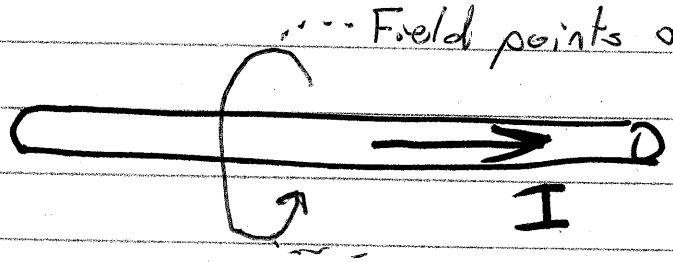
① Phys 1402 2014-10-02

Magnets!
- stick together — or repel
- Attract iron/steel
- Dipoles - they have opposite ends
- Compass
- redirect electron beam in CRT TV.
- store information - credit card stripe
- Convert energy
  Electricity ↔ motion
- MRI

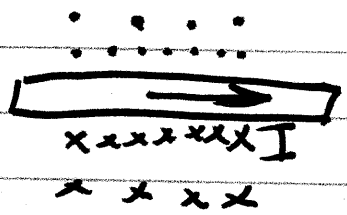
Magnetic Effects
- Forces - on magnets
  - on moving charges
  - on current-carrying wires
- Torques - on magnets
  - on current-carrying coils
- Can generate electric fields.
  - to generate electricity

Magnetism is always 3-D

E.g. Magnetic field of a wire

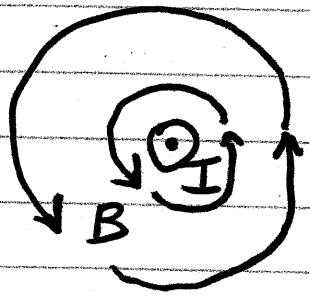


Flat drawings



Dots represent "out of the page"

X's represent "into the page"



Current is toward us.

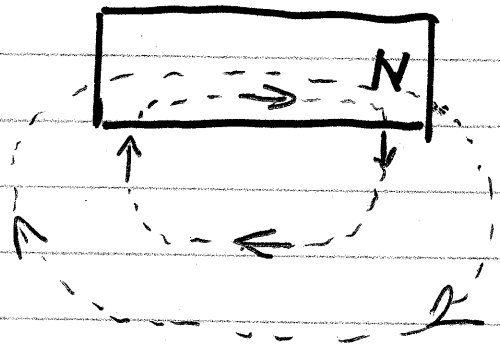
"B" points CCW.

Verbal

±x	right/left	E/W	F/B
±y	(top) up/down (bot)	N/S	L/R
±z	out/in	U/D	U/D
	page	geographic	relative

(3)

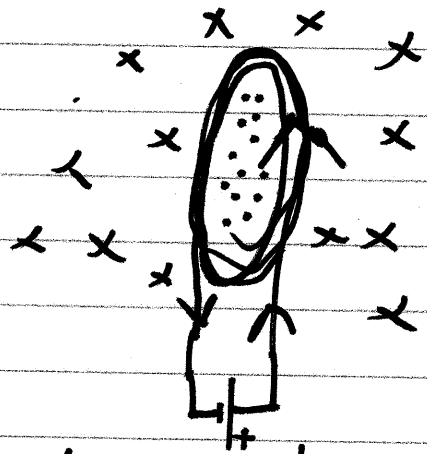
All magnetic fields point in loops.



The field lines try to spread out, but they also try to be short.

A coil uses loops of wire to concentrate B in the middle.

Coil:



(Coil is flat in plane of paper)

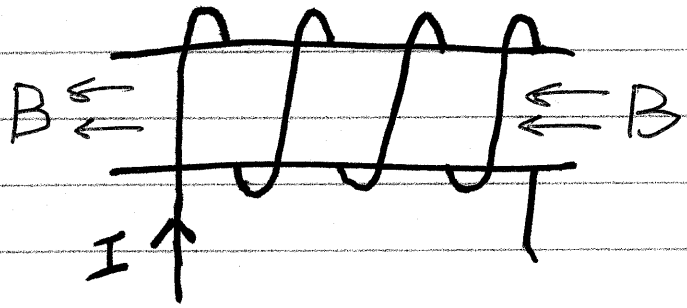
Dots are B pointing "out".

x's are B pointing "in".

Right-hand Rule:

- Curl fingers in dir of current.
- Thumb points in dir of B inside loop.

Solenoid Coil: Wire is wrapped in a spiral.



B is measured in tesla (T).

Inside the solenoid: $B = \mu_0 NI/\ell$

$\mu_0 = 4\pi \times 10^{-7}$ T·m/A
N = # loops of wire (must be capital N)
I = current
ℓ = length of solenoid

Also common: $n = N/\ell$
n = density of loops (turns per meter)

$$B = \mu_0 n I$$

Field of a wire:

$$B = \frac{\mu_0 I}{2\pi r}$$ r = our dist. from wire

(3)

Magnetism in book: Chap 19