

**69866, Physics / Electromagnetism**

**Question** Two charges lie in a line along the x axis. Charge 1 is  $q_1 = 1.1$  C and charge 2 is  $q_2 = 2.5$  C. They are each a distance of  $d = 0.061$  m from the origin. What is the distance on the x-axis from the origin at which the electric field will be zero. Give your answer in meters.

**Solution** The electric field is sum of fields from both charges

$$E = E_1 + E_2 = k \frac{q_1}{r_1^2} - k \frac{q_2}{r_2^2} = 0$$

The signs of  $E_1$  and  $E_2$  are different as they are on different sides of point, where there is no field. Let us suppose it is at distance  $x$  from origin. Then

$$k \frac{q_1}{r_1^2} = k \frac{q_2}{r_2^2}$$
$$\frac{q_1}{(r-x)^2} = \frac{q_2}{(r+x)^2}$$

where  $r = 0.061$ . Then we can find  $x$ :

$$q_2(r^2 - 2xr + x^2) = q_1(r^2 + 2xr + x^2)$$
$$x^2(q_2 - q_1) - 2rx(q_2 + q_1) + r^2(q_2 - q_1) = 0$$
$$1.4x^2 - 2 \cdot 3.6 \cdot 0.061x + 0.061^2 \cdot 1.4 = 0$$

Solving this quadratic equation we find that suiting solution is

$$x = 0.01237$$