$1-31$

> $$E_n = \sigma_{e^n}/2 = \begin{cases} 6 * 10^{-5} \\ 1 * 10^{-5} \\ 5.5 * 10^{-5} \end{cases}$$
>
> 以 σ_{e^2} 为零电势面
>
> $$\begin{cases} V_A = +5 * 10^{-6} \\ V_B = -7 * 10^{-7} \end{cases} \Rightarrow U_{AB} = -2 * 10^{-7}$$
>
> (2)
>
> > $$W = -U_{AB} \cdot q_0 = -2 * 10^{-15} J$$

$1-34$

> (1)
>
> > $$V = \frac{1}{4\pi\varepsilon_0 r} \cdot \frac{4}{3}\rho_e \pi R^3 = \frac{\rho_e R^3}{3\varepsilon_0 r}$$
>
> (2)
>
> > $$V = \frac{\rho_e R^2}{3\varepsilon_0}$$
>
> (3)
>
> > $$\vec{E} = \frac{4}{3}\rho_e \pi r^3 \frac{1}{4\pi\varepsilon_0 r^2} = \frac{\rho_e r}{3\varepsilon_0}$$
> > $$V = \frac{\rho_e R^2}{3\varepsilon_0} - \int_R^r \frac{\rho_e r'}{3\varepsilon_0} \mathrm{d}r' = \frac{\rho_e R^2}{3\varepsilon_0} - \left(\frac{\rho_e r^2}{6\varepsilon_0} - \frac{\rho_e R^2}{6\varepsilon_0}\right) = \frac{\rho_e R^2}{2\varepsilon_0} - \frac{\rho_e r^2}{6\varepsilon_0}$$

$1-36$

> (1)令内部圆柱面电荷线密度为 σ
>
> $$E(r) = \frac{1}{2\pi r\varepsilon_0}\sigma \,(R_1 < r < R_2)$$
> $$-\int_{R_1}^{R_2} E(r) = 450\mathrm{V}$$
> $$\Rightarrow \frac{\sigma}{2\pi\varepsilon_0}\ln\left(\frac{R_1}{R_2}\right) = 450\mathrm{V}$$
> $$\Rightarrow \sigma = \frac{900\pi\varepsilon_0}{\ln(0.3)}\mathrm{C} \cdot \mathrm{m}^{-1}$$
>
> (2)
>
> $$E(r) = \frac{1}{2\pi r\varepsilon_0}\sigma = \frac{450}{\ln(0.3) r}(V)\,(R_1 < r < R_2)$$

1.37

> 以无穷远点为势能零点

$$\vec{E}=\begin{cases}\dfrac{\rho_e r}{2\varepsilon_0} & r\leqslant R\\ \dfrac{\rho_e R^2}{2\varepsilon_0 r} & r>R\end{cases}$$

$$V=-\int_0^r\vec{E}\cdot\mathrm{d}\vec{r}=\begin{cases}\dfrac{\rho_e r^2}{4\varepsilon_0}\\ \dfrac{\rho_e R^2}{4\varepsilon_0}+\dfrac{\rho_e R^2}{2\varepsilon_0}\ln\dfrac{r}{R}\end{cases}$$

$1-43$

$$\begin{aligned}V_B&=\int_{-\frac{l}{2}}^{\frac{l}{2}}\frac{1}{4\pi\varepsilon_0}\frac{l_e\mathrm{d}x}{\sqrt{\left(\frac{x}{2}\right)^2+b^2}}\\&=\int_{-\arctan\frac{l}{4b}}^{\arctan\frac{l}{4b}}\frac{1}{2\pi\varepsilon_0}\frac{l_e}{\cos\theta}\mathrm{d}\theta\\&=-\int_{-\arctan\frac{l}{4b}}^{\arctan\frac{l}{4b}}\frac{1}{2\pi\varepsilon_0}\frac{l_e}{1-\sin^2\theta}\mathrm{dsin}\theta\\&=-\frac{1}{2\pi\varepsilon_0}\frac{l_e}{2}\ln\left(\frac{1+x}{1-x}\right)\Bigg|_{x=-\frac{l}{\sqrt{16b^2+l^2}}}^{x=\frac{l}{\sqrt{16b^2+l^2}}}\\&=-\frac{l_e}{2\pi\varepsilon_0}\ln\left(\frac{1+x}{1-x}\right)\Bigg|_{x=-\frac{l}{\sqrt{16b^2+l^2}}}^{x=\frac{l}{\sqrt{16b^2+l^2}}}\end{aligned}$$

$1-49$

(1)

$$\begin{aligned}\mathrm{V}_P&=\int_{R_1}^{R_2}\left(\frac{1}{4\pi\varepsilon_0}\cdot\frac{2\pi r\sigma_e\mathrm{d}r}{\sqrt{r^2+x^2}}\right)\\&=\int_{R_1}^{R_2}\left(\frac{r\sigma_e\mathrm{d}r}{2\varepsilon_0\sqrt{r^2+x^2}}\right)\\&=\frac{\sigma_e}{2\varepsilon_0}\left(\sqrt{R_2^2+x^2}-\sqrt{R_1^2+x^2}\right)\end{aligned}$$

(2)

令原点 O 的电势为

$$V=\frac{\sigma_e}{2\varepsilon_0}(R_2-R_1)$$

则无穷远处电势为

$$\begin{aligned}V&=\frac{\sigma_e}{2\varepsilon_0}\left(\sqrt{R_2^2+x^2}-\sqrt{R_1^2+x^2}\right)\\&=\frac{\sigma_e}{2\varepsilon_0}\left(\sqrt{1+\left(\frac{R_2}{x}\right)^2}-\sqrt{1+\left(\frac{R_1}{x}\right)^2}\right)\\&\approx\frac{\sigma_e\left(R_2^2-R_1^2\right)}{4x\varepsilon_0}\approx 0\end{aligned}$$

> > 因而得到
> >
> > $$\frac{1}{2}mv_{min}^2 = \frac{\sigma_e}{2\varepsilon_0}(R_2 - R_1)$$
> > $$\Rightarrow v_{min} = \sqrt{\frac{\sigma_e}{m\varepsilon_0}(R_2 - R_1)}$$
> >
> > (不是，这计算就是以无穷远点为势能零点算的啊，我还再算一次干嘛)

$1-51$

> 作法类似上一题（懒得算了）
>
> $$V = \frac{\sigma_e}{2\varepsilon_0}\sqrt{R_2^2 + \left(\frac{R_2}{\tan\theta}\right)^2} + \frac{\sigma_e}{2\varepsilon_0}\sqrt{R_1^2 + \left(\frac{R_1}{\tan\theta}\right)^2}$$

$1-55$

> $$V = \frac{\sigma_e}{2\varepsilon_0}\left(\sqrt{R_2^2 + x^2} - \sqrt{R_1^2 + x^2}\right)$$
> $$E = -\frac{\partial V}{\partial x} = -\frac{\sigma_e}{2\varepsilon_0}\left(\frac{x}{\sqrt{R_2^2 + x^2}} - \frac{x}{\sqrt{R_1^2 + x^2}}\right)$$