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

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