}\right\}m\right]$$

$$\vec{E} = (8.99\times10^9\, Nm^2/C)\left[\left\{8.54\times10^{-7}\,\hat{i} + 2.85\times10^{-7}\,\hat{j}\right\}C/m^2 + \left\{-2.85\times10^{-7}\,\hat{i} - 8.54\times10^{-7}\,\hat{j}\right\}C/m^2\right]$$

$$\vec{E} = (8.99\times10^9\, Nm^2/C)\left[\left\{5.69\times10^{-7}\,\hat{i} - 5.69\times10^{-7}\,\hat{j}\right\}C/m^2\right]$$

$$\vec{E} = \left\{5115\,\hat{i} - 5115\,\hat{j}\right\}N/C$$

Finding the magnitude and direction gives

$$E = \sqrt{(5115)^2 + (-5115)^2}\,N/C = 7230\ N/C$$

$$\theta = \tan^{-1}\left(\frac{-5115}{5115}\right) = -45.0^\circ$$

2. On the diagram given above draw electric field lines. In order to have enough lines to illustrate what the field looks like draw two lines for each 1 μC of charge represented on the diagram. (2 pts)