

[Ampère's law] .quiz

1) solenoid and Ampère's law

A solenoid with a length L and a radius R , and four different paths A, B, C, D are shown in fig.1. The current passing through the solenoid is I , with direction shown in the figure. We know that the magnetic field at the center is,

$$B_{\text{center}} = \mu_0 NI / \sqrt{4R^2 + L^2}. \quad (1)$$

- a) Find $\oint_A \mathbf{B} \cdot d\mathbf{l}$.
- b) Find $\oint_B \mathbf{B} \cdot d\mathbf{l}$.
- c) Find $\oint_C \mathbf{B} \cdot d\mathbf{l}$.
- d) When $L \ll R$ solenoid becomes a ring. Find the magnetic field of this ring at the center using (1).
- e) Using (1) show that for a really long solenoid, i.e. $R \ll L$, the magnetic field at the center can be written as $B = \mu_0 nI$ where $n = N/L$.
- f) The path D is an infinite line passing through the solenoid as shown in fig. 1. Find $\int_D \mathbf{B} \cdot d\mathbf{l}$.

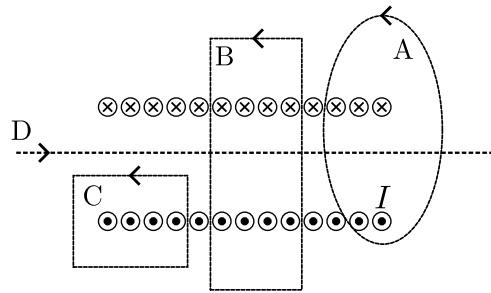


Figure 1: Solenoid and Ampère's law. The loops A, B, and C are on the plane that cuts the solenoid in half.