
Ampère's law

1. Consider a long straight wire carrying current I .
 - A. Imagine a closed circular path of radius r whose principal axis coincides with the current-carrying wire. Write an expression of Ampère's law describing the circulation of the magnetic field around the path.

 - B. Use Ampère's law to find the magnetic field strength along the path.

2. Consider a long, straight, cylindrical, conducting wire of radius R carrying current I .
 - A. Assume that the current density J (A/m²) in the wire is uniform. What is J in terms of I and R ?

 - B. Imagine a closed circular path of radius $r \leq R$ whose principal axis coincides with the principal axis of the conducting cylinder. What current is enclosed by this circle?

C. Use Ampère's law to find the magnetic field strength inside the wire at distance r from the central axis.

D. Imagine a closed circular path of radius $r \geq R$ whose principal axis coincides with the principal axis of the conducting cylinder. What current is enclosed by this circle?

E. Use Ampère's law to find the magnetic field strength inside the wire at distance r from the central axis.

F. Check that the formulas for the two zones give the same result for $r = R$.