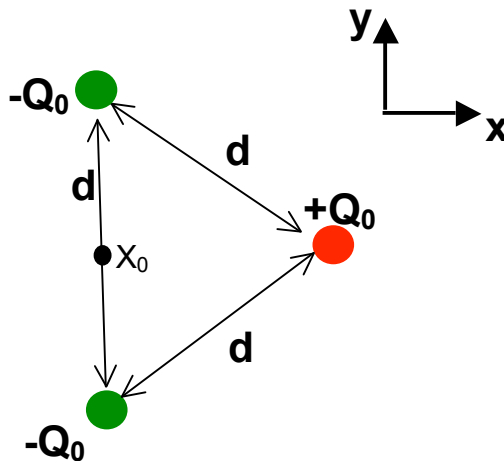


Problem 1 (25 points)

Consider the configuration of point charges shown below, with two negative charges $-Q_0$ and a positive charge $+Q_0$ forming an equilateral triangle (all sides have length d) in the x - y plane.

- (a) What is the direction and magnitude of the force on the positive charge $+Q_0$ in terms of the given quantities?
- (b) What is the direction and magnitude of the electric field at point x_0 halfway in between the two negative charges?
- (c) Now, assume that the two negative charges are fixed in space and that $+Q_0$ is freely movable. Describe the motion $+Q_0$ would undergo if released from rest from the original position shown below (2-3 sentences)



Problem 1 (25 points)

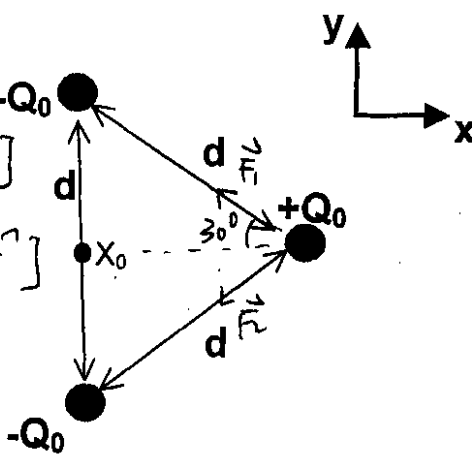
Consider the configuration of point charges shown below, with two negative charges $-Q_0$ and a positive charge $+Q_0$ forming an equilateral triangle (all sides have length d) in the x - y plane.

- What is the direction and magnitude of the force on the positive charge $+Q_0$ in terms of the given quantities?
- What is the direction and magnitude of the electric field at point x_0 halfway in between the two negative charges?
- Now, assume that the two negative charges are fixed in space and that $+Q_0$ is freely movable. Describe the motion $+Q_0$ would undergo if released from rest from the original position shown below (2-3 sentences)

a) $\vec{F} = \vec{F}_1 + \vec{F}_2$

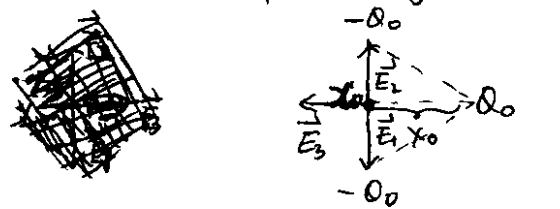
$$= \frac{Q_0^2}{4\pi\epsilon_0 d^2} [\cos 30^\circ \hat{i} + \sin 30^\circ \hat{j}] + \frac{Q_0^2}{4\pi\epsilon_0 d^2} [-\cos 30^\circ \hat{i} - \sin 30^\circ \hat{j}]$$

$$= -\frac{2Q_0^2}{4\pi\epsilon_0 d^2} \cos 30^\circ \hat{i}$$

$$= -\frac{\sqrt{3}Q_0^2}{4\pi\epsilon_0 d^2} \hat{i}$$


b) Apparently \vec{F}_1 and \vec{F}_2 cancel each other

$$\vec{E} = \vec{E}_3 = \frac{Q_0}{4\pi\epsilon_0 x_0^2} (-\hat{i})$$

$$= \frac{Q_0}{4\pi\epsilon_0 (\frac{\sqrt{3}}{2}d)^2} (-\hat{i}) = \frac{Q_0}{3\pi\epsilon_0 d^2} (-\hat{i})$$


c) $+Q_0$ will oscillate back and forth between $-\frac{\sqrt{3}}{2}d$ and $\frac{\sqrt{3}}{2}d$. Since energy is conserved, $+Q_0$ will keep oscillating forever.

