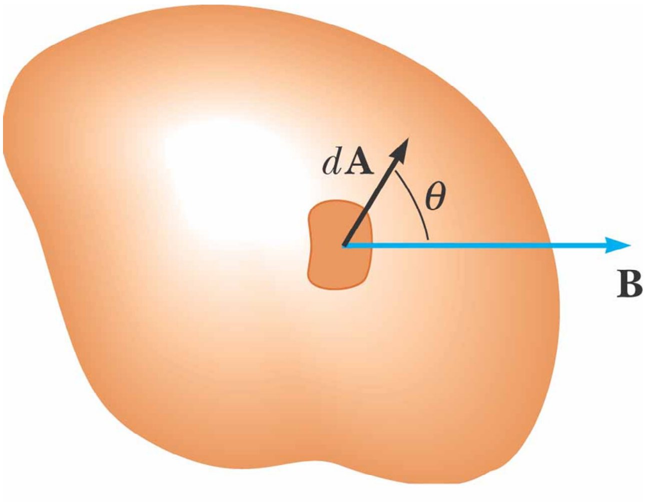
30.5 Gauss's Law in Magnetism

Magnetic flux:

The flux associated with the magnetic field is defined in a manner similar to that used to define electric flux.

In the figure, one can define the magnetic flux through the element area A as,

$$\Phi_B = \int \vec{B}.d\vec{A} \qquad 30.11$$

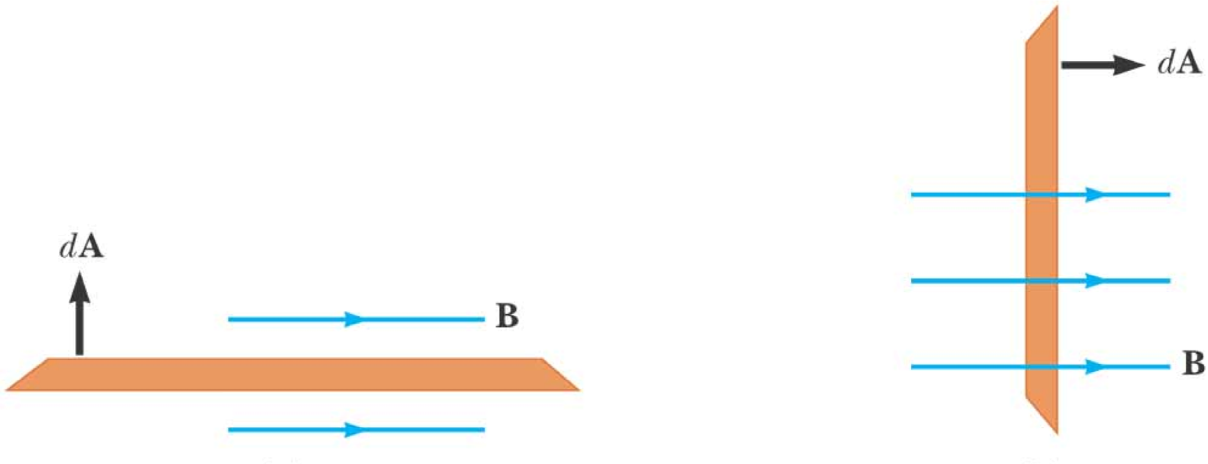


Special case, for a plane of area A in a uniform field B,

$$\Phi_B = BA\cos\theta$$

! Remember that θ is the angle between the field B and the vector $d\vec{A}$ that perpendicular to the surface.

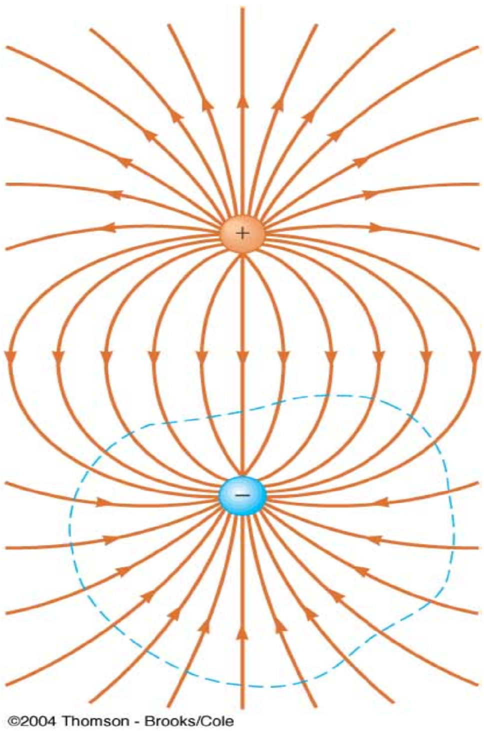
The unit of flux is $T.m^2$, which defined as a Weber (Wb); 1 Wb=$T.m^2$

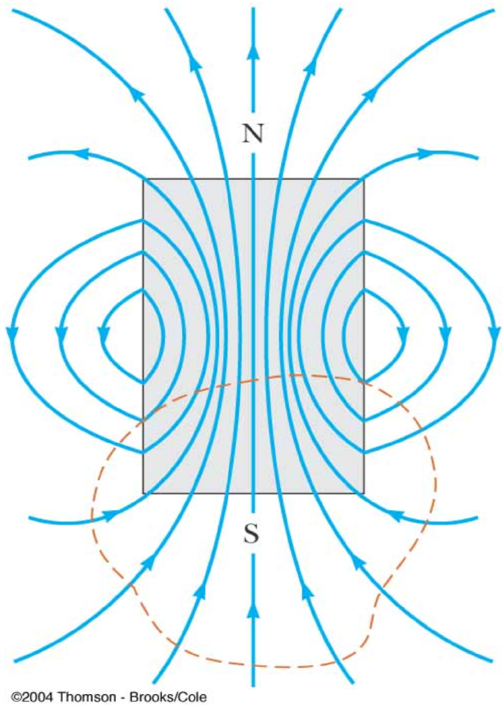


(a) (b)

$\Phi_B = 0$ $\Phi_B = BA$

In Chapter 24 we found that the electric flux through a closed surface surrounding a net charge is proportional to that charge (Gauss's law). In other words, the number of electric field lines leaving the surface depends only on the net charge within it. This property is based on the fact that electric field lines originate and terminate on electric charges. The situation is quite different for magnetic fields, which are continuous and form closed loops. The number of lines entering the surface equals the number leaving the surface; therefore, the net magnetic flux is zero.





The Gauss's law in magnetism states that "the net magnetic flux through any closed surface is always zero:

$$\oint \vec{B}.d\vec{A} = 0 \qquad \text{``} \qquad 30.12$$

Remember: **For Electric field**:

$$\Phi_E = \oint \mathbf{E} \cdot d\mathbf{A} = \frac{q_{\text{in}}}{\epsilon_0}$$