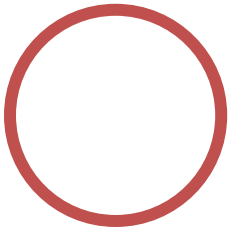
CONCEPT: MAGNETIC FIELD PRODUCED BY LOOPS AND SOLENOIDS

● Remember: Current-carrying wires PRODUCE NEW B-Fields → **B =** _____

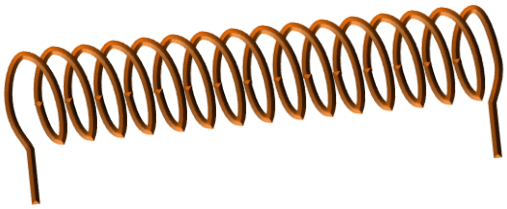
- In STRAIGHT wires: Current is STRAIGHT → _____ B is CURVED → _____

- In wire LOOPS: Current CURVES → _____ B is STRAIGHT → _____

(1) Single or Multiple Loops → **B =** _____



(2) Solenoid (very long loop) → **B =** _____



- Solenoids produce magnetic fields similar to _____!

● Remember: TWO Fields at same location: Same Direction → ADD Opposite → SUBTRACT

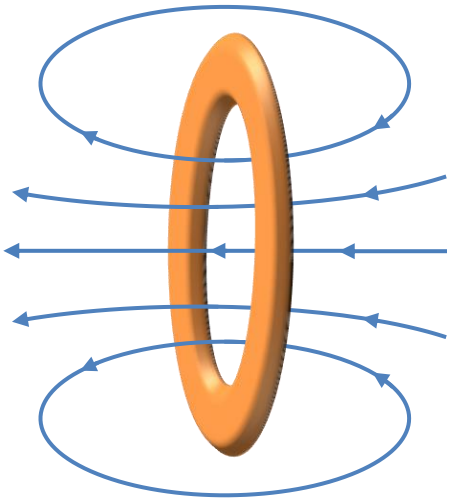
EXAMPLE: A wire is twisted into 5 tight loops 4 m in radius. A 3 A current is ran through the wire in the counter-clock direction. Find the magnitude and direction of the magnetic field produced by the loop in its center.

EXAMPLE: HOW MANY TURNS IN A SOLENOID

How many turns should a 2 m solenoid have in order to produce a 0.4 T magnetic field when a 3 A current is ran through it**?**

PRACTICE: FIND CURRENT IN LOOP PERPENDICULAR TO PAGE

The single loop below has a radius of 10 cm and is perpendicular to the page (shown at a slight angle so you can better visualize it)**.** If the magnetic field at the center is 10^{-6} T directed left, what is the magnitude of the current?
What is the direction of the current at the top of the wire**:** into the page or out of the page?



EXAMPLE: DESIGNING A SOLENOID

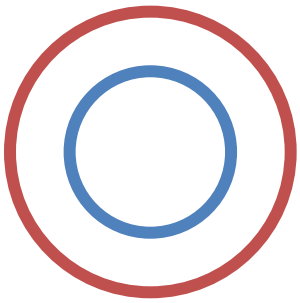
You are tasked with designing a solenoid that produces a magnetic field of 0.03 T at its center with a radius of 4 cm and length of 50 cm. What is the minimum total length of 12 A wire you should buy to construct this solenoid**?**

PRACTICE: FIND CURRENT THROUGH SOLENOID

A long wire having total resistance of 10 Ω is made into a solenoid with 20 turns of wire per centimeter. The wire is connected to a battery, which provides a current in order to produce a 0.04 T magnetic field through the center of the solenoid. What voltage must this battery have**?**

EXAMPLE: MAGNETIC FIELD BY TWO CONCENTRIC LOOPS

Two wire loops are arranged concentrically, as shown below. The inner wire has diameter 4 m and clock-wise current 5 A. The outer wire has diameter 6 m and counter-clockwise current 7 A. What is the magnitude and direction of the net magnetic field that is produced at the center of the two loops**?**



PRACTICE: MAGNETIC FIELD BY TWO CONCENTRIC SOLENOIDS

The two tightly wound solenoids below both have length 40 cm and current 5 A in the directions shown. The left solenoid has radius 20 cm and 50 m of total wire. The right solenoid has radius 0.5 m and 314 m of total wire. The thinner solenoid is placed entirely inside the wider one so their central axes perfectly overlap. Assume wires don't touch. What is the magnitude and direction of the magnetic field that is produced by a combination of the two solenoids at their central axis**?**