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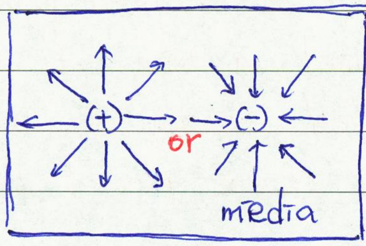
Chapter 1-4.

$\vec{E}$



current

$Q \to \frac{dQ}{dt} \to I$

$\vec{D}$

$\vec{J} = \sigma \vec{E}$

$\int \vec{J} \cdot d\vec{s} = I$

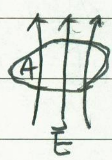
靜電學 + 介質

恆穩電場.

Chapter 5.

moving electron

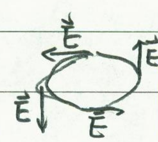
A. Divergency



$\frac{\vec{E} \cdot \Delta A}{\Delta V}$ = Density.

$\oint \vec{E} \cdot d\vec{s} = \int \rho \, dv$

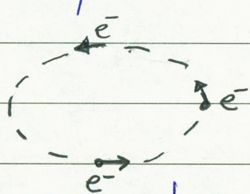
B. curl $\nabla \times \vec{E} = 0$



$\vec{E} \cdot d\vec{l} \Rightarrow \oint q\vec{E} \cdot d\vec{l} = 0$

potential closed path.

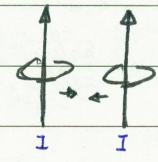
Chapter 5.



moving electron

Ampere in 1820s experiment.

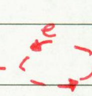
Case I:



Case II:

or +q, find.

or



moving.

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* The defintition of magnetic field is slightly more diffcult or formula. The electric field at a given point in space is defined in terms of the force the electric field exerts on a small stationary test charge placed there.

* Magnetic forces only acting on moving charges, so it is nature to use the magnetic force $\vec{F}$ exerts on a positive charge q, where velocity is $\vec{v}$. So Ampere can write down as

$$\vec{F} \propto q(\vec{v} \times \vec{B}) = qvB\sin\theta$$

* The magnitude is specified by

$$\boxed{B = \frac{F}{qv \cdot \sin\theta}}$$

The unit of magnetic field in SI is

$$\frac{\text{Newtons}}{\text{Ampere-meter}} = \text{tesla (T)}$$

* Thus a charged particle q of momentum $\vec{p}$ has the classical equation of motion.

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$$\vec{F} = ma \Rightarrow \frac{d\vec{P}}{dt} = \frac{dm\vec{v}}{dt} = q(\vec{E} + \vec{v} \times \vec{B})$$

* It is interesting to note that the magnetic field DOES NOT mechanical work on a moving charged particle..

* Newton said $\vec{F} \cdot d\vec{l} = dW = F\,dl \cos\theta$

  $\cos\theta = 1 \Rightarrow F\,dl$

* Prove the mechanical work is zero.

  (1) The vector product $\vec{v} \times \vec{B}$ is the force incorporate the fait that the force due to the $\vec{B}$-field is perpendicalur both $\vec{B}$ & $\vec{v}$ $\Rightarrow \vec{B} \cdot (\vec{v} \times \vec{B}) = 0$

  (2) or $\vec{F} = \frac{dW}{dl} \Rightarrow dW_{mag} = \vec{F} \cdot d\vec{l} = q(\vec{v} \times \vec{B}) \cdot \vec{v}\,dt$

  $= q\,dl\,[(\vec{v} \times \vec{B}) \cdot \vec{v}] = 0$