



Flipping Physics Lecture Notes:
Ampère's Law
Review for AP Physics C: Electricity and Magnetism
<http://www.flippingphysics.com/ampere.html>

Ampère's law is the magnetic field equivalent to Gauss' law:

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

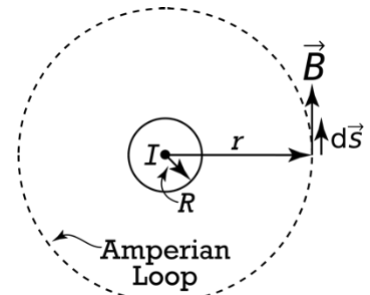
- Gauss' law:
 - Closed surface integral and charge inside a Gaussian surface.

$$\oint \vec{B} \cdot d\vec{S} = \mu_0 I_{in}$$

- Ampère's law:
 - Closed loop integral and current inside an Amperian loop.

Example: Determine the magnitude of the magnetic field outside an infinitely long, straight, wire with radius R and current I .

Start by drawing an Amperian loop in the shape of a circuit of radius $r \geq R$ which is concentric with the wire. And let's use Ampère's law.



$$\Rightarrow \oint B ds \cos \theta = \oint B ds \cos 0^\circ = B \oint ds = B(2\pi r) = \mu_0 I_{in}$$

$$\Rightarrow B = \frac{\mu_0 I}{2\pi r}$$