华鑫纸品 Hua Xin Zhi Pin
班级： 姓名：刘昱坚 编号：1120240901 第 页

17. 设P距轴O距离为r. 以同轴圆柱面作为高斯面

当 $r<R_1$, $E\int_{S侧}dS = \frac{\sum q_内}{\varepsilon_0}$

$$E\cdot 2\pi rl = \frac{\cancel{\frac{r^2}{R^2}\rho}\ \cancel{\frac{4}{3}\pi r^3}\pi r^2 l\rho}{\varepsilon_0}$$

$$E = \frac{\rho r}{2\varepsilon_0}$$

当 $R_1<r<R_2$. $E_1\int_{S侧}dS = \frac{\rho\cdot\pi R_1^2 l}{\varepsilon_0}$

$$E_1 = \frac{\rho R_1^2}{2\varepsilon_0 r}$$

方向均沿半径向外

当 $R_2<r<R_3$ $E = E_1+E_2$

$$E_2\int_{S侧}dS = \frac{(\pi r^2-\pi R_2^2)l\rho}{\varepsilon_0}$$

$$E_2 = \frac{(r^2-R_2^2)\rho}{2r\varepsilon_0}$$

$$E = \frac{\rho(R_1^2+r^2-R_2^2)}{2\varepsilon_0 r}$$

当 $r>R_3$

$$E\int_{S侧}dS = \frac{\rho\cdot\pi R_1^2 l}{\varepsilon_0} + \frac{\rho(\pi R_3^2-\pi R_2^2)l}{\varepsilon_0}$$

$$E = \frac{(R_1^2+R_3^2-R_2^2)\rho}{2\varepsilon_0 r}$$

18. 设P距球心距离为r. 以同心球面为高斯面

当 $r<R$. $E\int_S dS = \frac{q_内}{\varepsilon_0}$

$$E\cdot 4\pi r^2 = \frac{\int_0^r \rho_e\cdot 4\pi r^2 dr}{\varepsilon_0} = \frac{k\pi r^4}{\varepsilon_0}$$

$$E = \frac{kr^2}{4\varepsilon_0}$$

当 $r>R$. $E\int_S dS = \frac{q_内}{\varepsilon_0}$

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

方向沿球半径向外

19. 设P位于x轴上，距O点x，以矩形为高斯面，矩形高2x，侧面积S，

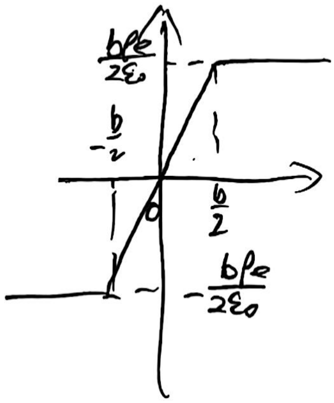
当 $x<\frac{b}{2}$　$E\cdot 2S = \frac{S\cdot 2x\cdot \rho_e}{\varepsilon_0}$

$E = \frac{x\rho_e}{\varepsilon_0}$

当 $x>\frac{b}{2}$　$E\cdot 2S = \frac{S\cdot b\cdot \rho_e}{\varepsilon_0}$

$E = \frac{b\rho_e}{2\varepsilon_0}$

方向沿x轴向外



20. ~~求挖去前~~ 设P在x轴上，距O点x，以同心(轴)圆柱面为高斯面

挖去前　$E_1 = \frac{\sigma}{2\varepsilon_0}$

设圆孔处全部负电荷：~~$E_2\cdot 2\pi R^2 = \frac{\pi R^2\sigma}{\varepsilon_0}$~~

~~$E_2 = \frac{\sigma}{2\varepsilon_0}$~~

∴ ~~$E = E_1 + E_2 = 0$~~

$$E_2 = \int_0^R \frac{-\sigma 2\pi r x\,dr}{4\pi\varepsilon_0 (x^2+r^2)^{\frac{3}{2}}} = -\frac{\sigma x}{2\varepsilon_0}\int_0^R \frac{r\,dr}{(x^2+r^2)^{\frac{3}{2}}}$$

$$= -\frac{\sigma x}{4\varepsilon_0}\int_0^{R^2}\frac{dA}{(x^2+A)^{\frac{3}{2}}} = -\frac{\sigma}{2\varepsilon_0}\left(1-\frac{x}{(x^2+R^2)^{\frac{1}{2}}}\right)$$

$$\therefore E = E_1+E_2 = \frac{\sigma}{2\varepsilon_0}\left(1-1+\frac{x}{(x^2+R^2)^{\frac{1}{2}}}\right)$$

$$= \frac{\sigma x}{2\varepsilon_0 (x^2+R^2)^{\frac{1}{2}}}$$

实验报告

课程名称：＿＿＿＿ 实验名称：＿＿＿＿ 实验日期：＿＿＿＿年＿＿＿＿月＿＿＿＿日

班 级：＿＿＿＿ 教学班级：＿＿＿＿ 学 号：1120240901 姓 名：刘显坚.

22. (1) ∵ $E_A=\frac{1}{2\varepsilon_0}(\sigma_1+\sigma_2-\sigma_3)$ $E_B=\frac{1}{2\varepsilon_0}(\sigma_1+\sigma_2-\sigma_3)$

以平面Ⅱ为电势零点

$\varphi_A=\int_{r_A}^{0}\vec{E_A}\,d\vec{l}=\frac{\sigma_1+\sigma_2-\sigma_3}{2\varepsilon_0}r_A$

$\varphi_b=\int_{r_B}^{0}\vec{E_B}\,d\vec{l}=\frac{\sigma_3-\sigma_1-\sigma_2}{2\varepsilon_0}r_B$

∴ $U_{ab}=\varphi_a-\varphi_b=\frac{(\sigma_1-\sigma_2-\sigma_3)r_A-(\sigma_3-\sigma_1-\sigma_2)r_B}{2\varepsilon_0}=9\times10^4V$

(2) $A_{ab}=U_{ab}q_0=-9\times10^{-4}J$ ∵ $A'=-A=9\times10^{-4}J$

24. ~~设内球面电势 φ_{a1} 外球面 φ_{a2}~~

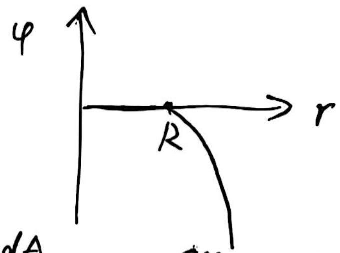
∵ $U_{ab}=\int_{R_a}^{R_b}E\,dr=\int_{R_a}^{R_b}\frac{q}{4\pi\varepsilon_0 r^2}dr=\frac{q}{4\pi\varepsilon_0}\left(\frac{1}{R_a}-\frac{1}{R_b}\right)$

∴ $E=\frac{1}{4\pi\varepsilon_0 r^2}=\frac{U_{ab}}{\left(\frac{1}{R_a}-\frac{1}{R_b}\right)r^2}$

28. ~~r>R时~~，以圆柱面为电势零点.

r>R时. $\varphi=\int_r^R\frac{\rho\,dr}{2\pi\varepsilon_0 r}=\frac{\rho}{2\pi\varepsilon_0}\ln\frac{R}{r}$

r<R时. $\varphi=\varphi_R=0$.



34. (1) ∵ $E=\int_{R_1}^{R_2}\frac{2\pi r\sigma x\,dr}{4\pi\varepsilon_0(x^2+r^2)^{\frac{3}{2}}}=\frac{\sigma x}{4\varepsilon_0}\int_{R_1^2}^{R_2^2}\frac{dA}{(x^2+A)^{\frac{3}{2}}}=\frac{\sigma x}{2\varepsilon_0}\left(\frac{1}{(x^2+R_1^2)^{\frac{1}{2}}}-\frac{1}{(x^2+R_2^2)^{\frac{1}{2}}}\right)$

∴ $\varphi=\int_x^{\infty}E\,dx=\int_x^{\infty}E\,dx=\frac{\sigma e}{2\varepsilon_0}\int_x^{\infty}\left(\frac{x}{(x^2+R_1^2)^{\frac{1}{2}}}-\frac{x}{(x^2+R_2^2)^{\frac{1}{2}}}\right)dx$

$=\frac{\sigma e}{4\varepsilon_0}\int_{x^2}^{\infty}\left(\frac{1}{(A+R_1^2)^{\frac{1}{2}}}-\frac{1}{(A+R_2^2)^{\frac{1}{2}}}\right)dA=\cancel{\frac{\sigma}{4\varepsilon_0}\ln\frac{A+R_1^2}{A+R_2^2}}\ \frac{\sigma e}{2\varepsilon_0}\left(\sqrt{R_2^2+x^2}-\sqrt{R_1^2+x^2}\right)$

(2) ∵ $A=eU=\frac{\sigma e}{2\varepsilon_0}(R_2-R_1)$

∵ $A=\frac{1}{2}m_e v_{min}^2$

$v_{min}=\sqrt{\frac{2A}{m_e}}=\sqrt{\frac{\sigma e}{\varepsilon_0 m_e}(R_2-R_1)}$

实 验 报 告

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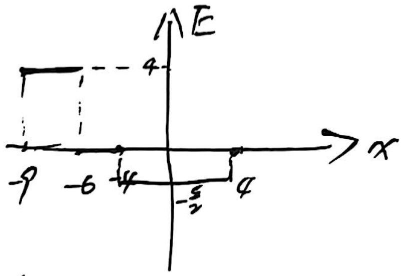
39. $\because \varphi = \frac{\sigma_e}{2\varepsilon_0}\left(\sqrt{R_2^2+x^2} - \sqrt{R_1^2+x^2}\right)$

由对称性. $E_y = E_z = 0$

$\therefore \vec{E} = E_x = \frac{\partial \varphi}{\partial x} = \frac{\sigma_e}{4\varepsilon_0}\left(\frac{2x}{\sqrt{R_2^2+x^2}} - \frac{2x}{\sqrt{R_1^2+x^2}}\right) = \frac{\sigma_e x}{2\varepsilon_0}\left(\frac{1}{\sqrt{R_2^2+x^2}} - \frac{1}{\sqrt{R_1^2+x^2}}\right)$

40. $\varphi = \begin{cases} 4x+36, & -9<x<-6 \\ 12, & -6<x<-4 \\ -\frac{5}{2}x+2, & -4<x<4 \end{cases}$



$\therefore E_x = \frac{\partial \varphi}{\partial x}$　　当 $-9<x<-6$.　$E_x = 4\,V/m$

$-6<x<-4$　　$E_x = 0$

$-4<x<4$　　$E_x = -\frac{5}{2}\,V/m$

34. (1) $\because d\varphi = \cancel{\frac{r\sigma_e dr}{2\varepsilon_0 (x^2+r^2)^{\frac{3}{2}}}}\ \frac{dq}{4\pi\varepsilon_0 (x^2+r^2)^{\frac{1}{2}}} = \frac{r\sigma_e dr}{2\cancel{\pi}\varepsilon_0 (x^2+r^2)^{\frac{1}{2}}}$

$\therefore \varphi = \int_{R_1}^{R_2} \frac{r\sigma_e dr}{2\varepsilon_0 (x^2+r^2)^{\frac{1}{2}}} = \frac{\sigma_e}{4\varepsilon_0}\int_{R_1^2}^{R_2^2} \frac{dA}{(x^2+A)^{\frac{1}{2}}} = \frac{\sigma_e}{2\varepsilon_0}\left(\sqrt{R_2^2+x^2} - \sqrt{R_1^2+x^2}\right)$