Answer on Question #71422 Physics / Electromagnetism

Two charges A and B of $Q = 5$uC each separated by a distance of 6cm. C is midpoint of the line joining A and B. A charge Q of -5uC is shot perpendicular to the line joining A and B through C with kinetic energy of $KE = 0.06$ J. The charge Q comes to rest at a point D. The distance CD is

Solution:

The potential of electric field at the points and D

$$V_c = k\frac{Q}{r_{AC}} + k\frac{Q}{r_{BC}}$$

$$V_D = k\frac{Q}{r_{AD}} + k\frac{Q}{r_{BD}}$$

The change of kinetic energy is equal of work done

$$KE = Q(V_c - V_D)$$

$$KE = kQ^2\left(\frac{1}{r_{AC}} + \frac{1}{r_{BC}} - \frac{1}{r_{AD}} - \frac{1}{r_{BD}}\right)$$

$$r_{AC} = r_{BC} = \frac{0.06\text{ m}}{2}0.03\text{ m}$$

$$r_{AD} = r_{BD}$$

Thus

$$0.06 = 9 \times 10^9 \times (5 \times 10^{-6})^2\left(\frac{2}{0.03} - \frac{2}{r_{AD}}\right)$$

$$r_{AD} = 0.03012\text{ m}$$

Finally

$$CD = \sqrt{r_{AD}^2 - r_{AC}^2} = 0.0027\text{ m} = 2.7\text{ mm}.$$

Answer: 2.7 mm.