Two point charges ql and q2 separated by a distance of 3.0 m experience a mutual force of 16 × 10–15 N. Calculate the magnitude of charge when q1 = q2 = q. What will be magnitude of force if separation between the charges is changed to 6.0 m?

Coulomb's law states that the electrical force between two charged objects is directly proportional to the product of the quantity of charge on the objects and inversely proportional to the square of the separation distance between the two objects. In equation form, Coulomb's law can be stated as

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

Where $q_1$represents the quantity of charge on object 1 (in Coulombs),q_2 represents the quantity of charge on object 2 (in Coulombs), and d represents the distance of separation between the two objects (in meters). In the case of air, the value of the Coulomb's law constant k is approximately 9.0 x 10^9 N • m^2 / C^2.

When $q_1 = q_2 = q$ the Coulomb's law can be written as

$$F = k\frac{q^2}{d^2}$$

Hence, the magnitude of charge is

$$q = \sqrt{\frac{d^2 F}{k}}$$

$$q = \sqrt{\frac{(3.0m)^2 \cdot 16 \times 10^{-15} N}{9 \times 10^9\ N\ m^2 C^{-2}}} = 4 \times 10^{-12} C$$

If separation between the charges is changed to 6.0 m the magnitude of force will be

$$F = k\frac{q^2}{d^2} = 9 \times 10^9\ N\ m^2 C^{-2} \frac{(4 \times 10^{-12} C)^2}{(6.0m)^2} = 4 \times 10^{-15} N$$