QUES 01:-

Three charges $+Q, q, +Q$ are placed respectively at distance $0, \frac{d}{2}$ and d from the origin on the X-axis. If the net force experienced by $+Q$ placed at $x = 0$ is zero, then value of q is

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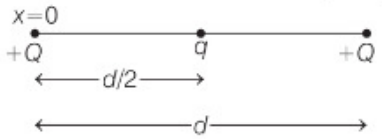
(a) $\frac{+Q}{2}$ (b) $\frac{+Q}{4}$ (c) $\frac{-Q}{2}$ (d) $\frac{-Q}{4}$

Ans - d

SOL:-

The given condition is shown in the figure given below,



Then, according to the Coulomb's law, the electrostatic force between two charges q_1 and q_2 such that the distance between them is (r) given as,

$$F = \frac{1 \cdot q_1 q_2}{4\pi\varepsilon_0 \cdot r^2}$$

$\therefore$ Net force on charge 'Q' placed at origin i.e. at $x = 0$ in accordance with the principle of superposition can be given as

$$F_{\text{net}} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q \times q}{\left(\frac{d}{2}\right)^2} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q \times Q}{(d)^2}$$

Since, it has been given that, $F_{\text{net}} = 0$.

$$\Rightarrow \quad \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q \times q}{\left(\frac{d}{2}\right)^2} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q \times Q}{(d)^2} = 0$$

$$\Rightarrow \quad \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q \times q}{\left(\frac{d}{2}\right)^2} = -\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q \times Q}{(d)^2} \text{ or } q = -\frac{Q}{4}$$