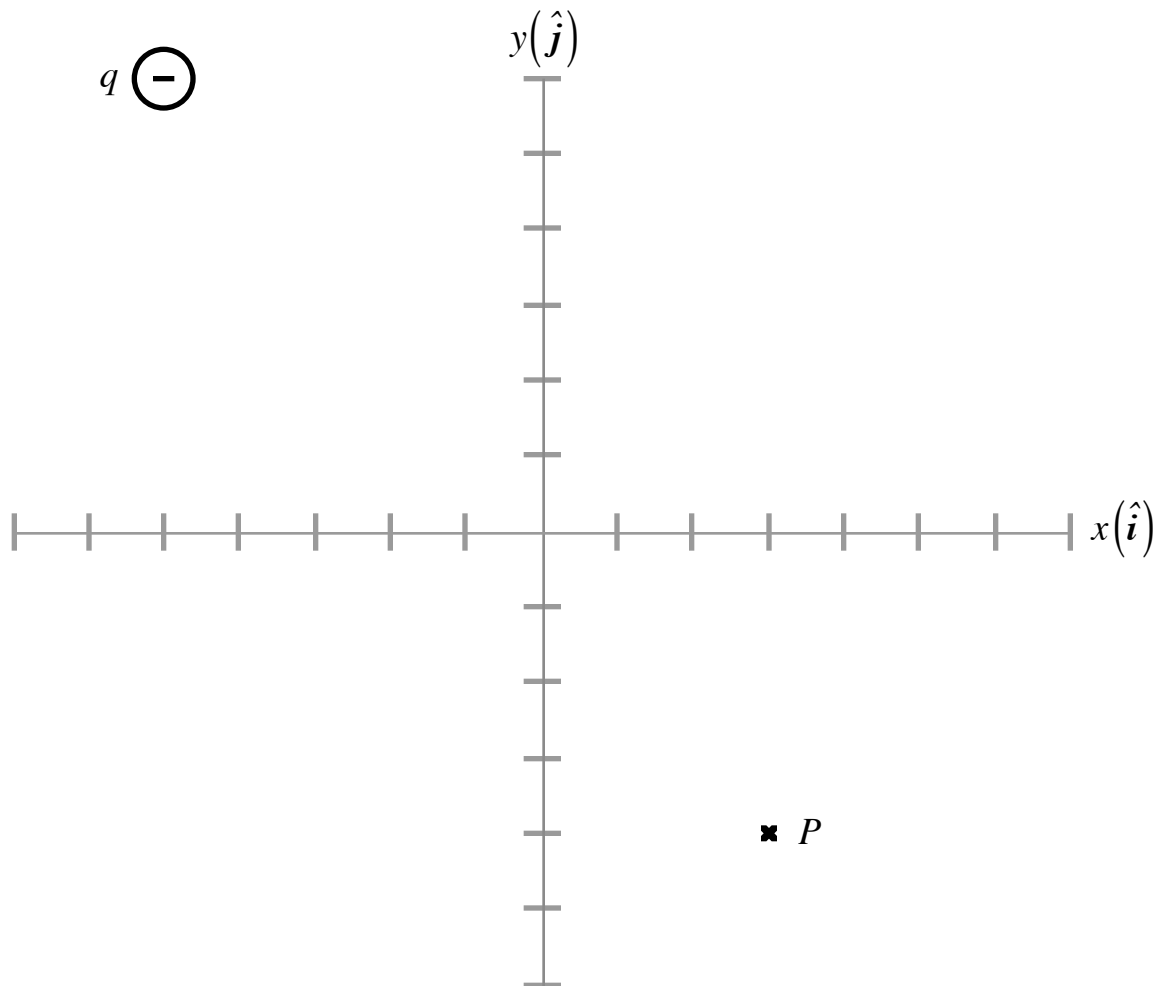


PHY2054 Practice Exam I

1.) An electric point charge $q = -6.75 \times 10^{-9} \text{ C}$ is fixed at a point the position of which is $\vec{r}_q = -5.00 \text{ m } \hat{i} + 6.00 \text{ m } \hat{j}$, as represented in the diagram below. Do the following:

- a) Calculate E , the magnitude of the electric field produce by q at point P the position of which is $\vec{r}_p = 3.00 \text{ m } \hat{i} - 4.00 \text{ m } \hat{j}$.
- b) Calculate \hat{E} , the unit vector that represents the direction of the electric field at P .
- c) Calculate θ , the angle the electric field vector makes to the negative branch of the x -axis.



2.) Two electric charges are related by $q_1 = 3q_2 = 9.63 \times 10^{-6} \text{ C}$ and have positions, respectively, given by

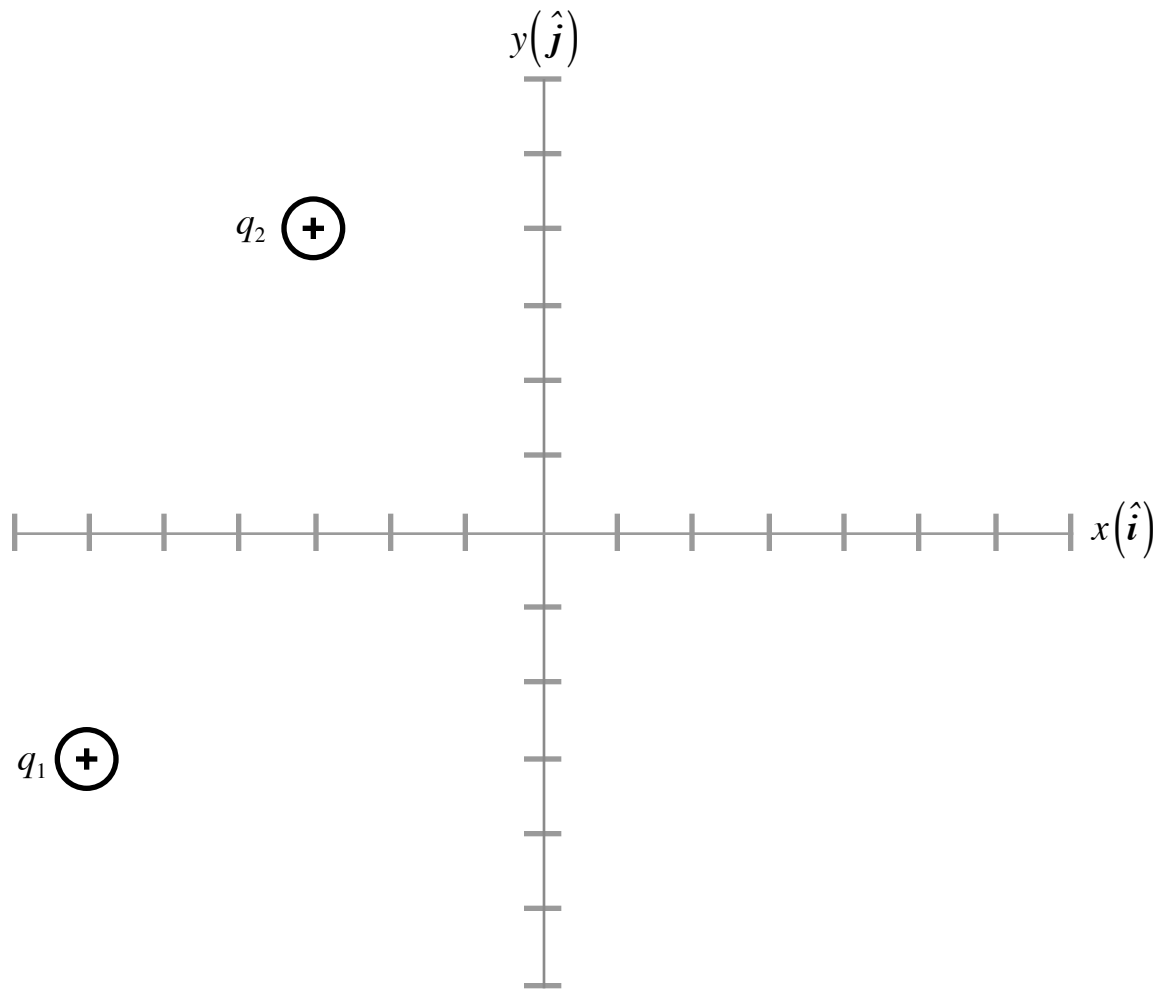
$$\vec{r}_1 = -6.00 \text{ m } \hat{i} - 3.00 \text{ m } \hat{j},$$

$$\vec{r}_2 = -3.00 \text{ m } \hat{i} + 4.00 \text{ m } \hat{j},$$

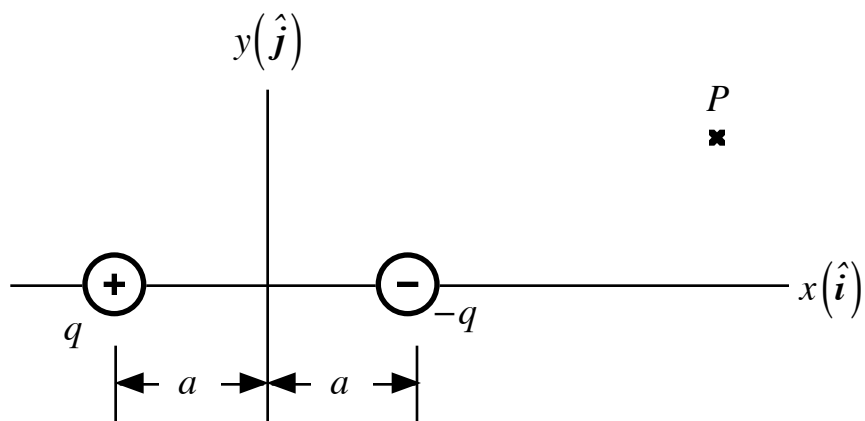
as represented in the diagram below. Do the following:

- a) Calculate F_{21}^E , the magnitude of the electric force exerted on charge two by charge one.

- b) Calculate $\hat{\mathbf{F}}_{21}^E$, the unit vector that represents the direction of the electric force exerted on charge two by charge one.
- c) Calculate θ_x , the angle that the unit vector $\hat{\mathbf{F}}_{21}^E$ makes to the positive branch of the x -axis.



3.)



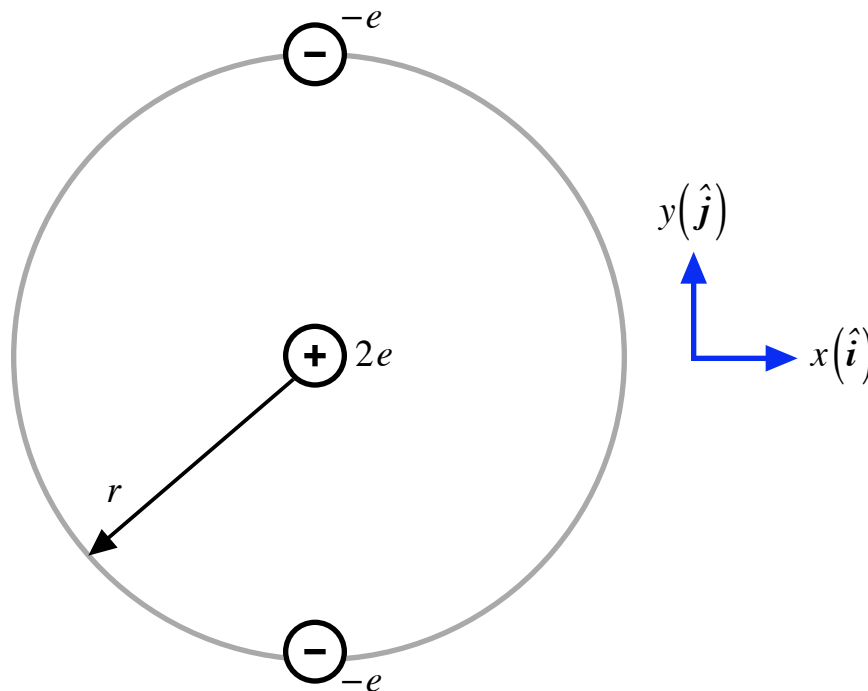
An electric dipole is represented in the diagram above. The charges may be treated as fixed, point

charges. Do the following:

- Calculate E_{tot} , the magnitude of the net electric field produced by these two charges at point P , where $q = 2.50 \times 10^{-9} C$, $\vec{r}_p = 3a \hat{i} + a \hat{j}$, and $a = 5.25 \times 10^{-3} m$.
- Calculate \hat{E}_{tot} , the unit vector that represents the direction of the net electric field at point P .
- Calculate the angles the unit vector makes to the positive branches of the x and y -axes.

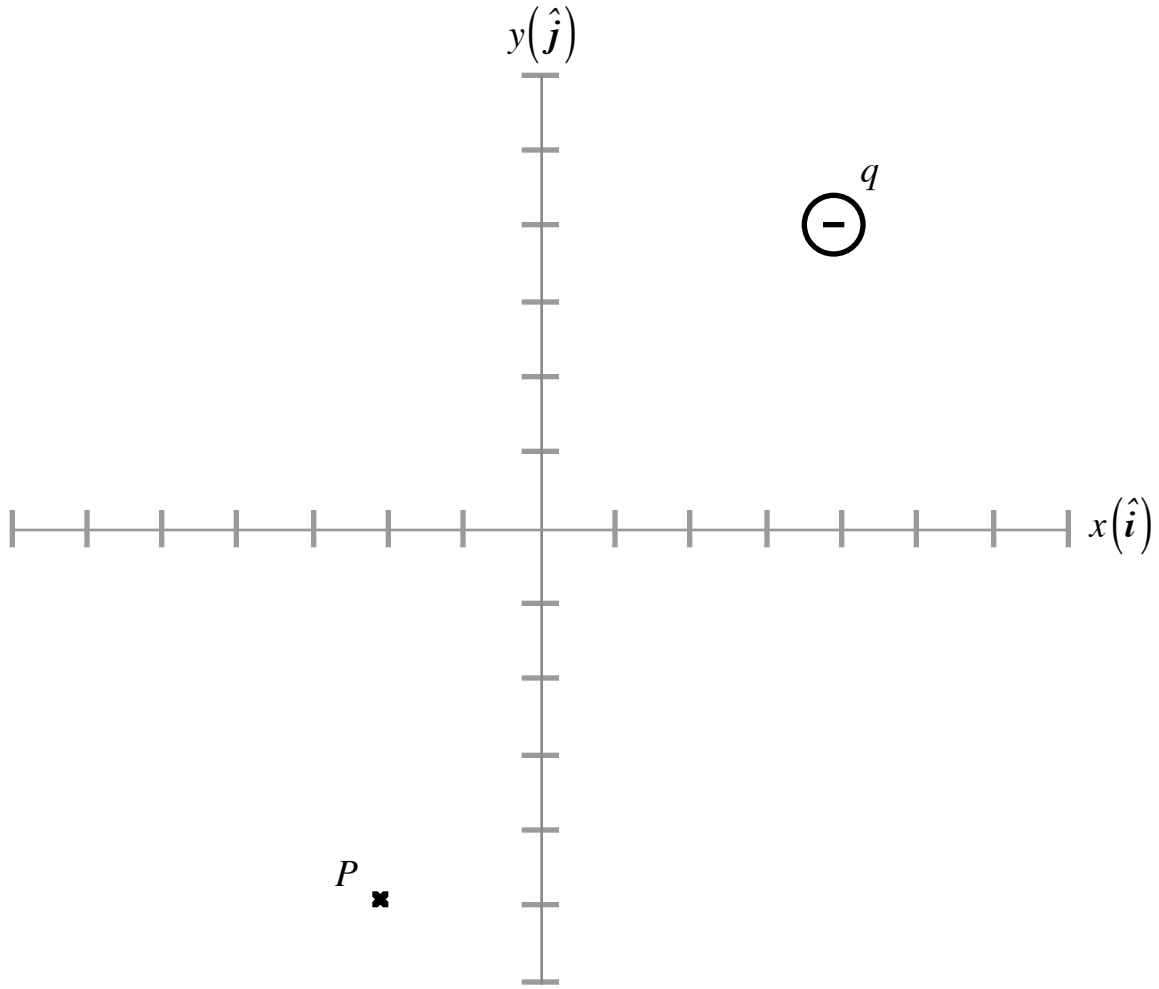
4.) At some instant in time, a helium atom is configured as represented in the diagram below. Two electrons orbit the stationary nucleus on a circular orbit of radius r . (All of the charges may be treated as point charges.) Do the following:

- Calculate the magnitude and the direction of the net electric force exerted on the **top** electron.
- For **five extra credit points**, calculate the speed of this electron in its orbit. Note: $r = 7.50 \times 10^{-11} m$, and $e = 1.602 \times 10^{-19} C$ and $M_{e^-} = 9.1 \times 10^{-31} kg$.

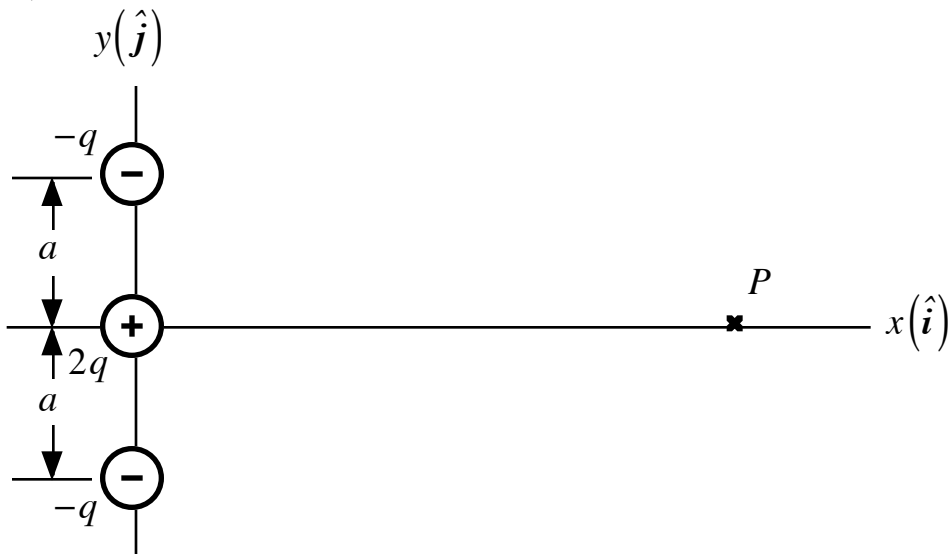


5.) An electric point charge $q = -7.75 \times 10^{-9} C$ is fixed at a point the position of which is $\vec{r}_q = 4.00 m \hat{i} + 4.00 m \hat{j}$, as represented in the diagram below. Do the following:

- Calculate E , the magnitude of the electric field produced by q at point P the position of which is $\vec{r}_p = -2.00 m \hat{i} - 5.00 m \hat{j}$.
- Calculate \hat{E} , the unit vector that represents the direction of the electric field at P .
- Calculate θ_x , the angle the electric field vector makes to the positive branch of the x -axis.



6.)

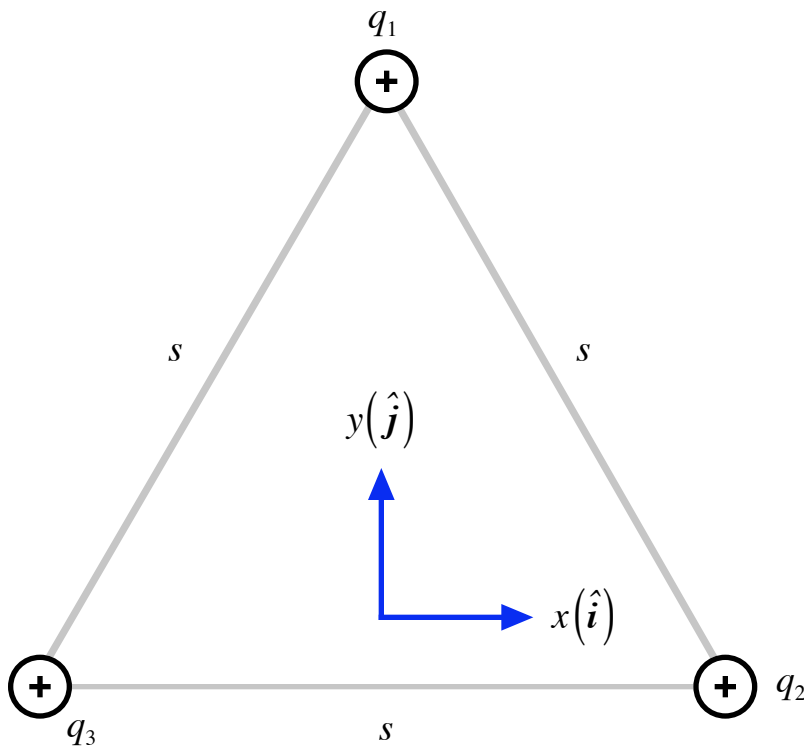


An electric quadrupole is represented in the diagram above. The charges may be treated as fixed, point charges. Do the following:

- a) Calculate E_{tot} , the magnitude of the net electric field produced by these three charges at point P , where $q = 7.50 \times 10^{-9} \text{ C}$, $\vec{r}_p = 4a \hat{i}$, and $a = 2.25 \times 10^{-3} \text{ m}$.
- b) Calculate \hat{E}_{tot} , the unit vector that represents the direction of the net electric field at point P .

7.) Three identical charges $q_1 = q_2 = q_3 = q = 6.275 \times 10^{-6} \text{ C}$ are fixed at the vertices of an equilateral triangle of side length $s = 0.225 \text{ m}$, as represented in the diagram below. Do the following:

- a) Calculate the magnitude of the net electric force on electric charge three due to the other two electric charges.
- b) Calculate the unit vector that represents the direction of the net electric force on electric charge three.
- c) **For three extra credit points each**, calculate the angle the net electric force makes to the positive branches of the x and y axes.



8.) Two electric charges are related by $q_1 = 2q_2 = 8.36 \times 10^{-6} \text{ C}$ and have positions, respectively, given by

$$\vec{r}_1 = 2.00 \text{ m } \hat{i} + 5.00 \text{ m } \hat{j},$$

$$\vec{r}_2 = -6.00 \text{ m } \hat{i} - 3.00 \text{ m } \hat{j},$$

as represented in the diagram below. Do the following:

- a) Calculate F_{12}^E , the magnitude of the electric force exerted on charge one by charge two.
- b) Calculate \hat{F}_{12}^E , the unit vector that represents the direction of the electric force exerted on charge one by charge two.

- c) Calculate θ_x , the angle that the unit vector $\hat{\mathbf{F}}_{12}^E$ makes to the positive branch of the x -axis.

