Unidad 4

Ley de Faraday

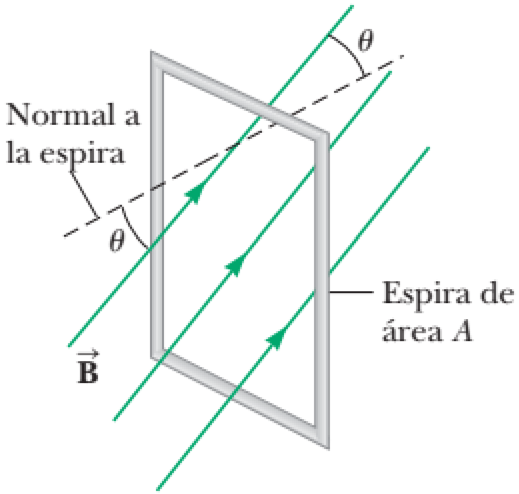
Ley de Lenz

Ecuaciones de Maxwell

Ley de Faraday

$$\varepsilon = -\frac{d\phi_B}{dt}$$

Ley de inducción de Faraday



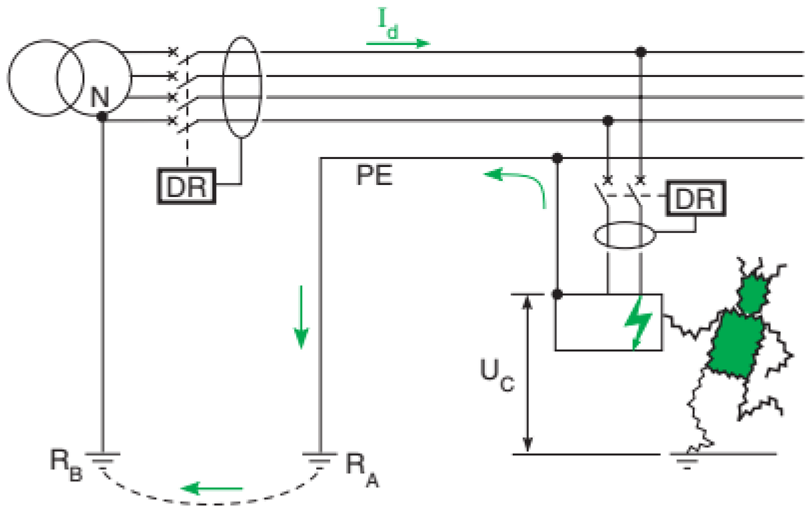
$$\phi_B = \int \vec{B}.d\vec{A}$$

$$\varphi = B.A.\cos\phi$$

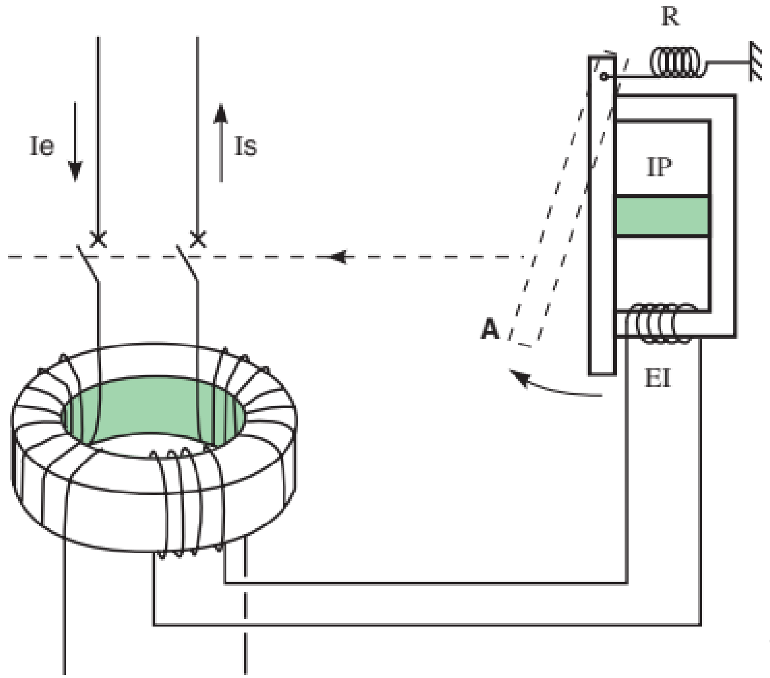
$$\varepsilon = -N\frac{d\phi_B}{dt}$$

Aplicación: Disyuntor diferencial

Esquema de conexión



Esquema de funcionamiento



Ley de Faraday

$$\vec{F}_B = q\vec{v} \times \vec{B}$$

$$qE = qvE \qquad E = vB$$

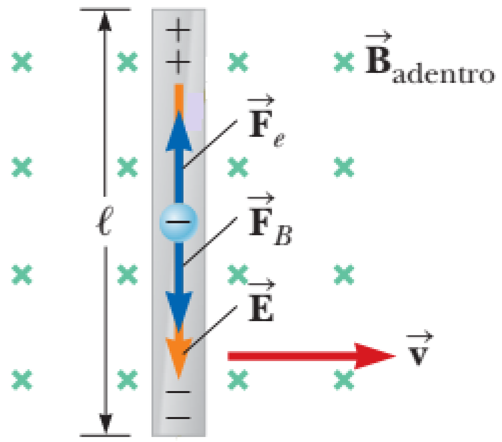
$$\Delta V = El = Blv$$

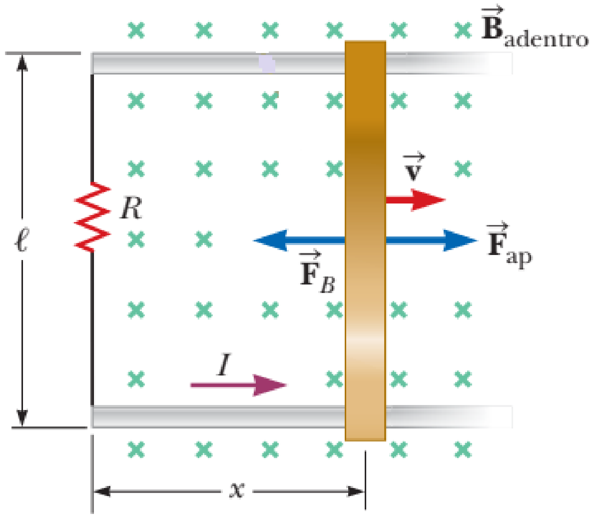
$$\phi_B = Blx$$

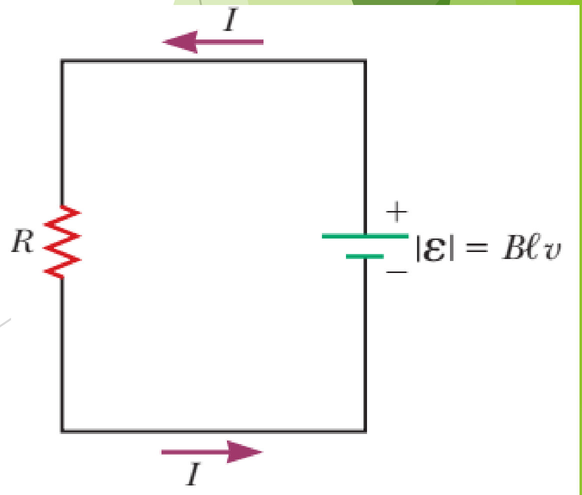
$$\varepsilon = -\frac{d\phi_B}{dt} = -\frac{d}{dt}(Blx) = Bl\frac{dx}{dt}$$

$$\varepsilon = -Blv \qquad I = \frac{|\varepsilon|}{R} = \frac{Blv}{R}$$

$$P = F_{ap}v = (IlB)v = \frac{B^2l^2v^2}{R} = \frac{\varepsilon^2}{R}$$



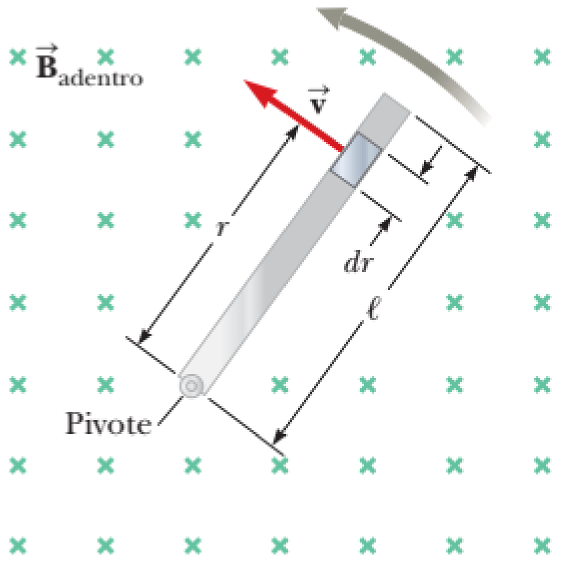




F.e.m inducida en una barra giratoria

$$d\varepsilon = Bvdr$$

$$\varepsilon = \int Bv\,dr = B\int v\,dr = B\omega\int_0^l r\,dr = \frac{1}{2}B\omega l^2$$



Ley de Lenz

- La corriente inducida en una espira está en la dirección que crea un campo magnético que se opone al cambio en el flujo magnético en el área encerrada por la espira.

F.e.m inducida y campo eléctrico

$$\Delta V = qE \ = qE(2\pi r)$$

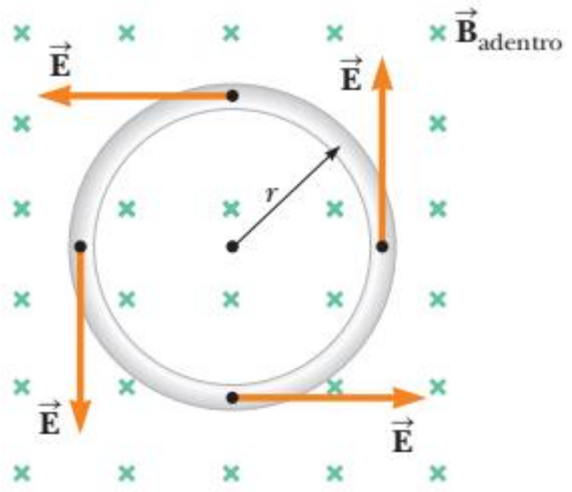
$$E = \frac{\varepsilon}{2\pi r} \qquad \phi_B = BA = B\pi r^2$$

$$E = -\frac{1}{2\pi r}\frac{d\phi_B}{dt} = -\frac{r}{2}\frac{dB}{dt}$$

$$\vec{E}.d\vec{s} \qquad \varepsilon = \oint \vec{E}.d\vec{s}$$

$$\boxed{\oint \vec{E}.d\vec{s} \ = -\frac{d\phi_B}{dt}}$$

Ley de Faraday

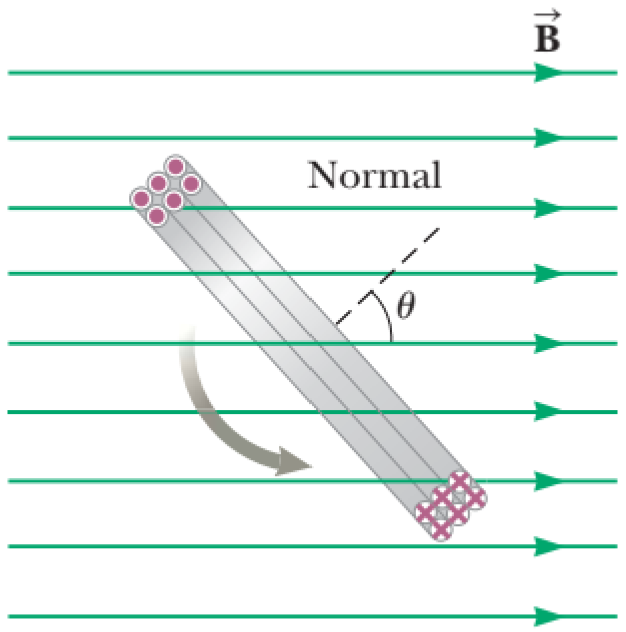


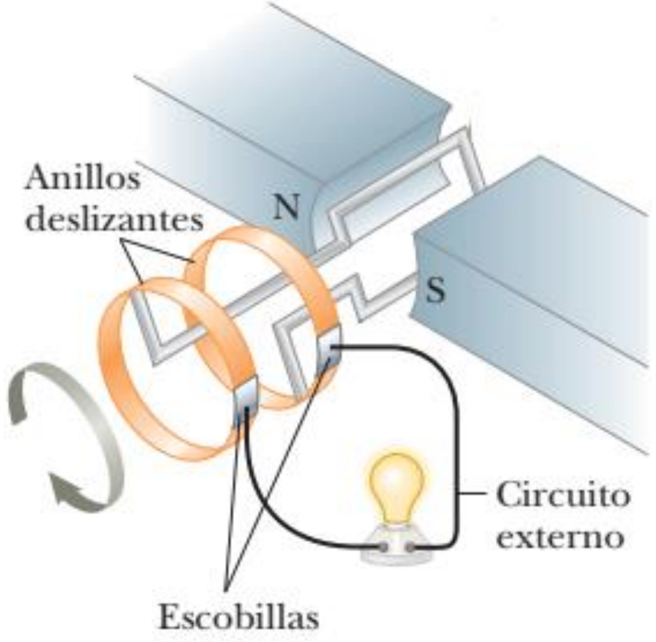
De acuerdo a la ley de Faraday, la presencia de un campo magnético variable con el tiempo induce una f.e.m.

La f.e.m inducida en la espira, implica la presencia de un campo eléctrica tangencial a la espira

Generadores y motores eléctricos

Generador de Corriente Alterna





$$\phi_B = B.A.\cos\theta = B.A.\cos\omega t$$

$$\varepsilon = -N\frac{d\phi_B}{dt} = -N.B.A\frac{d}{dt}(\cos\omega t)$$

$$\varepsilon = N.B.A.\omega\sin\omega t$$

$$\varepsilon_{max} = N.B.A.\omega$$

Generadores y motores eléctricos

Generador de Corriente Alterna

$$\phi_B = B.A.\cos\theta = B.A.\cos\omega t$$

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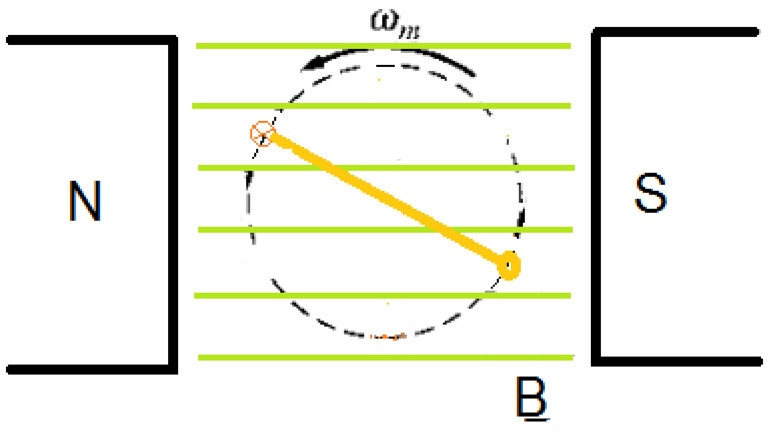
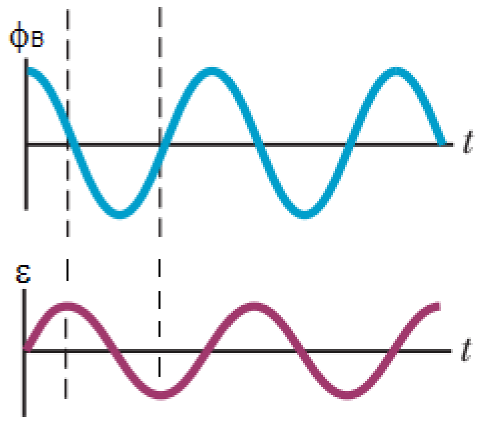
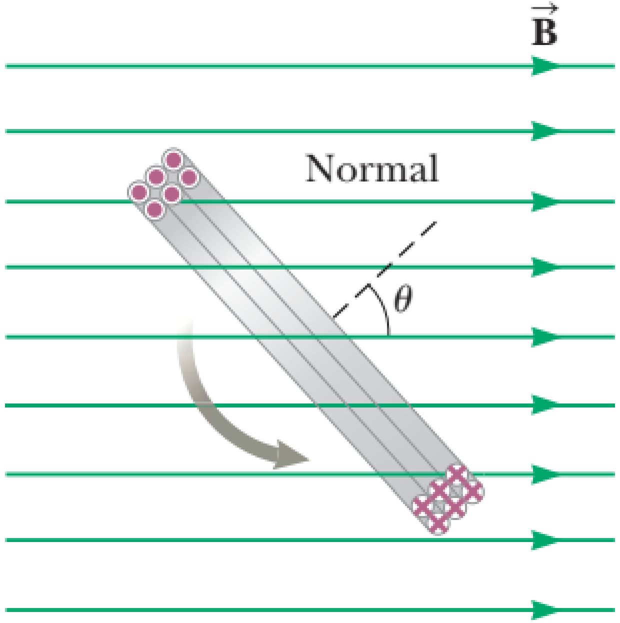
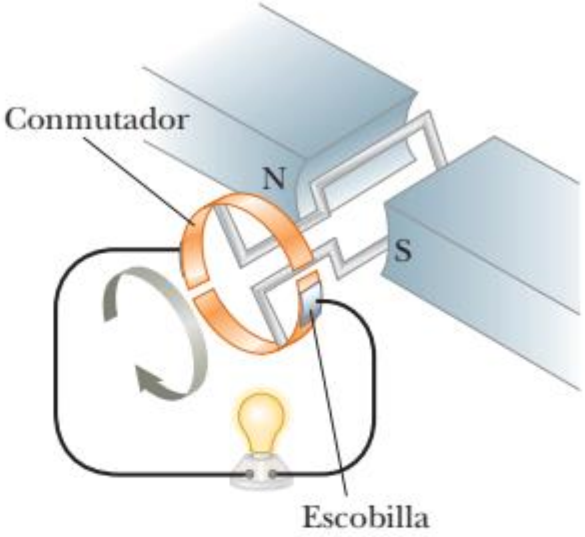




Generadores y motores eléctricos

Generador de Corriente Continua





$$\phi_B = B.A.\cos\theta = B.A.\cos\omega t$$

$$\varepsilon = -N\frac{d\phi_B}{dt} = -N.B.A\,\frac{d}{dt}(\cos\omega t)$$

$$\varepsilon = N.B.A.\omega\sin\omega t$$

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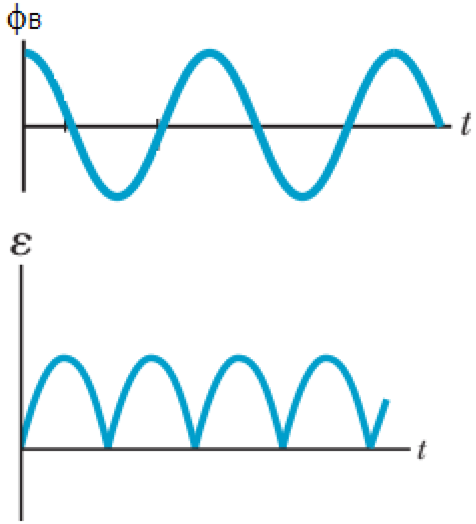
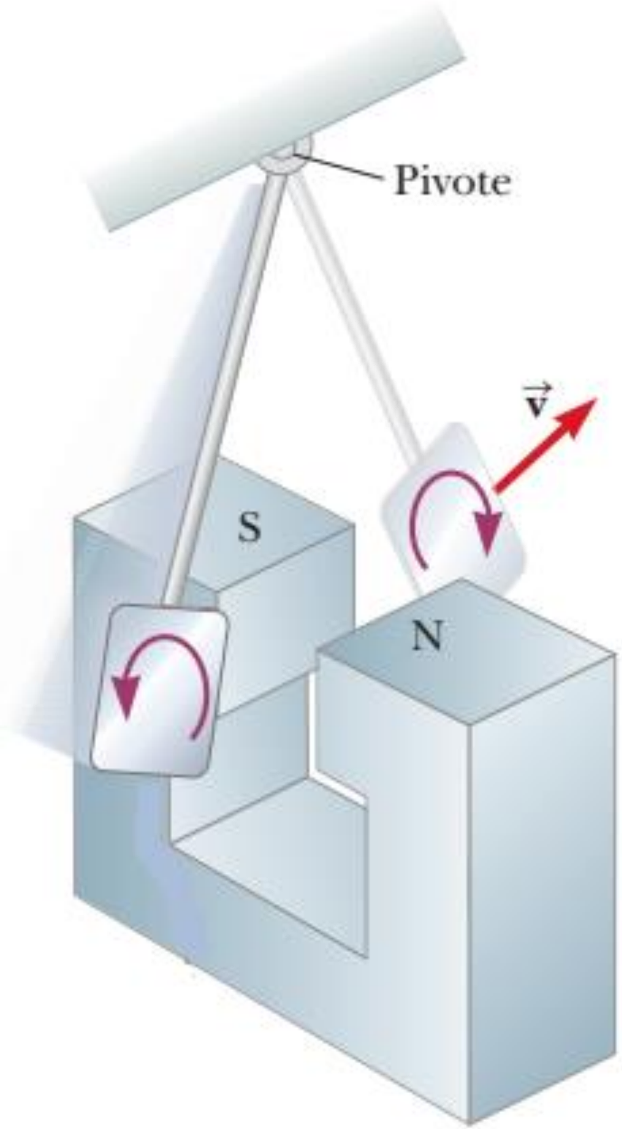
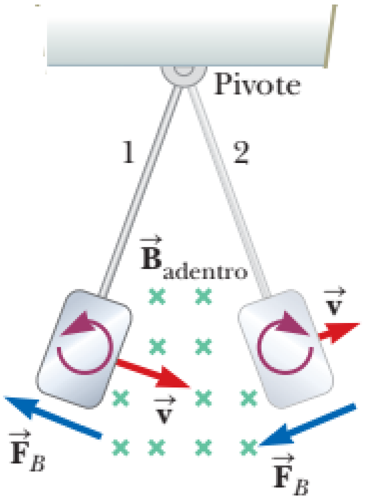
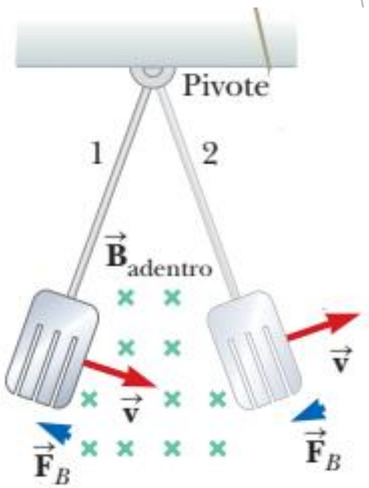
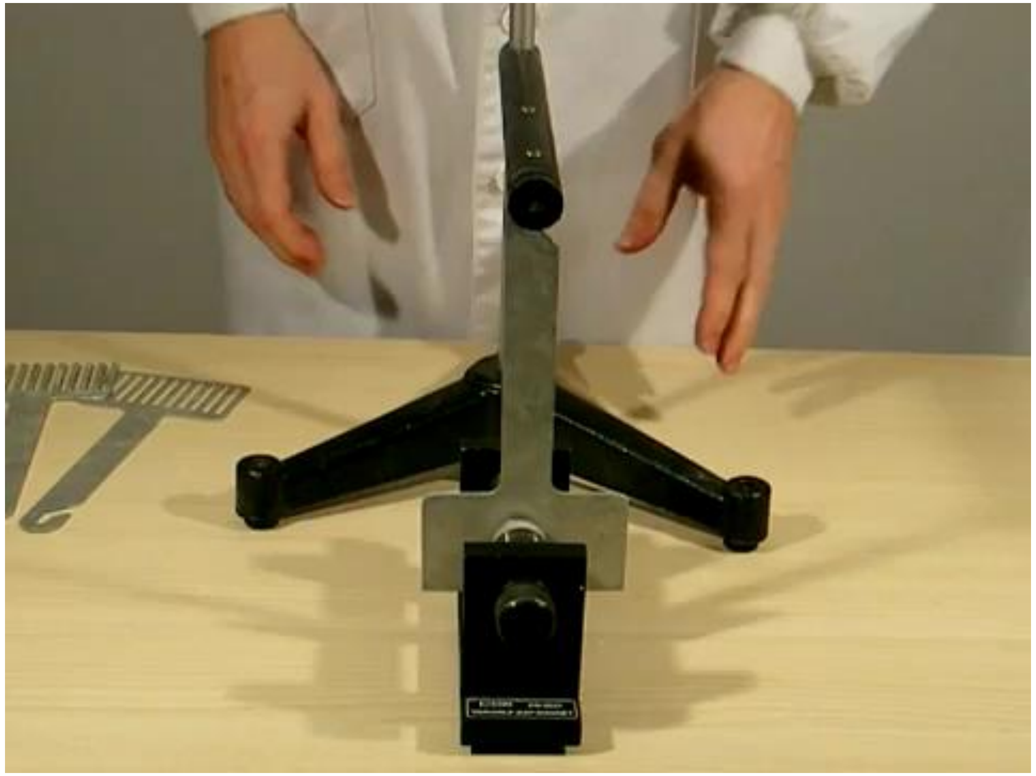


Corrientes de Eddy (Parásitas)





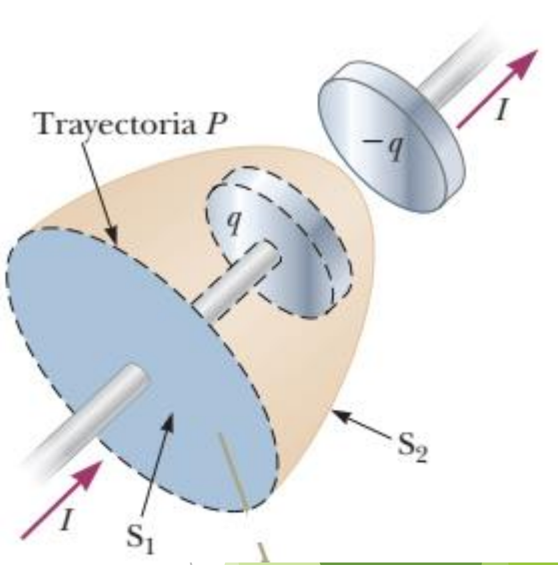




Corrientes de Eddy (Parásitas)

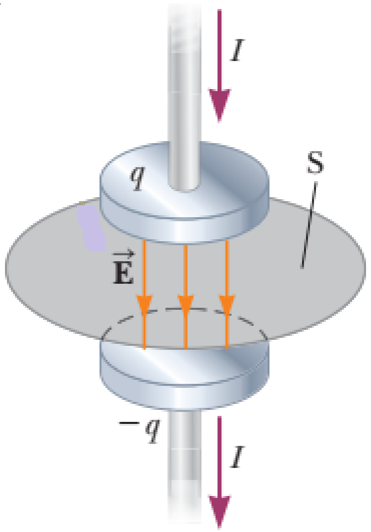
Ecuaciones de Maxwell

Ley de Ampere $\oint \vec{B}.d\vec{s} = \mu_0.I$



Corriente de desplazamiento $I_d \equiv \epsilon_0 \dfrac{d\phi_E}{dt}$ ϵ_0: permitividad del vacío

$$\phi_E \equiv \int \vec{E}\, d\vec{A} \quad \Rightarrow \quad \phi_E = E.A = \frac{q}{\epsilon_0}$$



$$I_d = \epsilon_0 \frac{d\phi_E}{dt} = \frac{dq}{dt}$$

$$\oint \vec{B}.d\vec{s} = \mu_0.(I + I_d) = \mu_0.\mathrm{I} + \mu_0\epsilon_0 \frac{d\phi_E}{dt}$$