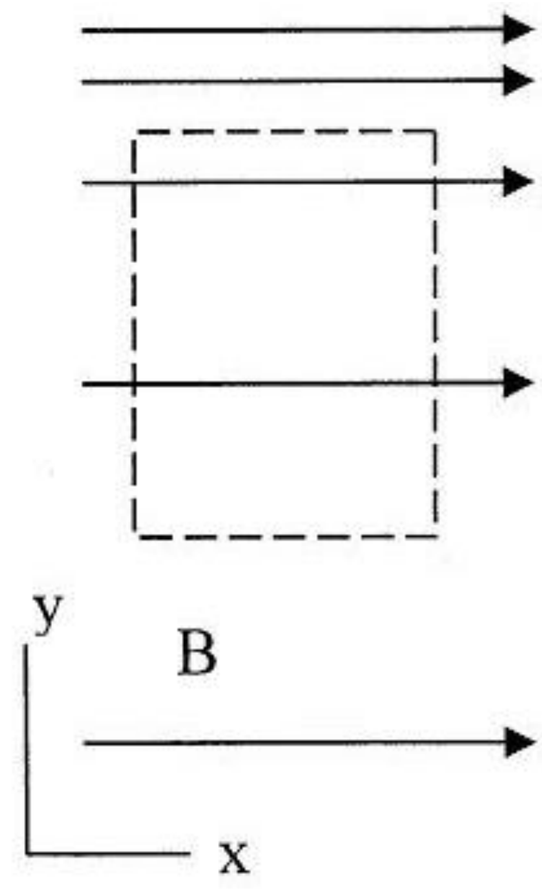
DIVERGENCE & CURL OF B; STOKES THEOREM

The magnetic field in a certain region is given by

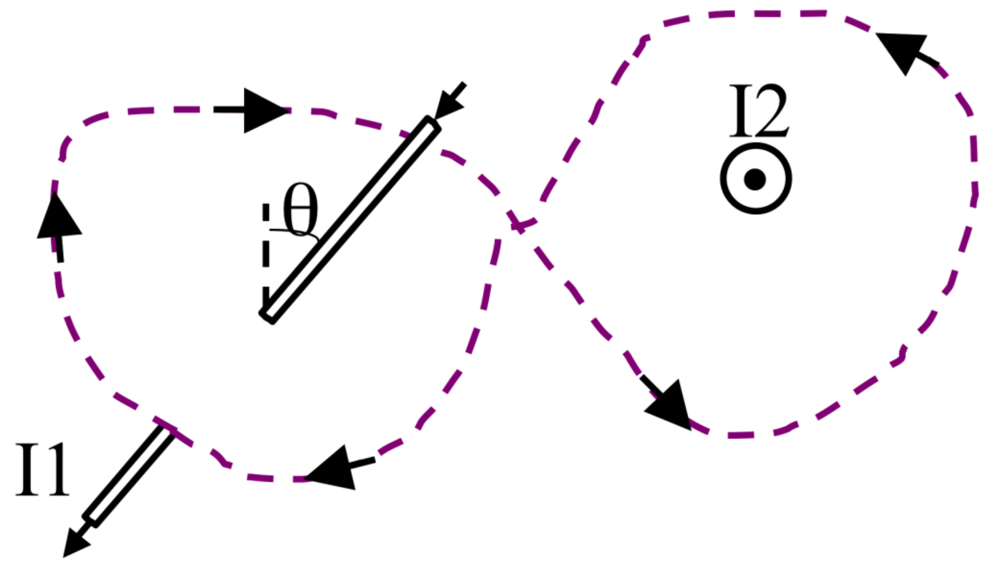
$$\vec{B}(x,y) = C y \hat{x}$$

(C is a positive constant) Consider the imaginary loop shown. What can you say about the electric current passing through the loop?

A. must be zero
B. must be nonzero
C. Not enough info



What is $\oint \vec{B} \cdot d\vec{l}$ around this purple



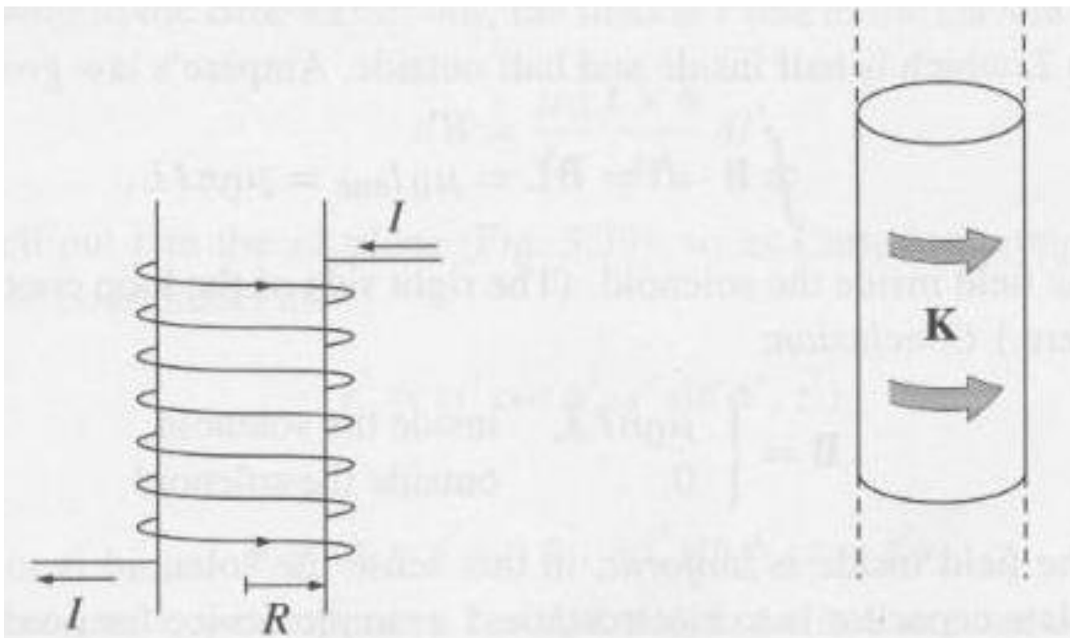
A) $\mu_0 (|I_2| + |I_1|)$ B) $\mu_0 (|I_2| - |I_1|)$

C) $\mu_0 (|I_2| + |I_1| \sin\theta)$ D) $\mu_0 (|I_2| - |I_1| \sin\theta)$

E) $\mu_0 (|I_2| + |I_1| \cos\theta)$

A solenoid has a total of N windings over a distance of L meters. We "idealize" by treating this as a surface current running around the surface.

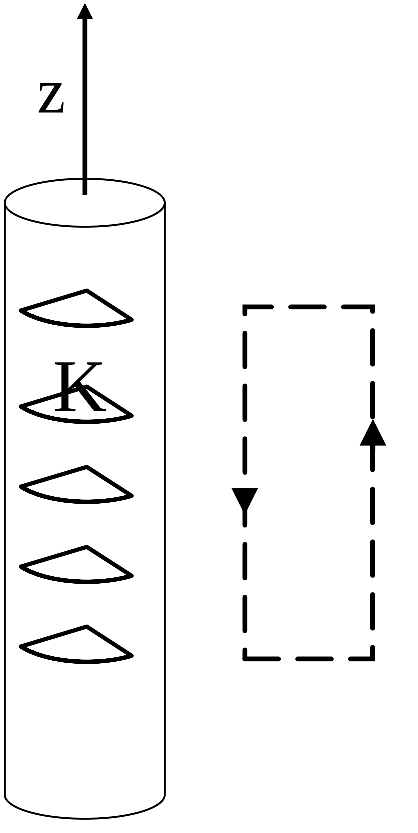
What is K?



A) I B) NI C) I/L D) I N/L

E) Something else...

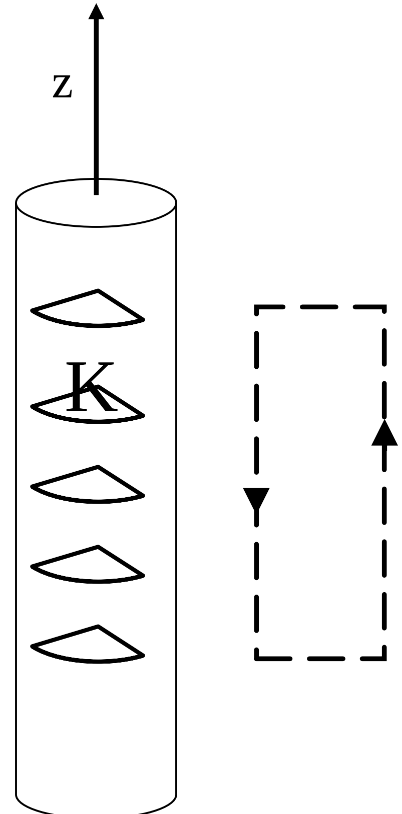
An infinite solenoid with surface current density K is oriented along the z-axis. Apply Ampere's Law to the rectangular imaginary loop in the yz plane shown. What does this tell you about Bz, the z-component of the **B**-field outside the solenoid?



A) Bz is constant outside
B) Bz is zero outside
C) Bz is not constant outside
D) It tells you nothing about Bz

An infinite solenoid with surface current density K is oriented along the z-axis. Apply Ampere's Law to the rectangular imaginary loop in the yz plane shown.

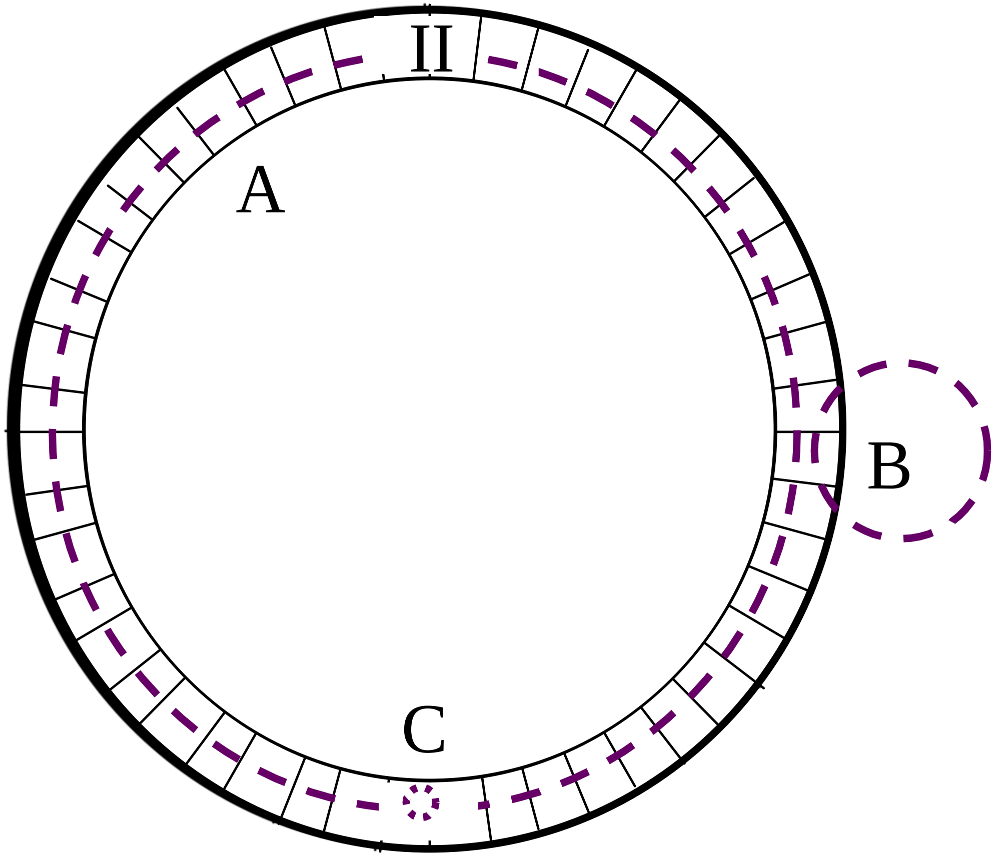
We can safely assume that B(s→∞)=0. What does this tell you about the **B**-field outside the solenoid?



A) |B| is a small non-zero constant outside
B) |B| is zero outside
C) |B| is not constant outside
D) We still don’t know anything about |B|

What Amperian loop would you draw to find B “inside” the Torus (region II)

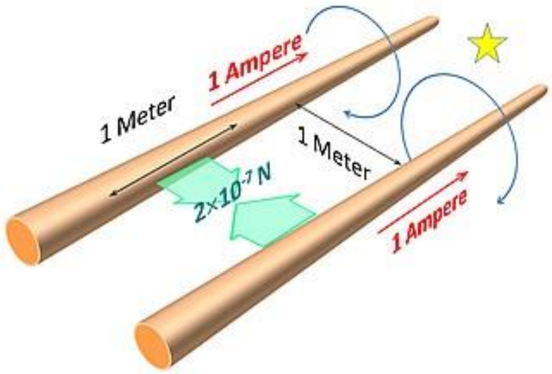
A) Large “azimuthal” loop
B) Smallish loop from region II to outside (where B=0)
C) Small loop in region II
D) Like A, but perp to page
E) Something entirely diff



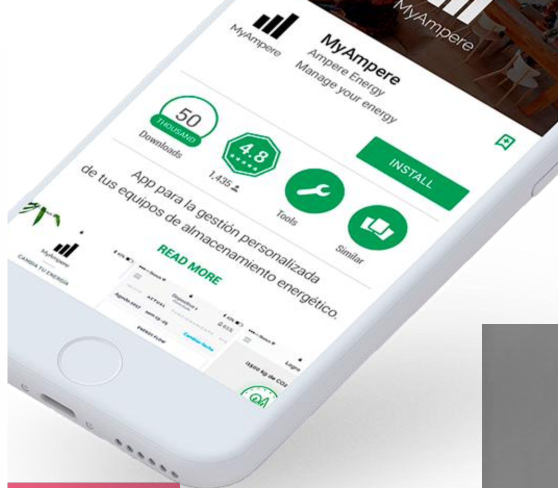
André-Marie Ampère
(1775 –1836)
French physicist and mathematician
Self-taught according to Rousseau philosophy

First theory of electromagnetism - postulated “electrodynamic molecule" (electron) as source of both electricity and magnetism.

Invented solenoid, electrical telegraph, + ….



Did <u>not</u> discover
“Ampere’s (circuit) law”.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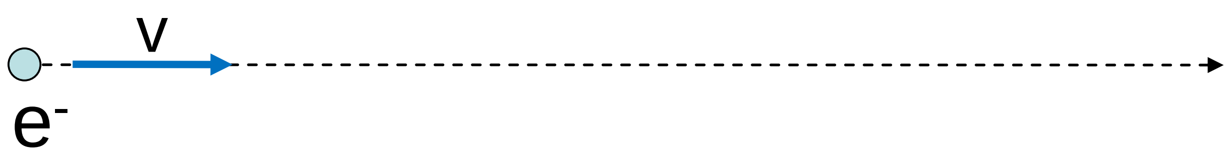
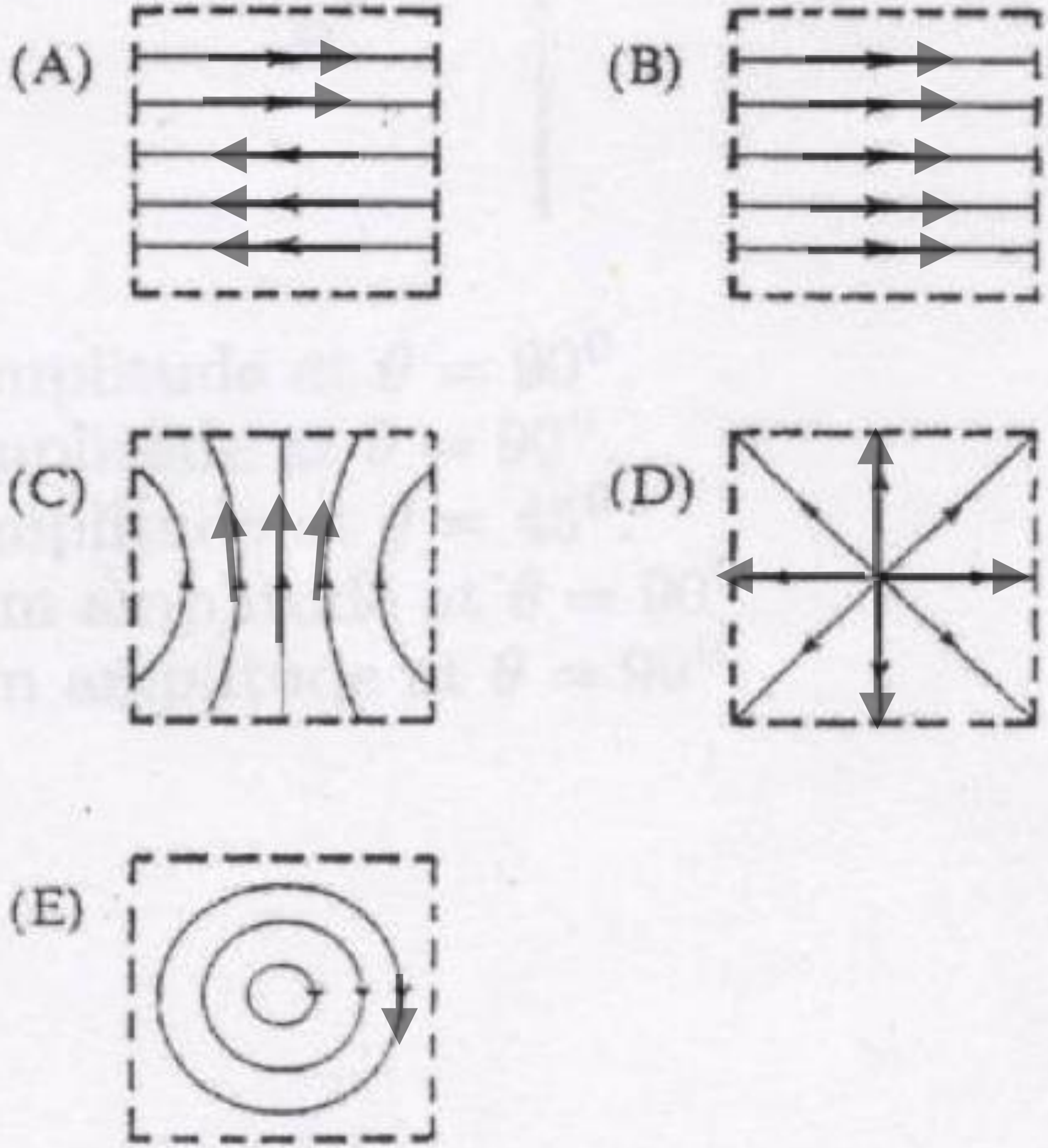
An electron is moving in a straight line with constant speed v. What approach would you choose to calculate the B-field generated by this electron?



A) Biot-Savart
B) Ampere’s law
C) Either of the above.
D) Neither of the above.

Pick a sketch showing B field lines that *violate* one of Maxwell's equations within the region bounded by dashed lines.



(What currents would be needed to generate the others?)

Choose all of the following Maxwell's equations for electrostatics and magnetostatics that need to be changed if magnetic charges exist:

(I) the one related to $\nabla \cdot \vec{B}$

(II) the one related to $\nabla \cdot \vec{E}$

(III) the one related to $\nabla \times \vec{E}$

a) (I) only

b) (II) only

c) (III) only

d) (I) and (II) only

e) (I) and (III) only