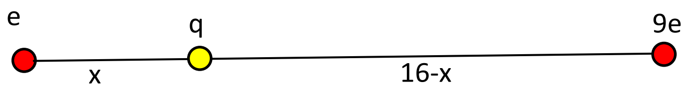
Answer on Question#68705 – Physics – Electromagnetism

Distance between the two point charges +9e and +e is 16 centimeter, where we can keep a third charge q between them so that they will be in equilibrium?

Solution. Let's draw a sketch of the placement of charges



Let x – distance between charges e and q. Hence distance between charges $9e$ and q. Since the charges are in equilibrium, the resultant force acting on each of the charges is zero. Let us consider the forces acting on the charge q. The interaction of point charges is described by the Coulomb law

$$F = \frac{k \cdot q_1 \cdot q_2}{r^2}$$

where r – distance between charges q_1 and q_2, $k = 8.99 \cdot 10^9 \frac{Nm^2}{C^2}$.

Therefore force between charges e and q equal to

$$F_1 = \frac{k \cdot e \cdot q}{x^2}.$$

Therefore force between charges e and q equal to

$$F_2 = \frac{k \cdot 9e \cdot q}{(16-x)^2}.$$

As result $F_1 = F_2 \to \frac{k \cdot e \cdot q}{x^2} = \frac{k \cdot 9e \cdot q}{(16-x)^2} \to \frac{1}{x^2} = \frac{9}{(16-x)^2} \to \frac{16-x}{x} = 3 \to 16 - x = 3x.$

$4x = 16 \to x = 4$ cm.

Answer. For the charge to stay in equilibrium, it is necessary to place a charge of q at a distance of 4 cm from the charge e.