1-17. 当 $r \le R_1$ 时.

高斯定理. $\frac{\pi r^2 l \rho_e}{\varepsilon_0} = \Phi = 2\pi r l \cdot E$ $\therefore E = \frac{\rho_e}{2\varepsilon_0} r$

$R_1 \le r \le R_2$. $q = \pi R_1^2 l \rho_e$ $E = \frac{R_1^2 \rho_e}{2\varepsilon_0 r}$

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

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

1-18. $q = \int_0^R 4\pi r^2 \cdot kr\, dr = \int_0^R 4\pi r^3 k\, dr$

$0 \le r \le R$ $\pi r^4 k \Big|_0^R = k\pi R^4$

$\frac{q}{\varepsilon_0} = E \cdot 4\pi r^2 \Rightarrow E = \frac{q}{4\pi\varepsilon_0 r^2} = \frac{k\pi R^4}{4\pi\varepsilon_0 r^2} = \frac{kr^2}{4\varepsilon_0}$

$r \ge R$ $q = \pi R^4 k$. $E = \frac{q}{4\pi\varepsilon_0 r^2} = \frac{\pi R^4 k}{4\pi\varepsilon_0 r^2} = \frac{R^4 k}{4\varepsilon_0 r^2}$

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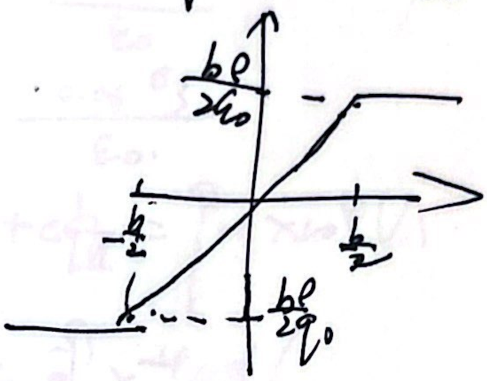
1-19. $q = e\,2Sx = 2SE\varepsilon_0$

$|x| \le \frac{b}{2}$ $\begin{cases} \Phi = \frac{q}{\varepsilon_0} \\ \Phi = 2SE \end{cases}$ ∴ $E = \frac{ex}{2\varepsilon_0}$

$|x| > \frac{b}{2}$ $E = \frac{be}{2\varepsilon_0}$

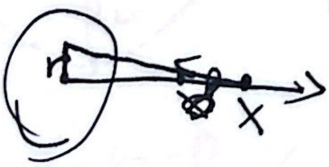


1-20. 先计算薄板.

$q = \sigma_e S$ ⇒ $E = \frac{\sigma_e}{2\varepsilon_0}$

$\frac{q}{\varepsilon_0} = 2SE$

再计算面密度 $-\sigma_e$ 的圆孔电场



$$E = \int_0^R \frac{2\pi r(-\sigma_e)\,dr}{4\pi\varepsilon_0 (r^2+x^2)} \sin\theta$$

$$\sin\theta = \frac{x}{(r^2+x^2)^{\frac{1}{2}}}$$

叠加原理 $E = \frac{\sigma_e x}{2\varepsilon_0 (R^2+x^2)^{\frac{1}{2}}}$

联系方式:

1-22 (1) $E = \frac{\sigma}{2\varepsilon_0}$

$\Delta\varphi_{I} = E_1 \cdot 12cm = \frac{0.06\sigma_1}{\varepsilon_0}$

$\Delta\varphi_{II} = -E_2 \cdot 2cm = \frac{0.01\sigma_2}{\varepsilon_0}$

$\Delta\varphi_{III} = -E_3 \cdot 12cm = \frac{0.06\sigma_3}{\varepsilon_0}$

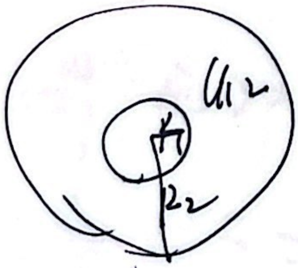
$\therefore \Delta\varphi_{AB} = \Delta\varphi_{I} + \Delta\varphi_{II} + \Delta\varphi_{III} = 7.0\times10^{4} V$

(2) $A = \varphi_{AB} \cdot q_0 = 7\times10^{-4} J$

∴外力做功 $7\times10^{-4} J$

1-24

~~取半径r的高斯面~~



~~$4\pi r^2 E$~~

$U_{12} = \frac{q_1}{4\pi\varepsilon_0 R_1} - \frac{q_1}{4\pi\varepsilon_0 R_2}$

$R_1 \le r \le R_2$　$E = \frac{q_1}{4\pi\varepsilon_0 r^2} = U_{12}\frac{R_1 R_2}{R_2 - R_1}$

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1-28 

$r<R$ 时

$E_{内} = \frac{\rho_e r}{2\varepsilon_0}$

$\varphi_{内} = \int_r^{R} E_{内} dr = \frac{-\rho_e}{4\varepsilon_0} r^2$

$r \geq R$ 时

$E_{外} = \frac{R^2 \rho_e}{2\varepsilon_0 r} e_r$

$\varphi_{外} = \int_R^{0} E_{内} dr + \int_r^{R} E_{外} dr$

$= -\frac{\rho_e R^2}{4\varepsilon_0} + \frac{\rho_e R^2}{2\varepsilon_0} \ln\frac{R}{r}$

1-34. ~~$E = \int_{R_1}^{R_2} \frac{2\pi r \sigma_e dr}{4\pi\varepsilon_0 (x^2+r^2)} \frac{x}{(x^2+r^2)^{\frac{1}{2}}}$~~

(1) $d\varphi = \frac{\sigma 2\pi r dr}{4\pi\varepsilon_0 (x^2+r^2)^{\frac{1}{2}}}$ $\varphi = \int_{R_1}^{R_2} d\varphi = \frac{\sigma}{2\varepsilon_0}\left[(R_2^2+x^2)^{\frac{1}{2}} - (R_1^2+x^2)^{\frac{1}{2}}\right]$

(2) $\frac{1}{2} m v_1^2 = e\varphi \Rightarrow v = \sqrt{\frac{e\sigma}{\varepsilon_0 m}(R_2 - R_1)}$

1-39. $E(x) = \varphi'(x) = \frac{-\partial\varphi}{\partial x} = \frac{\sigma}{2\varepsilon_0}\left(\frac{x}{\sqrt{R_1^2+x^2}} - \frac{x}{\sqrt{R_2^2+x^2}}\right)$

1-46. $E = -\frac{\partial\varphi}{\partial x} = \begin{cases} -3, & x \in [-9, -6] \\ 0, & x \in [-6, -2] \\ \frac{5}{2}, & x \in [-2, 0] \end{cases}$

联系方式：