# 第十一次作业

15.9, 15.17, 17.1, 17.9, 18.1, 19.4, 20.4

#### 15.9

对于无限薄的的  $\mathrm{d}x'$  形成的电场:

$$E=rac{1}{4\piarepsilon_0}2\pi(-eax')\mathrm{d}x'$$

因此

$$egin{aligned} E(x) &= rac{1}{4\piarepsilon_0} 2\pi \int_{-rac{x_m}{2}}^x (-eax') \mathrm{d}x' - rac{1}{4\piarepsilon_0} 2\pi \int_x^{rac{x_m}{2}} (-eax') \mathrm{d}x' \ &= -rac{ea}{2arepsilon_0} \left[rac{x^2}{2} - rac{x_m^2}{8} - rac{x_m^2}{8} + rac{x^2}{2}
ight] \ &= rac{ea}{2arepsilon_0} \left[rac{x_m^2}{4} - x^2
ight] \end{aligned}$$

在薄片之外, E=0

#### 15.17

由两块金属板电势相等可知:

$$rac{d}{3}\cdot E_1 = rac{2d}{3}\cdot E_2$$

对塑料薄片上的一小块面积分析, 由高斯定理可知:

$$rac{q}{arepsilon_0} = rac{\sigma \mathrm{d} S}{arepsilon_0} = (E_1 + E_2) \mathrm{d} S$$

联解可得:

$$E_1 = rac{2\sigma}{3arepsilon_0}, E_2 = rac{\sigma}{3arepsilon_0}$$

## 17.1

由公式 
$$oldsymbol{B}=rac{\mu_0}{4\pi}\ointrac{I\mathrm{d}oldsymbol{l} imesoldsymbol{r}}{r^3}$$
 可知

$$\therefore B = rac{\mu_0}{4\pi} \left( rac{I \cdot \pi R_2}{r^2} - rac{I \cdot \pi R_1}{r^2} 
ight) = rac{\mu_0 I}{4r^2} (R_2 - R_1)$$

方向垂直纸面向外.

#### 17.9

已知  $2~{
m keV}\ll 0.511~{
m MeV}, V_{\parallel}=V_0\cos 89^{\circ}, V_{\perp}=V_0\cos 1^{\circ}$ 

### (a)

因为  $V_{\parallel}$  是平动,而  $V_{\perp}$  是转动,所以正电子的轨迹是螺旋线,轴线沿  $\vec{B}$  方向.

## (b)

$$egin{aligned} dots qV_ot B &= mrac{V_ot^2}{r} \ &\omega &= rac{V_ot}{r} = rac{qB}{m} \ &dots T &= rac{2\pi}{\omega} = 3.57 imes 10^{-10} ext{ s} \ &p &= V_\|T = 0.17 ext{ mm} \end{aligned}$$

#### 18.1

$$\therefore B(r) = \frac{\mu_0}{4\pi} \cdot \frac{2I}{r}$$

$$\therefore \frac{d\Phi}{dt}(r) = B \frac{dA}{dt} = B \cdot dr \cdot v$$

$$\therefore \varepsilon = -\int_a^b B(r) \cdot v \cdot dr$$

$$= -\frac{\mu_0}{4\pi} 2Iv \ln \frac{b}{a}$$

$$= -10^{-7} \times 2 \times 100 \times 5.0 \times \ln 20 \text{ V}$$

$$= -3.0 \times 10^{-4} \text{ V}$$

# 19.4

$$\because I = Q \frac{\omega}{2\pi}$$

$$\therefore \mu = I\pi r^2 = \frac{1}{2}Q\omega r^2$$

## 20.4

$$E_
ho = rac{\lambda}{2\piarepsilon_0
ho}$$

## (a)

$$\therefore q = Carepsilon = rac{2\piarepsilon_0 l}{\ln\left(rac{R_2}{R_1}
ight)}arepsilon$$

$$:: arepsilon_0 E_
ho 2\pi 
ho l = q$$

$$\therefore E_{
ho} = rac{1}{
ho} \cdot rac{arepsilon}{\ln\left(rac{Rr_2}{R_1}
ight)}$$

$$\therefore B_{arphi} 2\pi 
ho = \mu_0 I = \mu_0 rac{arepsilon}{R}$$

$$\therefore B_{\varphi} = \frac{\mu_0}{4\pi} \cdot \frac{2\varepsilon}{\rho R}$$

## (b)

$$\therefore S = rac{arepsilon^2}{2\pi R \ln\left(rac{R_2}{R_1}
ight)} rac{1}{
ho^2} k$$

# (c)

$$\therefore P = rac{arepsilon^2}{2\pi R \ln\left(rac{R_2}{R_1}
ight)} \int_{R_1}^{R2} rac{1}{
ho^2} \cdot 2\pi 
ho \mathrm{d}r = rac{arepsilon^2}{R}$$

所以是合理的.