

本答案为参考答案，可能有细微错误，请谨慎使用

一、选择题

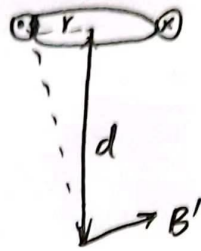
BDCAD CCBAD CBD

二、计算题

2-1

一圆导线在 d 处磁场:

$$B' = \int_0^{2\pi} \frac{\mu_0 I r d\theta}{4\pi \sqrt{d^2 + r^2}}$$
$$= \frac{\mu_0 I}{2\sqrt{d^2 + r^2}}$$



沿轴线 $B'_r = \frac{\mu_0 I r}{2(d^2 + r^2)^{\frac{3}{2}}}$

补偿法, $B = \mu_0 n I - \frac{\mu_0 I r}{2(d^2 + r^2)^{\frac{3}{2}}}$

2-2 (1) $Uq = \frac{1}{2}mv^2$

$$\frac{mv^2}{2} = Bvq$$

$$\Rightarrow \frac{m}{q} = \frac{B^2 x^2}{8U}$$

(2) $\vec{m} = I\vec{S}$

$$S = \pi r^2$$

$$I = \frac{q\omega}{2\pi}$$

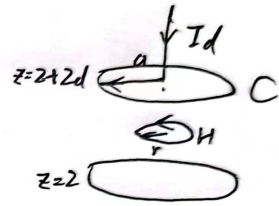
$$\Rightarrow L = J\omega = \frac{B^2 x^2 m}{10U}$$

2-3 (1) 电容内一处 $D \Delta S = \sigma \Delta S = \frac{Q}{\pi a^2} \Delta S$

$$E(z) = \frac{D}{\epsilon(z)} = \frac{Q}{\pi a^2 z}$$

$$U_C = \int_z^{z+2d} E(z) dz = \frac{Q}{\pi a^2} \ln(1+d)$$

$$C = \frac{Q}{U} = \frac{\pi a^2}{\ln(1+d)}$$



(2) $I_d = I = \frac{U}{R} e^{-\frac{t}{RC}}$

(3) $W = \frac{1}{2} C U_C^2 = \frac{1}{2} C (U - IR)^2 = \frac{\pi a^2 U^2}{2 \ln(1+d)} (1 - e^{-\frac{t}{RC}})^2$

(4) $2\pi r H = \frac{I_d}{a^2} I_d$

$$\Rightarrow \vec{H} = \frac{U r}{2\pi a^2 R} e^{-\frac{t}{RC}} \vec{e}_\phi$$

2-4 (1) 仅导体内有电场

$$\text{内层 } \vec{E} = \frac{j}{\sigma} \vec{e} \quad \text{外层 } \vec{E} = -\frac{j}{\sigma} \vec{e}$$

\vec{e} 为内层电流流向

(2) $0 < r < R_1$ 时:

$$2\pi r B = \mu_1 j \cdot \pi r^2 \Rightarrow \vec{B} = \frac{j \mu_1 r}{2} \vec{e}_r$$

$R_1 < r < R_2$ 时:

$$2\pi r B = \mu_2 j \pi R_1^2 \Rightarrow \vec{B} = \frac{j \mu_2 R_1^2}{2r} \vec{e}_r$$

$R_2 < r < R_3$ 时:

$$2\pi r B = \mu_1 j [\pi R_1^2 - \pi(r^2 - R_3^2)]$$

$$\Rightarrow \vec{B} = \frac{\mu_1 j (R_1^2 - r^2 + R_3^2)}{2r} \vec{e}_r$$

$$r > R_3 \text{ 时 } \vec{B} = 0$$

(3) 对长度 L 的一段

$$0 < r < R_1 \text{ 时: } \Phi = \int_0^{R_1} B(r) dr = \frac{j \mu_1 R_1^2}{4}$$

$$R_1 < r < R_2 \text{ 时: } \Phi = \int_{R_1}^{R_2} B(r) dr = \frac{j \mu_2 R_1^2}{2} \ln \frac{R_2}{R_1}$$

$$R_2 < r < R_3 \text{ 时: } \Phi = \int_{R_2}^{R_3} B(r) dr = \frac{j \mu_1 (R_1^2 + R_3^2)}{2} \ln \frac{R_3}{R_2} - \frac{\mu_1 j (R_3^2 - R_2^2)}{4}$$

$$L = \frac{\sum \Phi}{I} = \frac{\mu_1}{4\pi} + \frac{\mu_2}{2\pi} \ln \frac{R_2}{R_1} + \frac{\mu_1 (R_1^2 + R_3^2)}{2\pi R_1^2} \ln \frac{R_3}{R_2} + \frac{\mu_1 (R_3^2 - R_2^2)}{4\pi R_1^2}$$

$$(4) \text{ 内导体: } \vec{S} = \vec{E} \times \vec{H} = \frac{j^2 \mu_1 r}{2\mu_0} \vec{e}_r$$

$$\text{外导体: } \vec{S} = \vec{E} \times \vec{H} = -\frac{j^2 \mu_1 (R_1^2 - r^2 + R_3^2)}{2r\mu_0} \vec{e}_r$$

三、问答题:

(1) 负电荷

(2) 大小不变符号相反

(3) 正负电荷分离。或者回答诸如“电势差加倍”等，言之有理即可