Answer on Question #74185-Physics-Electromagnetism

1.) Four equal magnitude point charges (3 uC) are placed at the corners of a square that is 4 cm on a side. Two diagonally opposite each other, are positive and the other two are negative. Determine the force on either negative charge.

Solution

$$F_1 = F_2 = \frac{kQ^2}{a^2} = \frac{(9\cdot 10^9)(3\cdot 10^{-6})^2}{(0.04)^2} = (50.625)N.$$

$$F_3 = \frac{kQ^2}{\left(\sqrt{2}a\right)^2} = \frac{(9\cdot 10^9)(3\cdot 10^{-6})^2}{(0.04\sqrt{2})^2} = (25.3125)N.$$

$$F_x = F_y = F_1 - \frac{F_3}{\sqrt{2}}$$

Therefore, the force on either negative charge

$$F = \sqrt{2}\left(F_1 - \frac{F_3}{\sqrt{2}}\right) = \sqrt{2}F_1 - F_3 = \sqrt{2}(50.625) - (25.3125) = 46.3\ N.$$

2.) Charges of +2,+3, and -8 uC are placed at the vertices of an equilateral triangle of side 10 cm. Calculate the magnitude of the force acting on the -8 uC due to the other two charges

Solution

$$F_1 = \frac{kq_1Q}{a^2} = \frac{(9\cdot 10^9)(2\cdot 10^{-6})(8\cdot 10^{-6})}{(0.1)^2} = (14.4)N.$$

$$F_2 = \frac{kq_2Q}{a^2} = \frac{(9\cdot 10^9)(3\cdot 10^{-6})(8\cdot 10^{-6})}{(0.1)^2} = (21.6)N.$$

The magnitude of the force acting on the -8 uC due to the other two charges is

$$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\alpha}$$

$$F = \sqrt{(14.4)^2 + (21.6)^2 + 2(14.4)(21.6)\cos 60} = 31.4\ N.$$