Given a long solenoid which has a current $I$ and the linear number density (turns per length), $n$.

![Diagram of a long solenoid with a hollow core](image)

Find $\vec{B}_A$, the magnetic field at the point $A$, located on the axis at the right end of the solenoid.

A) $||\vec{B}_A|| = \mu_0 I n$; and its direction is $\leftarrow$.
B) $||\vec{B}_A|| = \mu_0 I n$; and its direction is $\rightarrow$.
C) $||\vec{B}_A|| = \frac{\mu_0 I n}{2}$; and its direction is $\leftarrow$.
D) $||\vec{B}_A|| = \frac{\mu_0 I n}{2}$; and its direction is $\rightarrow$.

Assume the solenoid is long. Near the center $B_{in} = B_R + B_L = 2B_R$.

By inspection, $B_A = B_R$, or $B_A = \frac{B_{in}}{2} = \frac{\mu_0 I n}{2}$.

This is a special case of $B = \mu_0 I n \frac{\sin \phi_2 - \sin \phi_1}{2}$, where $\phi_2 = 0^\circ$, and $\phi_1 = -90^\circ$.

Answer C.

30.05-01 'B' at 'One' End of a 'Long' Solenoid 2004-3-24