数学作业纸

科目 大物

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3-29. ∵ 当 $r<R_1$. $\oint \vec{H_1}\, d\vec{l} = \frac{\pi r^2}{\pi R_1^2} I$

$H_1 \cdot 2\pi r = \frac{r^2}{R_1^2} I$

$H_1 = \frac{rI}{2\pi R_1^2}$

$B_1 = \mu_1 H = \frac{\mu_1 r I}{2\pi R_1^2}$　方向顺时针

当 $R_1<r<R_2$　$\oint \vec{H_2}\, d\vec{l} = I$

$H_2 = \frac{I}{2\pi r}$

$B_2 = \frac{\mu_2 I}{2\pi r}$　方向同 B_1

$r>R_2$. $H_3 = B_3 = \frac{I}{2\pi r}$　方向同 B_1

3-30. $\oint \vec{H}\, d\vec{l} = nIl$

$Hl = nIl$

$H = nI$

$B = \mu_0\mu_r H = \mu_0\mu_r nI$　方向遵循右手螺旋

$M = (\mu_r-1)H = (\mu_r-1)nI$

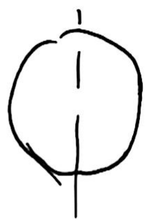
$\vec{j} = \vec{M}\times\vec{e_n} = (\mu_r-1)nI$　方向沿介质圆切向

4-1. $\psi = 2\Phi = 2\int_a^{a+b} \frac{\mu I}{2\pi x} l\, dx = \frac{\mu I_0 l \sin\omega t}{\pi} \ln\frac{a+b}{a}$

$\therefore \varepsilon = -\frac{d\psi}{dt} = -\frac{\mu I_0 l \omega}{\pi}\cos\omega t \ln\frac{a+b}{a}.$

4-2. ∵ $\psi = NBS = NB\cdot\pi R^2\cos\theta$

$= NB\pi R^2\cos\omega t$



$\therefore \varepsilon = NB\pi R^2\omega\sin\omega t$　　$\varepsilon_{max} = NB\pi R^2\omega$

设起始面线圈平面与B垂直. 则 ε_{max} 出现在 $t = \frac{(2n-1)\pi}{2\omega}$ $(n=1,2,3\ldots)$ 时

即 $\sin\omega t = 1$

4-4. $\because$ $B \cancel{= \frac{nBt}{nIL}} = \cancel{\frac{N}{L} \mu_0 I L = N\sin}$

$$B = \mu_0 n I = \frac{25 N \sin\omega t\, \mu_0}{L}$$

$$\therefore \Phi = BS = \frac{2\mu_0 N \sin\omega t\, \pi r^2}{L}$$

$$\varepsilon = -\frac{25 N \mu_0 \omega \pi r^2}{L} \cos\omega t$$

$$I = \frac{\varepsilon}{R} = -\frac{2\mu_0 N \omega \pi r^2}{LR} \cos\omega t$$

$$\therefore I_{max} = \frac{2\mu_0 N \omega \pi r^2}{LR} \approx \cancel{2.37 \times 10^{7}}\ \underset{29.77}{} A.$$

4-5. 将CD相连. 则 $\oint_L \vec{E}_i d\vec{l} = 0$. 即 $\varepsilon = 0$

故 $\varepsilon_{C\overset{\frown}{D}} + \varepsilon_{CD} = 0$.

$\because \varepsilon_{CD} = \int_{a-R}^{a+R} \frac{\mu_0 I}{2\pi x} \cdot v\, dx = -\frac{\mu_0 I v}{2\pi} \ln \frac{a+R}{a-R}$ 故方向由 $D \to C$.

$\therefore \varepsilon_{C\overset{\frown}{D}} = \frac{\mu_0 I v}{2\pi} \ln \frac{a+R}{a-R}$ 方向由 $D \to C$. C端电势高.

4-7. $\because \varepsilon = \int_0^{l_0} Bv\cos(\frac{\pi}{2}-\theta)\, dl = \int_0^{l_0} B l \omega \sin^2\theta\, dl = \frac{1}{2} B l_0^2 \omega \sin^2\theta$

$\therefore U_{OA} = -\varepsilon = -\frac{1}{2} B l_0^2 \omega \sin^2\theta$. A端电势更高

4-8. (1) 由右手螺旋. 方向. 为 ~~A→C→D→O→A~~ $A \to O \to D \to C \to A$

(2) AOD不切割磁感线 $\varepsilon_{AOD} = 0$.

$\varepsilon_{DCA} = -\frac{d\Phi}{dt} = -B\frac{dS}{dt} = -B\frac{d(\frac{\pi a^2}{2}\sin\omega t)}{dt} = -B \cdot \frac{\pi a^2 \omega}{2}\cos\omega t$

$t=0$ 时. $\varepsilon_{DCA} = -B \cdot \frac{\pi a^2 \omega}{2}$ 大小 $B \cdot \frac{\pi a^2 \omega}{2}$

4-9、(1) ∵ $\varepsilon = \int_C^D (\vec{v}\times\vec{B})\cdot d\vec{l} = \int v B_0 \frac{x\tan 30^\circ}{\tan 30^\circ}\cdot 2 = \frac{2\sqrt{3}}{3} v^2 B_0 t$ 方向 $C\to D$

(2) ∵ $\varepsilon_{动} = \frac{2\sqrt{3}}{3} v^2 B_0 t^2$

$\varepsilon_{感} = -\oint_S \frac{\partial B}{\partial t} d\vec{S} = \int_0^{x} B_0 \frac{2x'\tan 30^\circ}{\tan 30^\circ} dx' = \frac{\sqrt{3}}{3} B_0 x^2 = \frac{\sqrt{3}}{3} B_0 v^2 t^2$

$= \frac{\sqrt{3}}{3} v^2 B_0 t^2$

∴ $\varepsilon = \frac{\sqrt{3}}{3} B_0 x^2 + \frac{2\sqrt{3}}{3} v^2 B_0 t^2$ 方向由 $C\to D$

4-10. ∵ $\varepsilon_{动} = \int_0^b (\vec{v}\times\vec{B}) d\vec{l} = \int_0^b v\cdot\frac{\mu_0 I}{2\pi(a+x)} dx = -\frac{v\mu_0 I_0 e^{-\lambda t}}{2\pi} \ln\frac{a+b}{a}$

以下到上为正

$\varepsilon_{感} = -\oint_S \frac{\partial \vec{B}}{dt}\cdot d\vec{S} = -\int_0^b \frac{-\lambda\mu_0 I_0 e^{-\lambda t}}{2\pi(a+x)} vt\cdot dx = \frac{\lambda\mu_0 I_0 e^{-\lambda t}}{2\pi} vt \ln\frac{a+b}{a}$

$\varepsilon = \frac{v\mu_0 I_0 e^{-\lambda t}}{2\pi} \ln\frac{a+b}{a} (\lambda t - 1)$

当 $\lambda t > 1$ 方向自下向上 $\lambda t < 1$ 方向自上向下