$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{d^2} \ldots \mathbf{1}$$

$$F_A = \frac{Q}{4\pi\varepsilon_0}\frac{-Q}{0^2+9^2+12^2} = \frac{Q^2}{4\pi\varepsilon_0}\frac{-1}{225} \ldots \mathbf{1}$$

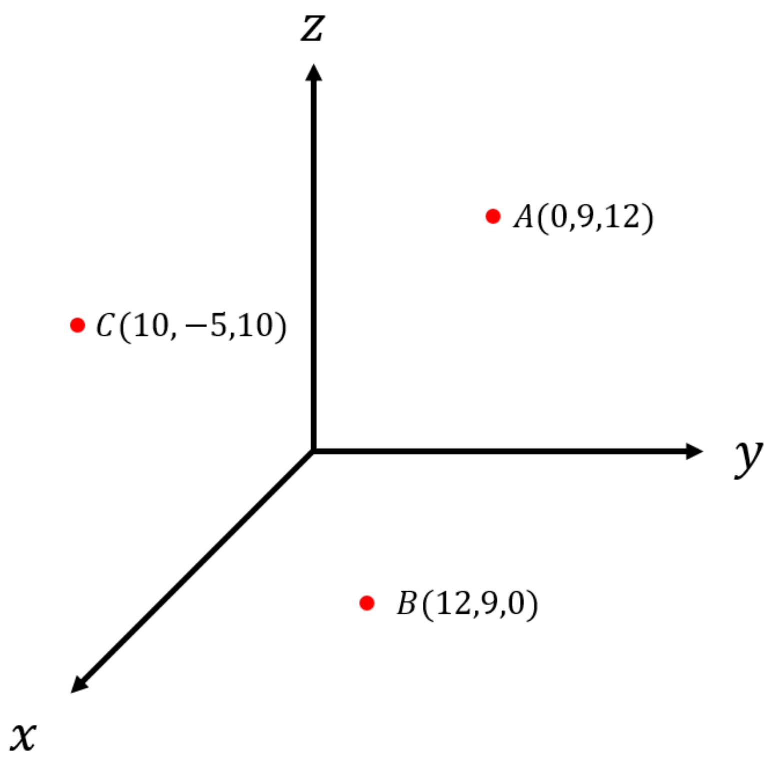
$$F_B = \frac{Q}{4\pi\varepsilon_0}\frac{Q}{12+9^2+0^2} = \frac{Q^2}{4\pi\varepsilon_0}\frac{1}{225} \ldots \mathbf{1}$$

$$F_C = \frac{Q}{4\pi\varepsilon_0}\frac{Q}{10^2+(-5)^2+10^2} = \frac{Q^2}{4\pi\varepsilon_0}\frac{1}{225} \ldots \mathbf{1}$$

$$F_{net_x} = \frac{-Q^2}{4\pi\varepsilon_0}\frac{1}{225}\left(-1\cdot\frac{0}{15}+1\cdot\frac{12}{15}+1\cdot\frac{10}{15}\right) = \frac{Q^2}{4\pi\varepsilon_0}\frac{1}{225}\left(\frac{-22}{15}\right) \ldots \mathbf{2}$$

$$F_{net_y} = \frac{-Q^2}{4\pi\varepsilon_0}\frac{1}{225}\left(-1\cdot\frac{9}{15}+1\cdot\frac{9}{15}+1\cdot\frac{-5}{15}\right) = \frac{Q^2}{4\pi\varepsilon_0}\frac{1}{225}\left(\frac{1}{3}\right) \ldots \mathbf{2}$$

$$F_{net_z} = \frac{-Q^2}{4\pi\varepsilon_0}\frac{1}{225}\left(-1\cdot\frac{12}{15}+1\cdot\frac{0}{15}+1\cdot\frac{10}{15}\right) = \frac{Q^2}{4\pi\varepsilon_0}\frac{1}{225}\left(\frac{2}{15}\right) \ldots \mathbf{2}$$



Q.2 In Figure 2, there is a charged particle q lies on the z-axis along with the centers of two uniformly charged rings. The location of q is $z = 6\ m$, the center of the green ring is $z = 0\ m$ and blue ring is $z = -6\ m$. The radius of the green ring $R1 = 8\ m$ and blue ring $R2 = 5\ m$. If we know the total charge of the green ring is -8π $(Coulomb)$ and the net electric field at q is zero. What is the linear charge density of the blue ring? (10 points)

the linear charge density of the gren ring $\lambda_G = \frac{-8\pi C}{2\pi \cdot 8\,m} = -\frac{1}{2}\, C/m$ (1) (1)

$$\vec{E}_{G\to q} = \frac{6m\cdot(-\frac{1}{2}\,C/m)\cdot(2\pi\cdot 8m)}{4\pi\varepsilon_0\,((6m)^2+(8m)^2)^{3/2}}\,(+\hat{z}) \quad (2)$$

$$= -\vec{E}_{B\to q} \quad (2)$$

$$= -\frac{12m\cdot\lambda_B\cdot(2\pi\cdot 5m)}{4\pi\varepsilon_0\,((12m)^2+(5m)^2)^{3/2}}\,(+\hat{z}) \quad (2)$$

$$\Rightarrow \lambda_B = \frac{6m\cdot(-\frac{1}{2}\,C/m)\cdot 8m}{(10m)^3}\cdot\left(-\frac{(13m)^3}{12m\cdot 5m}\right) = \frac{4394}{5000}\,C/m \quad (2)$$

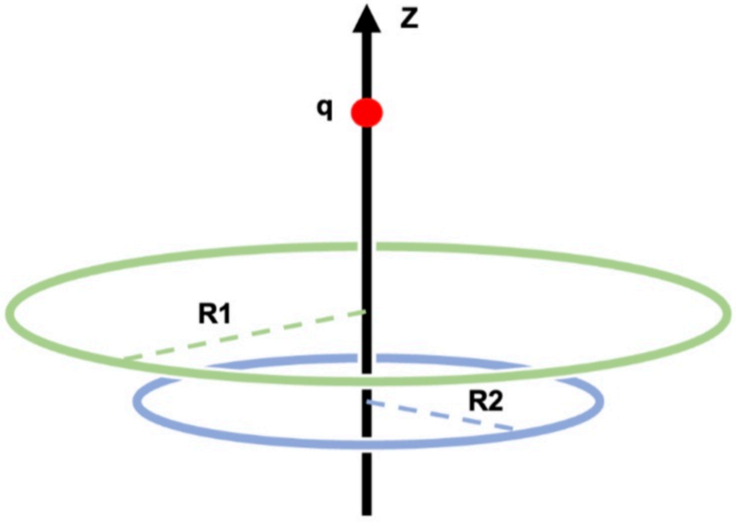


Figure 1: one charged particle and two rings