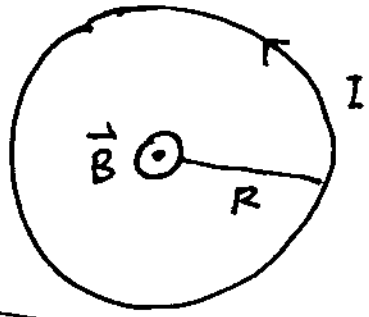
Physics 102.

Lecture 17. Wed. Oct. 20, 2004.

- $\vec{B}$-field at the centre of a circular current loop.

Can be shown:

$$B = \frac{\mu_0 I}{2R} \quad \text{(at centre)}.$$

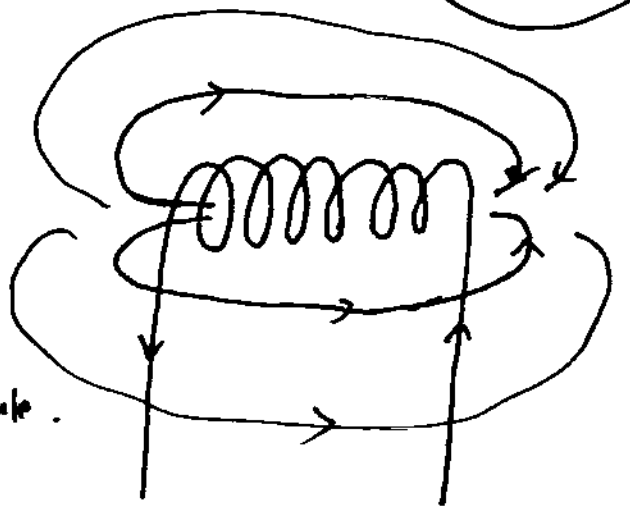


- Solenoid.

Magnetic field inside:

- Direction -

another right-hand-rule.



- $B_{inside} >> B_{outside}$.

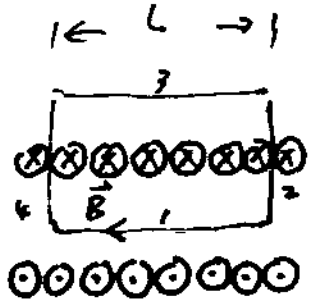
- $B_{inside} \approx$ uniform.

$$B = \mu_0 \frac{N}{L} \cdot I.$$

$$\boxed{B = \mu_0 n I}$$

n - # of loops per unit length.

How ? use Ampere's Law.



Closed path : 1, 2, 3, 4.

$$\Sigma B_{\parallel} \Delta L = \mu_0 I N.$$

$$= B_1 \cdot L + 0 + 0 + 0 = \mu_0 I N$$

$$\therefore \quad B = \frac{\mu_0 I N}{L}.$$

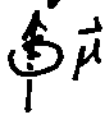
N — # of loops enclosed.

$$B = \mu_0 n I.$$

To get a stronger $\vec{B}$-field, we can put some material inside the solenoid.
Then. μ_0 is replaced by $\mu_0 \mu_r = \mu$.
μ_r can be $\gg 1$.

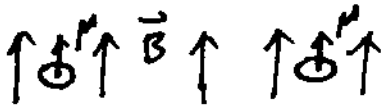
- Magnetism in Matter.

Idea: Microscopic currents (form magnetic moments) { — electrons moving in orbits. — spin of electrons.



① Ferromagnetism.
There are built-in magnetic moments. These moments can self-align. to form domains. (μ_r — large)

② Paramagnetism.
External $\vec{B}$-field will align the random magnetic moments.



③ Diamagnetism.
external $\vec{B}$-field makes the moments point at opposite direction