2-43

解

$$\frac{1}{2}mv^2 = Uq \to v = \sqrt{\frac{2Uq}{m}}$$

$$qvB = \frac{mv^2}{r}$$

$$qB = \frac{m\sqrt{\frac{2Uq}{m}}}{\frac{x}{2}}$$

$$m = \frac{qB^2}{8U}x^2$$

2-45

解　(1)

$$E = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2E}{m}}$$

$$B = \frac{mv}{qR} = \frac{\sqrt{2mE}}{qR} = 0.48\text{T}$$

(2)

$$n = \frac{E}{Uq} = 200$$

$$F = ma$$

$$\frac{U}{d}q = ma$$

$$a = \frac{Uq}{md}$$

又因为圆周运动满足 $R = \frac{mv}{Bq}$,故运动周期为

$$T = \frac{2\pi R}{v} = \frac{2\pi m}{Bq}$$

故

$$t = \frac{v}{a} + n\frac{T}{2} = \frac{\sqrt{\frac{2E}{m}}}{\frac{Uq}{md}} + \frac{200\pi m}{Bq} = 1.38 \times 10^{-5}\text{s}$$

2-50

解　(1)N 型

(2)

$$\frac{U}{b}e = Bev \to v = \frac{U}{Bb}$$

$$I = neSv$$

$$n = \frac{I}{nev} = \frac{BI}{eaU} = 2.9 \times 10^{20}/\mathrm{m}^3$$

2-50

解 (1)N 型

(2)

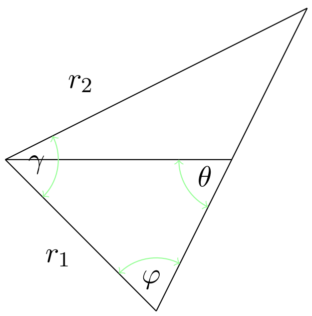
$$\frac{U}{b}e = Bev \to v = \frac{U}{Bb}$$

$$I = neSv$$

$$n = \frac{I}{nev} = \frac{BI}{eaU} = 2.9 \times 10^{20}/\mathrm{m}^3$$

3-5

解



$$\begin{aligned}\Phi &= \int \mathbf{B} \cdot \mathrm{d}\mathbf{S} \\ &= \int_0^{\gamma} 2a \frac{r\,\mathrm{d}\alpha}{\sin\beta} \frac{\mu_0 I}{2\pi r} \cos\beta \\ &= \frac{a\mu_0 I}{\pi} \int_0^{\gamma} \frac{\cos\beta\,\mathrm{d}\alpha}{\sin\beta}\end{aligned}$$

又因为 $\beta = \varphi + \alpha$ 故

$$\begin{aligned}\Phi &= \frac{a\mu_0 I}{\pi} \int_{\varphi}^{\gamma+\varphi} \frac{\cos\beta\,\mathrm{d}\beta}{\sin\beta} \\ &= \frac{a\mu_0 I}{\pi} \ln\frac{\sin(\varphi+\alpha)}{\sin(\phi)} \\ &= \frac{a\mu_0 I}{2\pi} \ln\frac{r_1}{r_2} \\ &= \frac{a\mu_0 I}{2\pi} \left(\ln(a^2+b^2-2ab\cos\theta) - \ln(a^2+b^2+2ab\cos\theta)\right)\end{aligned}$$

故电动势为

$$\begin{aligned}\mathscr{E} &= \frac{\mathrm{d}\Phi}{\mathrm{d}t} \\ &= \frac{\mathrm{d}\Phi}{\mathrm{d}\theta}\frac{\mathrm{d}\theta}{\mathrm{d}t} \\ &= \frac{-\mu_0 I a^2 b\omega\sin(\omega t)}{\pi}\left(\frac{1}{a^2+b^2+2ab\cos(\omega t)}+\frac{1}{a^2+b^2-2ab\cos(\omega t)}\right)\end{aligned}$$

3-8

解

$$Q = I\,\mathrm{d}t$$

$$Q = \frac{\mathrm{d}\Phi}{R\,\mathrm{d}t}\,\mathrm{d}t$$

$$\Delta Q = \frac{\Delta\Phi}{R}$$

$$\Delta Q = \frac{N\pi d^2 B}{2R}$$

$$B = \frac{2R\Delta Q}{N\pi d^2} = 1.3\times10^{-4}\mathrm{T}$$