Date. /

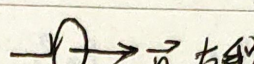
磁力

一、磁现象及其本质

二、磁感应强度 B 磁力线

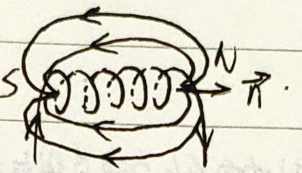
载流试验线圈.

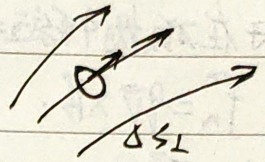
平面载流线圈：磁矩 $\vec{P_m} = IS\vec{n}$.



$B = \frac{M_{max}}{P_m}$

载流电累线管.





$B = \frac{\Delta N}{\Delta S_\perp}$

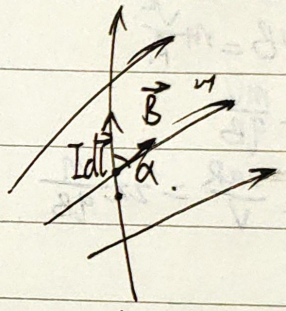
闭合曲线.

$d\Phi_m = \vec{B}\,d\vec{S}$

$\Phi_m = \int d\Phi_m = \int_S \vec{B}\,d\vec{S}$.

$\oint_S \vec{B}\cdot d\vec{S} = 0$

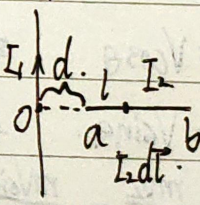
三、安培定律



$d\vec{F} = Id\vec{l} \times \vec{B}$

$dF = IB\sin\alpha\, dl$.

例题：无限长 I_1，载流导线 ab 长 l.



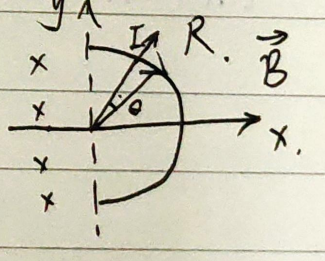
$dF = IB\sin\alpha\, dl$

$= I_2 B\sin 90^\circ dl$

$= I_2 \frac{\mu_0 I_1}{2\pi l} dl$. ↑方向向上.

$F = \int_d^{d+l} \frac{\mu_0 I_1 I_2}{2\pi l} dl = \frac{\mu_0 I_1 I_2}{2\pi} \ln\frac{d+l}{d}$ ↑

例题：载流半圆环.



$dF = IB\sin 90^\circ dl = IB\,dl$.

$= IBR\,d\theta$.

$F_x = \int dF_x = \int dF\sin\theta = \int_0^\pi IBR\sin\theta\, d\theta = 2IBR$. $F_y = \int dF_y = \int_0^\pi dF\cos\theta = 0$

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四 匀强磁场对载流线圈的作用

$\begin{cases} \sum \vec{F} = 0 & \text{不平动} \\ \vec{M} = \vec{P}_m \times \vec{B} & \text{转动.} \end{cases}$

$\varphi = 0 \quad \vec{M} = 0.$

$\varphi = 90° \text{ 时 } M_{max} = P_m B.$

五. 带电粒子在磁场中的运动.

洛仑兹力 $\vec{F}_m = q\vec{v} \times \vec{B}$.

① $\vec{v}$ 与 $\vec{B}$ 平行: $\vec{F}_m = 0$ 沿 $\vec{B}$ 时方向做匀速直线运动.

② $\vec{v}$ 与 $\vec{B}$ 垂直: 与 $\vec{B}$ 垂直的平面内做匀速圆周运动.

$\cdot\ qvB = m\frac{v^2}{R}$

$R = \frac{mv}{qB}$

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

③ 斜交

$\begin{cases} v_{//} = v\cos\theta & \text{平行 } \vec{B} \text{ 做匀速直线运动.} \\ v_{\perp} = v\sin\theta & \text{垂直 } \vec{B} \text{ 做匀速圆周运动.} \end{cases}$

$\begin{cases} R = \frac{mv_{\perp}}{qB} = \frac{mv\sin\theta}{qB} \\ h = v_{//}T = v\cos\theta\frac{2\pi m}{qB} \end{cases}$

例.