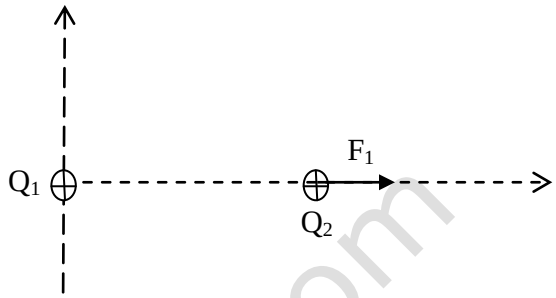
Q- Two positive, 1 nC charges are located on the x-axis. Charge Q_1 is located at the origin and charge Q_2 is located at (4, 0) which is 4 cm from the origin.
(a) Calculate the magnitude and direction of the force experienced by Q_2 due to Q_1.

The magnitude of the force is given by Coulombs law as

$$F_1 = \frac{1}{4\pi\epsilon_0} * \frac{Q_1 Q_2}{.x^2}$$

Or $$F_1 = (9 * 10^9) * \frac{(1*10^{-9}C)*(1*10^{-9}C)}{(0.04m)^2} = 5625 * 10^{-9}$$

Or F_1 = **$5.625*10^{-6}$ N**



(b) A third charge Q_3 of 2 nC is positioned on the y-axis at (0, 4) which is 4 cm from the origin. Calculate the magnitude and direction of the total force on Q_2 due to both Q_1 and Q_3.

The distance between Q_3 and Q_2 is

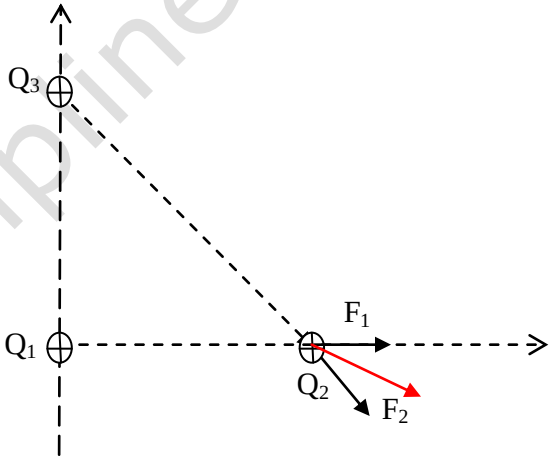
$$r = \sqrt{0.04^2 + 0.04^2} = \sqrt{0.0032}\ \text{m}$$

hence magnitude of the force on Q_2 due to Q_3 is given by

$$F_2 = \frac{1}{4\pi\epsilon_0} * \frac{Q_3 Q_2}{r^2}$$

Or $$F_2 = (9 * 10^9) * \frac{(2*10^{-9}C)*(1*10^{-9}C)}{0.0032} = 5625 * 10^{-9}$$

Or $F_2 = 5.625*10^{-6}$ N



As the angle between F_1 and F_2 is 45^0 and they are equal in magnitude their resultant is given by

$$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2cos45^0}$$

Or $$F = 5.625 * 10^{-6}\sqrt{2 + 2cos45^0} = 5.625 * 10^{-6} * 1.85 = 1.04 * 10^{-5}\ N$$

As the two forces are equal in magnitude, the resultant will bisect the angle between them and hence the resultant force on Q_2 due to Q_1 and Q_3 will be **$1.04*10^{-5}$ N** making angle **22.5^0** bellow the x direction.