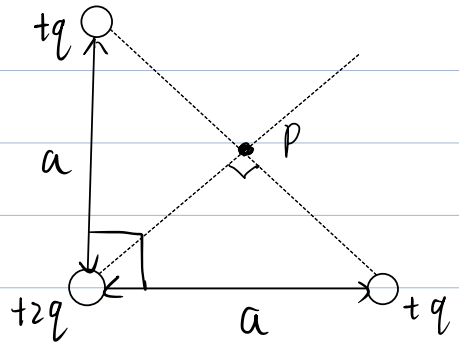
1. 三个点电荷如图放置，求P点的电场强度

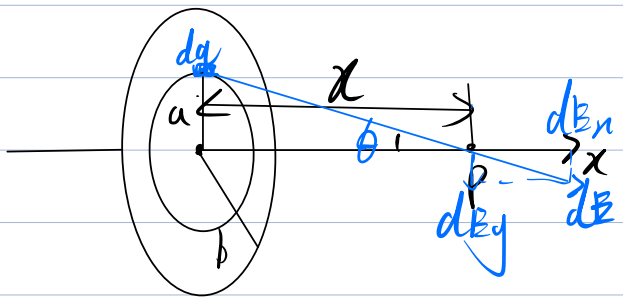


$$E = \frac{2q}{4\pi\varepsilon_0 r^2} = \frac{q}{2\pi\varepsilon_0 r^2}$$

$$r = \frac{a}{\sqrt{2}}$$

$$\therefore E = \frac{q}{\pi\varepsilon_0 a^2}$$

2. 一均匀带电圆环形平面的电荷面密度为σ，环的内、外半径分别为a和b。求圆环中心轴线上与环面相距为x处点P的电场强度以及当$b \to \infty$时点P的电场强度



$$dq = \sigma dS = \sigma 2\pi r dr$$

$$E_{环} = \frac{x \cdot \sigma}{4\pi\varepsilon_0 (x^2+R^2)^{\frac{3}{2}}}$$

$$dE = \frac{x \cdot dq}{4\pi\varepsilon_0 (x^2+R^2)^{\frac{3}{2}}}$$

$$E = \int dE = \int_a^b \frac{x \cdot \sigma 2\pi r dr}{4\pi\varepsilon_0 (x^2+r^2)^{\frac{3}{2}}},$$

$$= \int_a^b \frac{x\cdot\sigma}{2\varepsilon_0}\cdot\frac{r\,dr}{(x^2+r^2)^{\frac{3}{2}}}$$

$$= \frac{x\sigma}{2\varepsilon_0}\int_a^b \frac{1}{2}\cdot\frac{dr^2}{(x^2+r^2)^{\frac{3}{2}}}$$

$$= \frac{x\sigma}{4\varepsilon_0}(x^2+r^2)^{-\frac{1}{2}}\Big|_a^b\cdot(-2)$$

$$= -\frac{x\sigma}{2\varepsilon_0}\left(\frac{1}{\sqrt{x^2+b^2}}-\frac{1}{\sqrt{x^2+a^2}}\right)$$

$$= \frac{x\sigma}{2\varepsilon_0}\left(\frac{1}{\sqrt{x^2+a^2}}-\frac{1}{\sqrt{x^2+b^2}}\right)$$

当 $b\to\infty$ 时，$E=\frac{x\sigma}{2\varepsilon_0}\cdot\frac{1}{\sqrt{x^2+a^2}}$