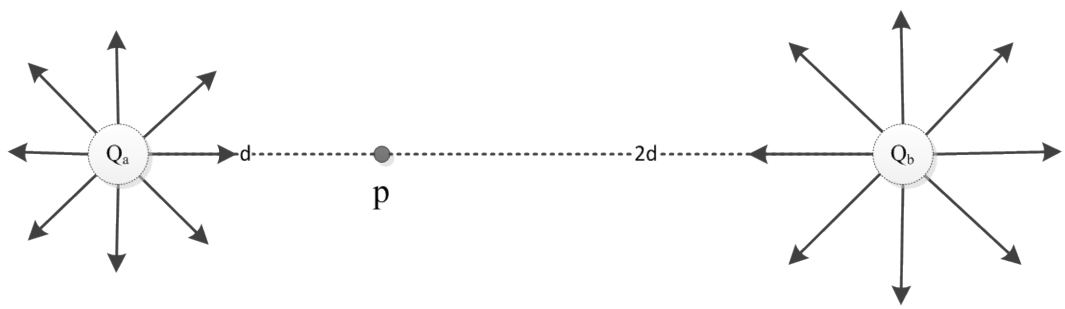
Field Easy Example (determine the electric field due to two charges):

Determine the magnitude and direction of the electric field vector at point p.
Given: Q_a = 1 C and Q_b = 2 C.

Solution

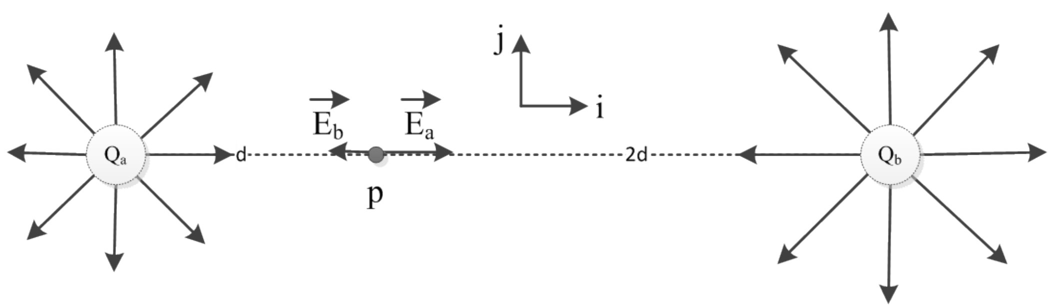
Step 1: Determine the direction of the electric field due to each charge separately.

Recall that the electric field is pointing away from the centre of a charge if the charge is positive, and towards the centre of the charge, if it is negative. In this example, both charges are positive, resulting in an electric field as illustrated below:



Step 2: Determine the direction of the electric field at point p.

Since p is on the (dotted) line connecting the centres of the charges, the direction of the electric field at point p corresponds to the electric field direction along the dotted line.



Note: The electric field decreases with distance from the charge. As such, the electric field vectors, $\overrightarrow{E_a}$ *and* $\overrightarrow{E_b}$ *, at point p are smaller than those closer to the charges,* Q_a *and* Q_b*.*

Step 3: Calculate the magnitude of each electric field at point p.

In general, the value of the electric field due to a charge Q and at a distance r from the charge is given by: $\left|\vec{E}\right| = \frac{kQ}{r^2}$

Applying this to $\overrightarrow{E_a}$ and $\overrightarrow{E_b}$ and noting that $r_a = d$ and $r_b = 2d$, we obtain:

$$\left|\overrightarrow{E_a}\right| = \frac{kQ_a}{d^2} \quad \text{and} \quad \left|\overrightarrow{E_b}\right| = \frac{kQ_b}{(2d)^2} = \frac{kQ_b}{4d^2}$$

Step 4: Add up the electric fields at point p, accounting for their respective directions.

$$\overrightarrow{E_{Total}} = \overrightarrow{E_a} + \overrightarrow{E_b} = \frac{kQ_a}{d^2} i - \frac{kQ_b}{4d^2} i = \frac{k}{d^2}\left(Q_a - \frac{1}{4} Q_b\right) i$$

Step 5: Plug in values for the charges.

$$\overrightarrow{E_{Total}} = \frac{k}{d^2}\left(1 - \frac{1}{4} * 2\right) i = \frac{k}{2d^2}\, i$$

This result indicates that the total electric field is pointing in the positive ***i*** *direction.*

Step 6: Draw the direction of the total electric field at p: