Answer on Question #53095-Physics-Field Theory

Two equal point charges A and B are R distance apart. A third point charge placed on perpendicular bisector at a distance "d" from the centre will experience max electrostatic force when

Solution

Let r be the distance between A and C, the third charge. We have $r^2 = \frac{R^2}{4} + D^2$.

The force $F(D)$ between them is proportional to $\frac{1}{r^2}$. If α is the angle between AB and AC than $sin(\alpha) = \frac{D}{r}$ and the component of F in vertical direction is $F(D)sin(\alpha)$. So we have for the vertical component of $F(D)$:

$$F(D)sin(\alpha) = \frac{k1}{r^2}\frac{D}{r} = \frac{kD}{\left(\frac{R^2}{4} + D^2\right)^{\frac{3}{2}}}$$

$\frac{dF(D)}{dD} = 0$ as condition for extremum leads to

$$\frac{R^2}{4} + D^2 = 3D^2 \; or \; D = \frac{R}{2\sqrt{2}}.$$

Answer: $\frac{R}{2\sqrt{2}}$.