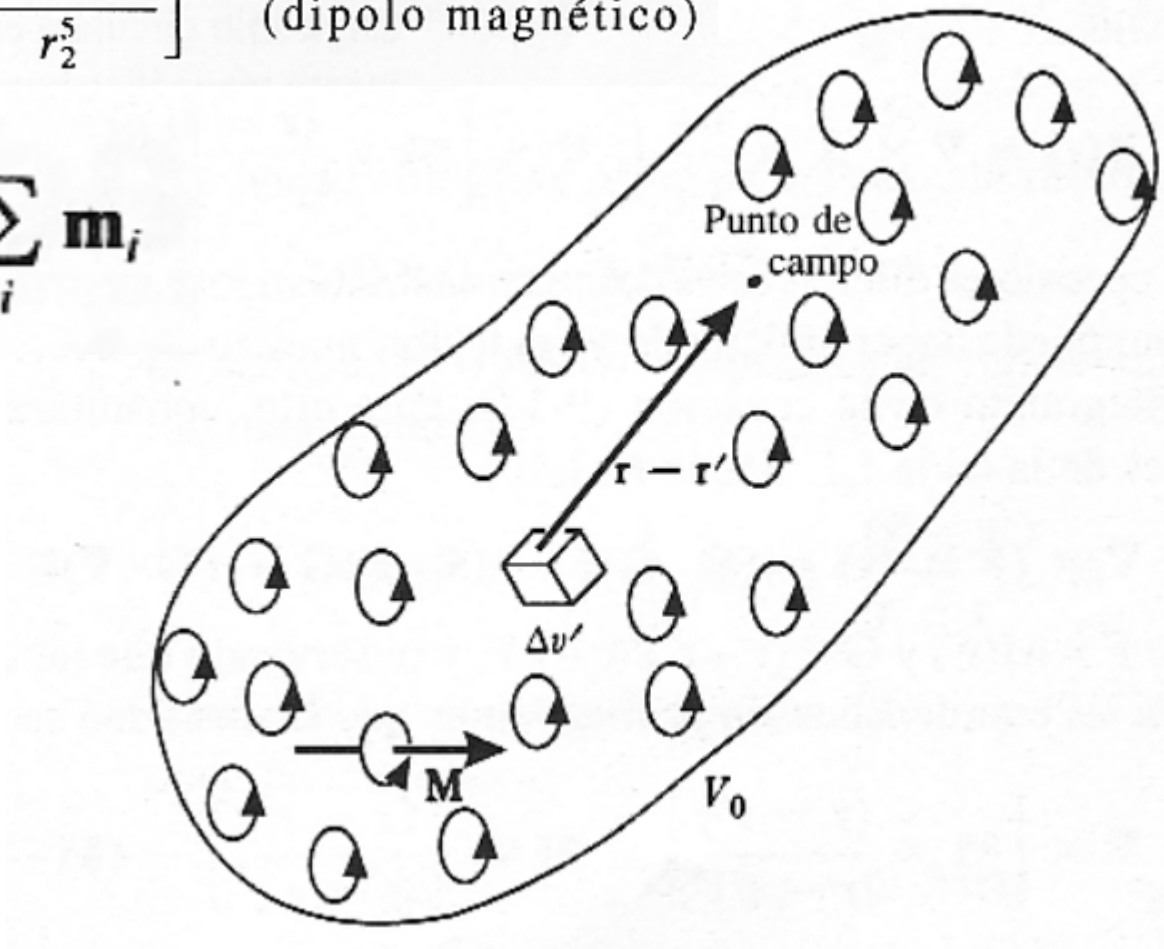
Magnetismo

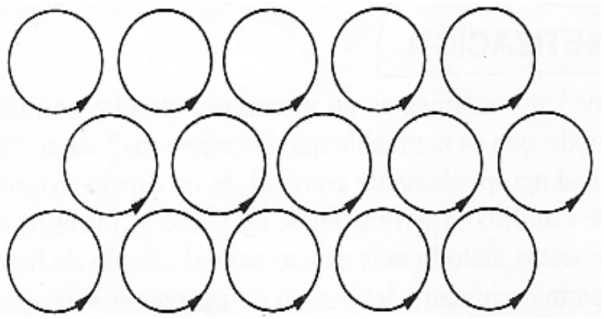
Materiales Magnéticos

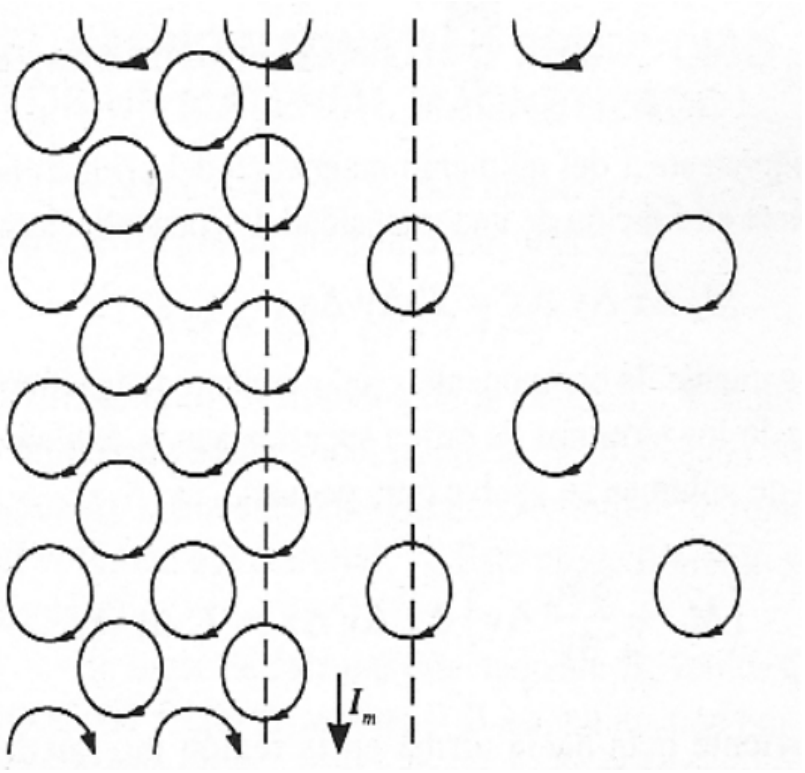
$$\mathbf{B}(\mathbf{r}_2) = \frac{\mu_0}{4\pi}\left[-\frac{\mathbf{m}}{r_2^3} + \frac{3(\mathbf{m}\cdot\mathbf{r}_2)\mathbf{r}_2}{r_2^5}\right] \quad \text{(dipolo magnético)}$$

$$\mathbf{M} = \lim_{\Delta v \to 0} \frac{1}{\Delta v} \sum_i \mathbf{m}_i$$

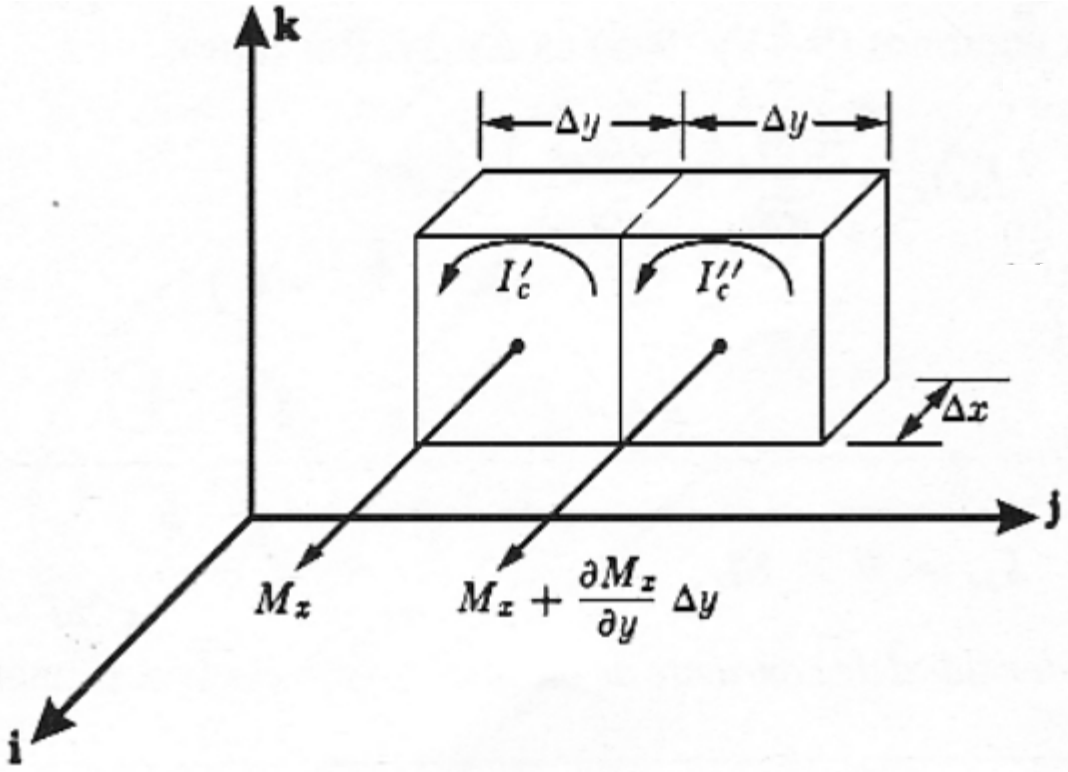


Materiales Magnéticos





Materiales Magnéticos



$$I'_c - I''_c = -\frac{\partial M_x}{\partial y}\Delta x\,\Delta y$$

$$(I_c)_{\text{arriba}} = \frac{\partial M_y}{\partial x}\Delta x\,\Delta y$$

$$\mathbf{J}_M = \nabla \times \mathbf{M}$$

Ecuaciones de campo

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{B} = \mu_0(\mathbf{J} + \mathbf{J}_M)$$

$$\nabla \times \left(\frac{1}{\mu_0}\mathbf{B} - \mathbf{M}\right) = \mathbf{J}$$

$$\nabla \times \mathbf{H} = \mathbf{J}$$

Materiales magnéticos Lineales

$$\mathbf{M} = \chi \mathbf{H}$$

$$\mathbf{B} = \mu_m \mathbf{H}$$

$$\mu_m = \mu_0 (1 + \chi)$$

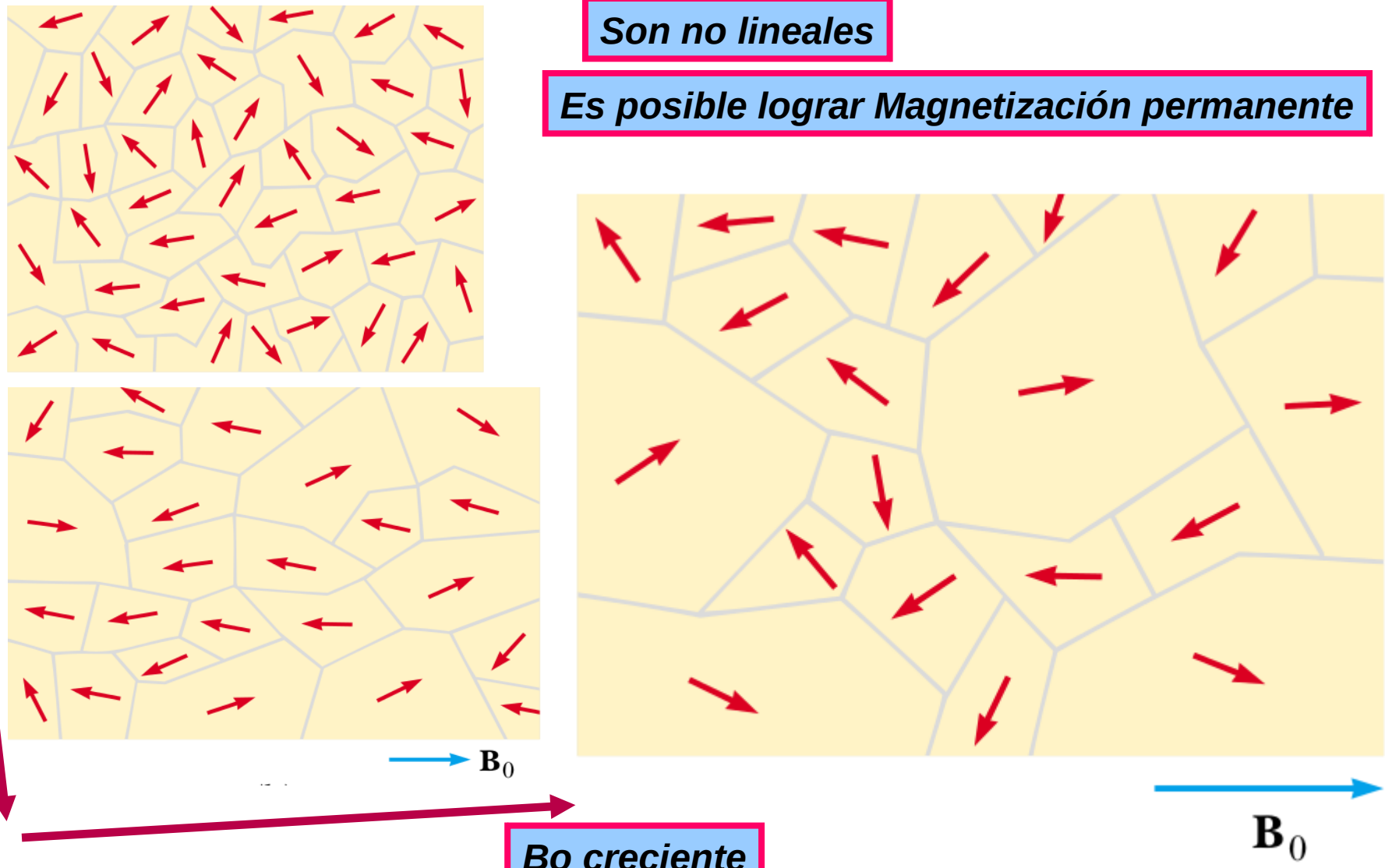
Magnetic Susceptibilities of Some Paramagnetic and Diamagnetic Substances at 300 K

Paramagnetic Substance	χ	Diamagnetic Substance	χ
Aluminum	2.3×10^{-5}	Bismuth	-1.66×10^{-5}
Calcium	1.9×10^{-5}	Copper	-9.8×10^{-6}
Chromium	2.7×10^{-4}	Diamond	-2.2×10^{-5}
Lithium	2.1×10^{-5}	Gold	-3.6×10^{-5}
Magnesium	1.2×10^{-5}	Lead	-1.7×10^{-5}
Niobium	2.6×10^{-4}	Mercury	-2.9×10^{-5}
Oxygen	2.1×10^{-6}	Nitrogen	-5.0×10^{-9}
Platinum	2.9×10^{-4}	Silver	-2.6×10^{-5}
Tungsten	6.8×10^{-5}	Silicon	-4.2×10^{-6}

Materiales Ferromagnéticos

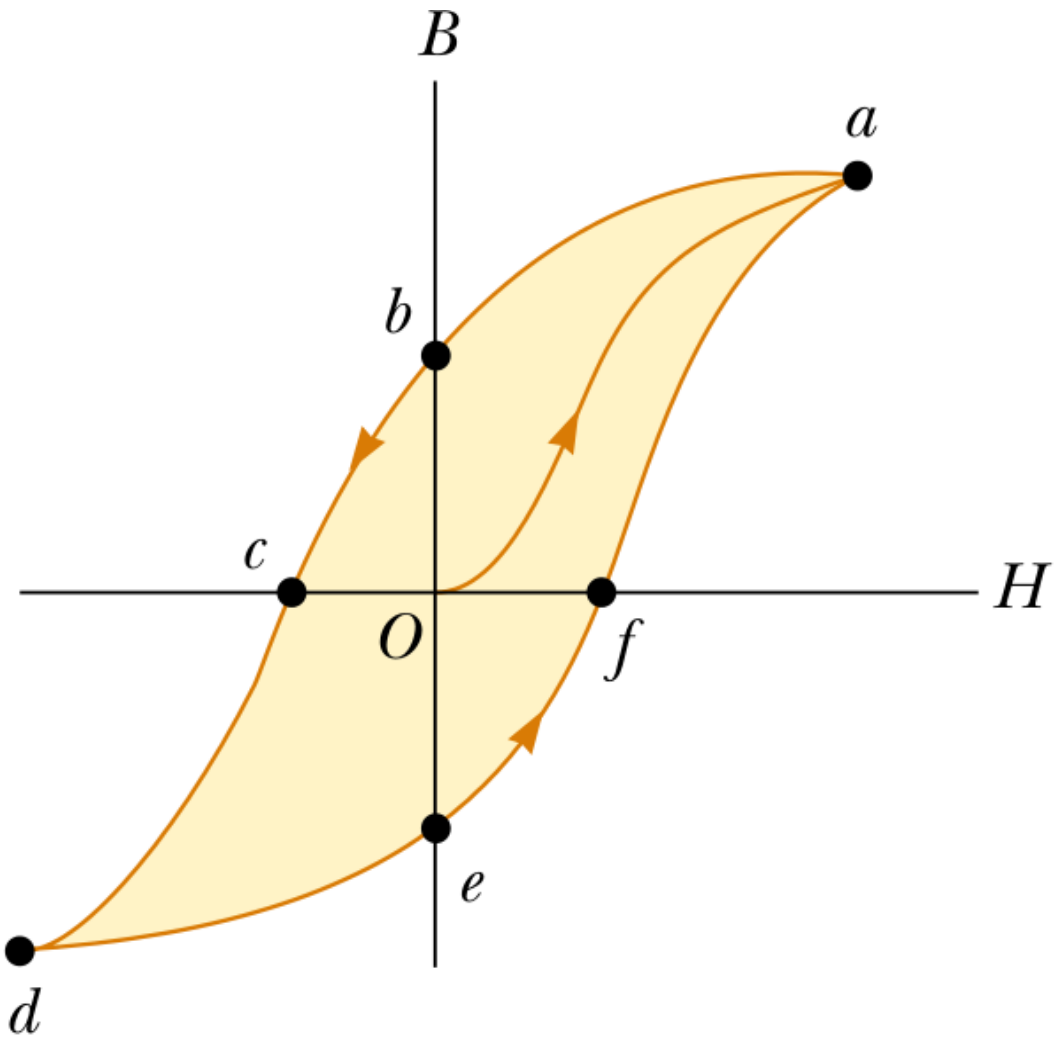
Son no lineales

Es posible lograr Magnetización permanente

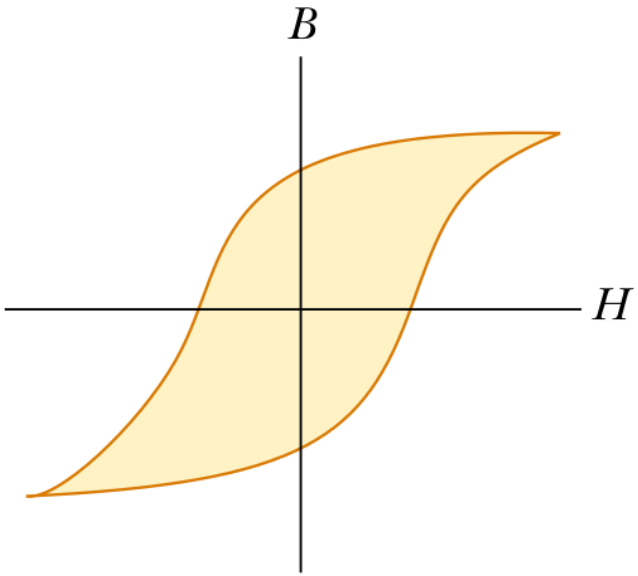


Bo creciente

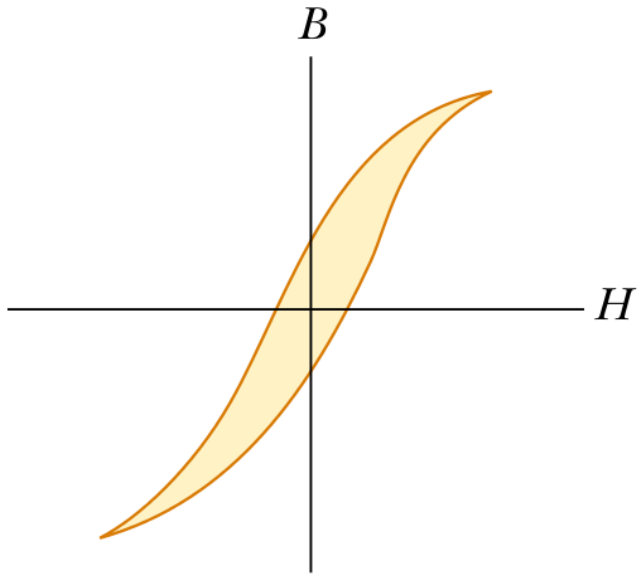
Materiales Ferromagnéticos



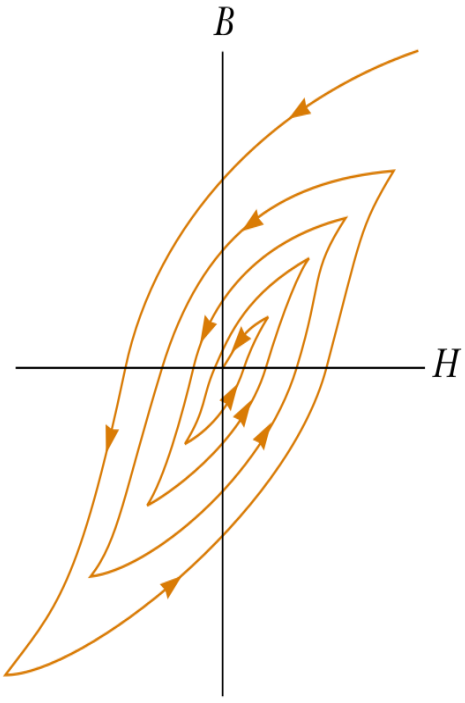
Materiales Ferromagnéticos



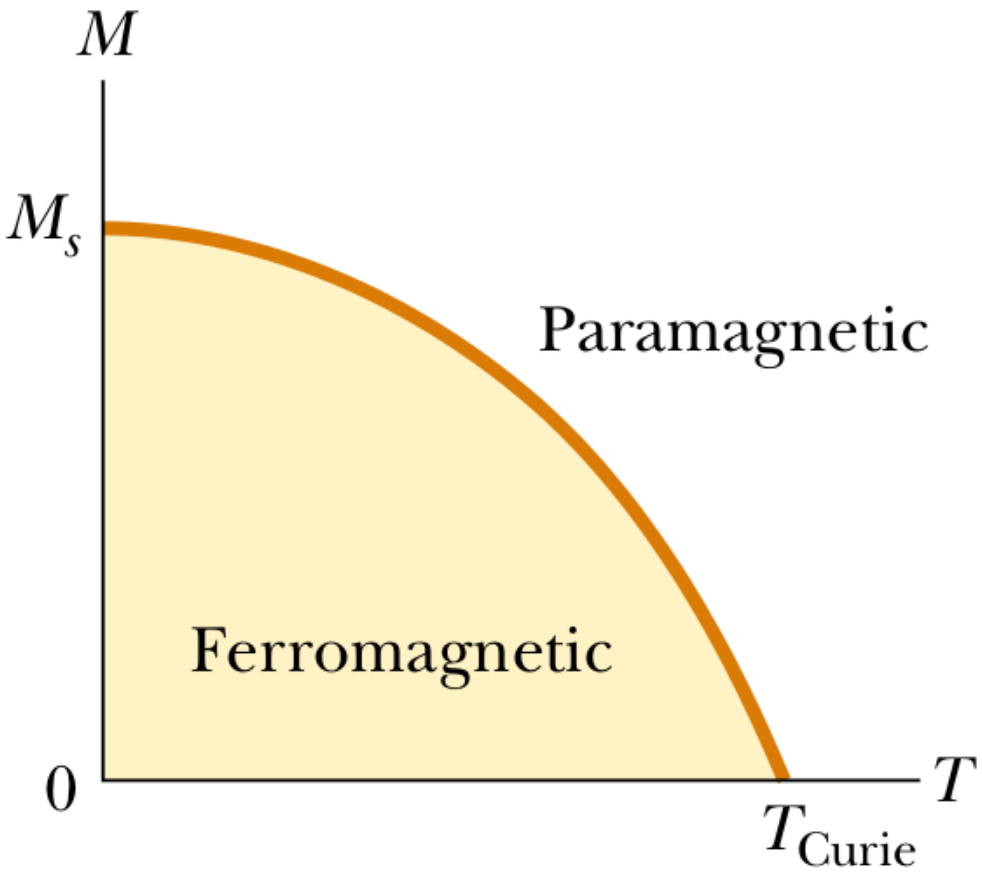
(a)



(b)



Paramagnetismo-Temp. Curie

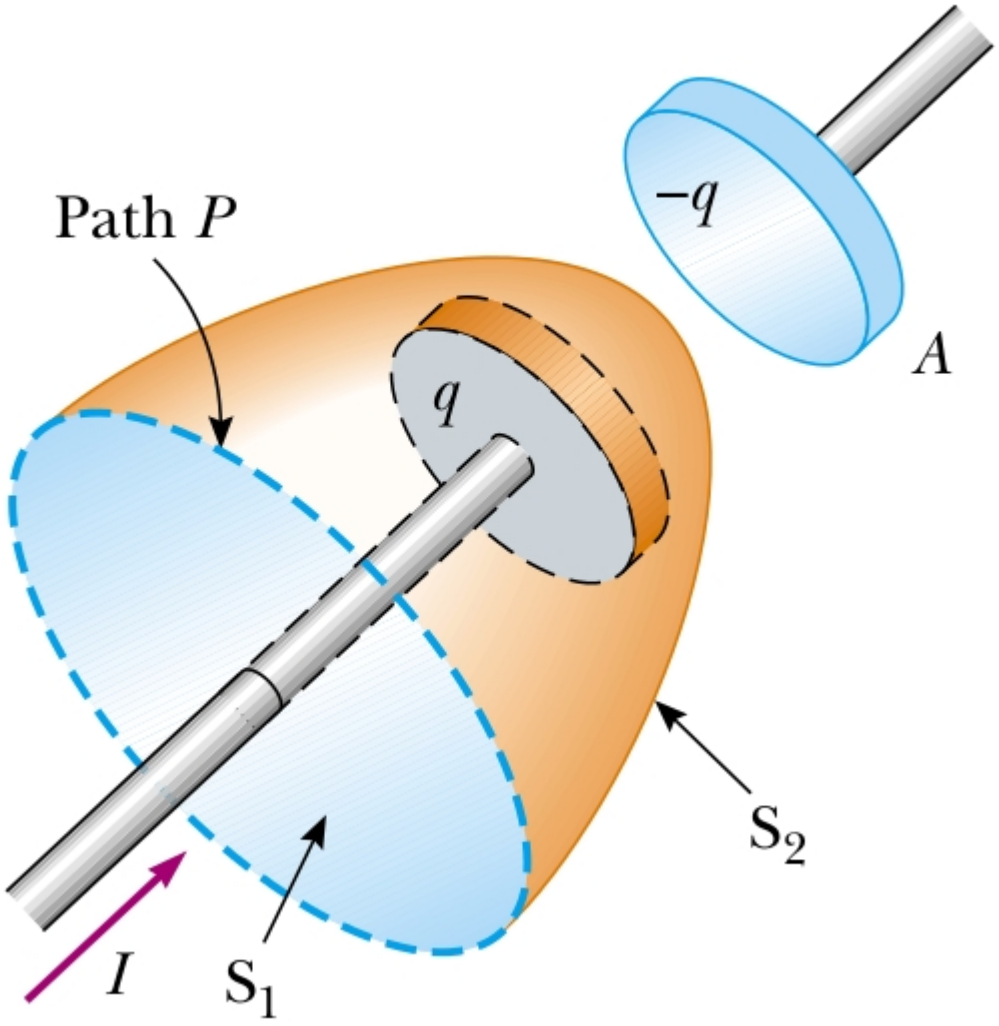


Curie Temperatures for Several Ferromagnetic Substance

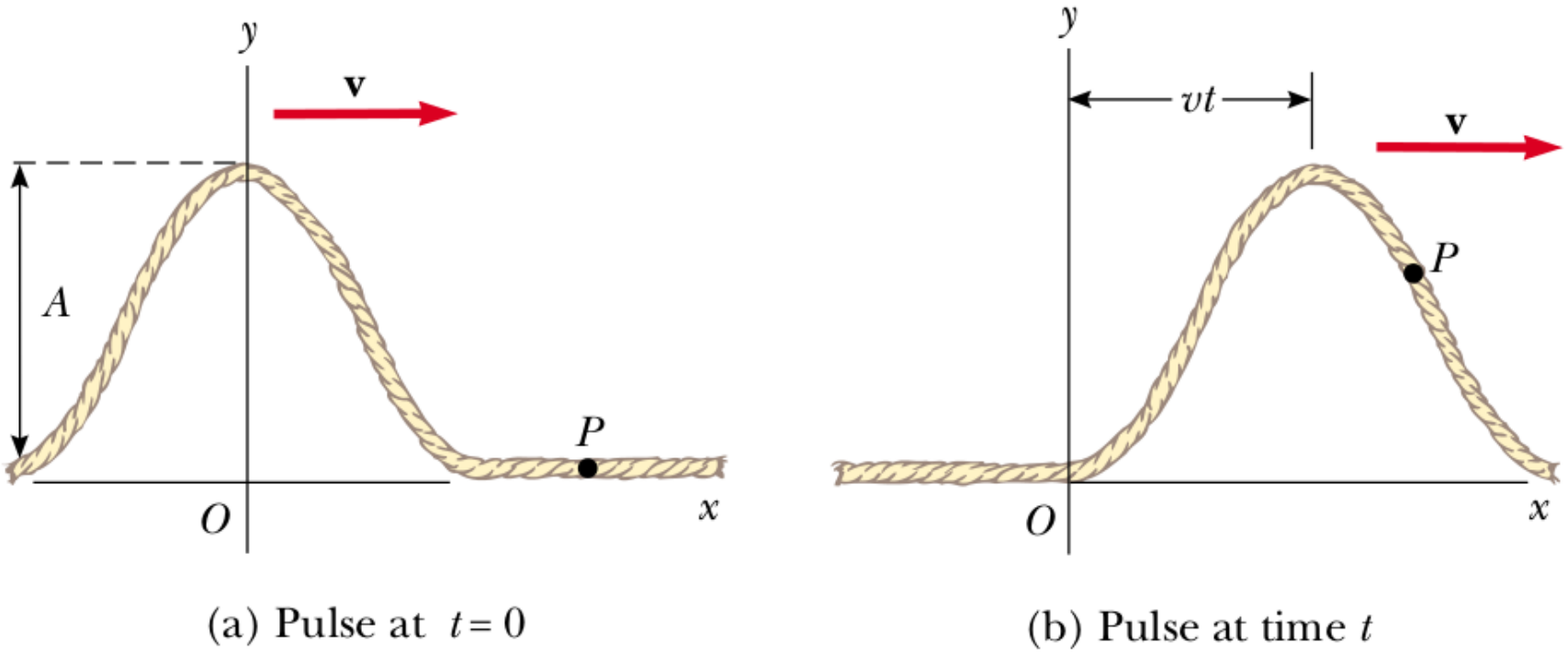
Substance	T_{Curie}(K)
Iron	1 043
Cobalt	1 394
Nickel	631
Gadolinium	317
Fe_2O_3	893

Diamagnetismo

Ley de Ampere Generalizada



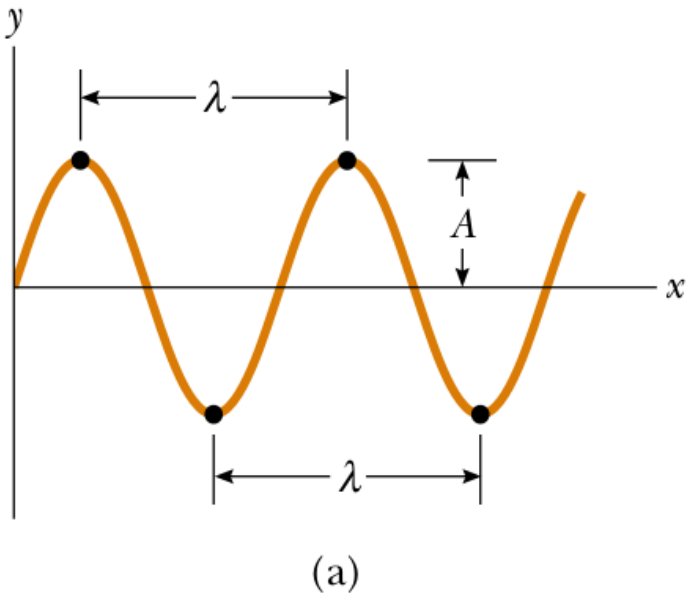
Ecuación de Ondas



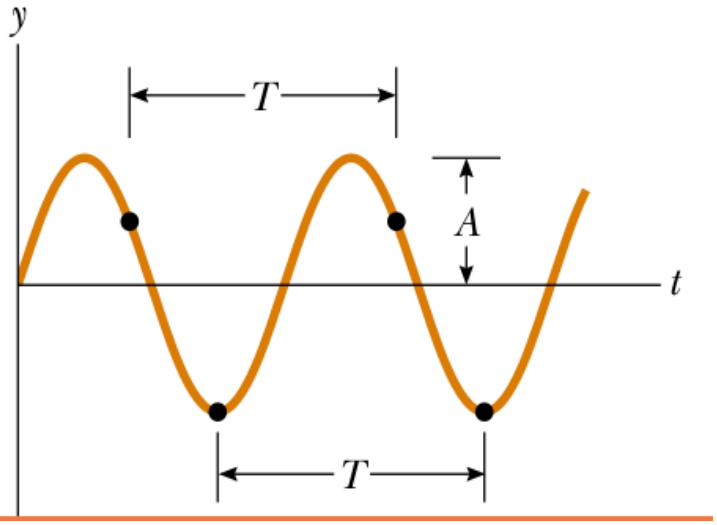
(a) Pulse at $t = 0$

(b) Pulse at time t

Ecuación de Ondas



(a)



$$f = \frac{1}{T}$$

$$k \equiv \frac{2\pi}{\lambda}$$

$$\omega \equiv \frac{2\pi}{T}$$

$$y = A \sin(kx - \omega t)$$