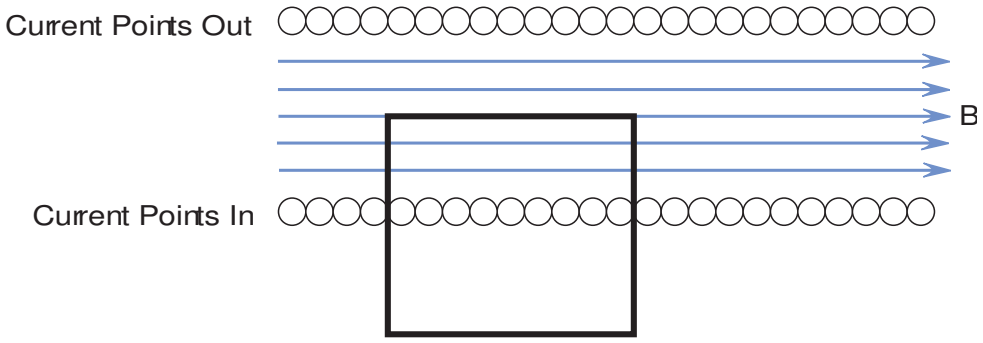
Name:_____

Ampere's Law Homework

1. Consider a tightly wound infinitely long solenoid with *n* turns per meter and a current of *I*. You may assume that the magnetic field generated by the solenoid is parallel to the axis of the solenoid for all points inside the solenoid and zero outside the solenoid. Use the rectangle cutting through the solenoid in the cross section shown below as an Amperian loop to determine the strength of the magnetic field inside the solenoid.



2. Consider a long straight, thick copper wire with a radius of 2 cm carrying 500 Amps of current. Use Ampere's law to find the strength of the magnetic field at a distance *r* from the center of the wire both when *r* is less than 2 cm (inside the wire) and when *r* is more than 2 cm (outside the wire). Make a graph of the field strength as a function of distance. Then explain why the magnetic force inside the wire will produce a force pulling electrons towards the center of the wire. You may assume that the current is evenly distributed throughout the wire.

3. Although as shown in problem 2, a current carrying wire will produce a magnetic field pulling electrons into the center; this effect is normally not observed in conductors where only free electrons are free to move. This effect, known as the pinch effect, does occur quite noticeably when a current flows through a plasma, where both electrons and positive ions are free to move and act as charge carriers. Explain why the pinch effect is much more dramatic in a plasma than in a wire.