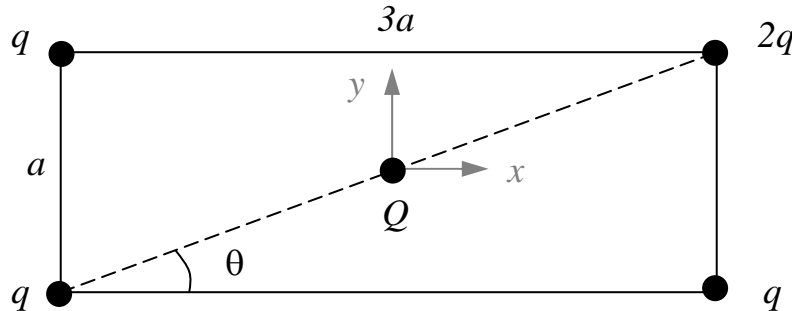


Discussion Question 2B
P212, Week 2
Electric Field Due to Point Charges

Four point charges $2q$, q , q , and q are placed at the corners of a rectangle of dimensions a and $3a$ as shown in the figure. A fifth charge Q is placed at the center of the rectangle. Our task is to compute the **electric field** at the center of the rectangle, and then determine the force on Q .



(a) Each of the 4 charges at the corners contributes to the **electric field** \mathbf{E} at the center of the rectangle. You'll have to add these contributions by components. First, start by finding the **magnitudes** of all the electric field contributions you will need to add together.

*Did you draw a sketch? Without it this problem is
much harder than it needs to be ...*

(b) *Without using your calculator*, calculate $\sin(\theta)$, $\cos(\theta)$, and $\tan(\theta)$ where θ is the angle defined in the diagram. (Express your answer algebraically.)

(c) Now compute the **x- and y-components** of the relevant contributions to the electric field at the center of the rectangle.

(d) What is the **total** electric field \mathbf{E} at the center of the rectangle, given the particular values $q = 3 \mu\text{C}$ and $a = 2 \text{ cm}$?

(e) Finally, what is the **force** on the fifth charge Q due to this electric field, given $Q = 4 \mu\text{C}$? Remember that force is also a vector, and you should give both its x and y components.