MAGNETIZATION+DIPOLES

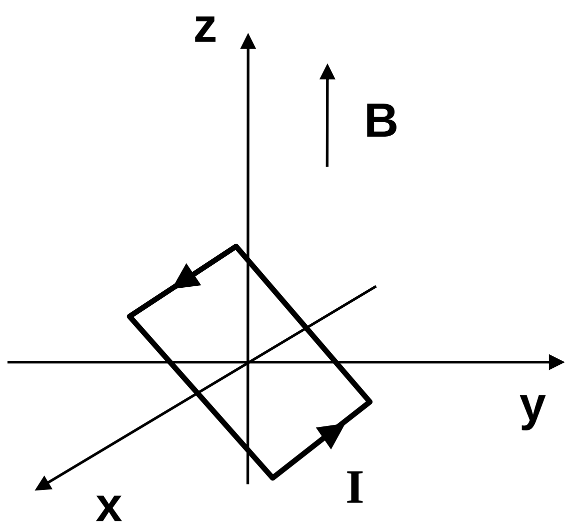
The force on a segment of wire L is $\vec{F} = I\,\vec{L} \times \vec{B}$

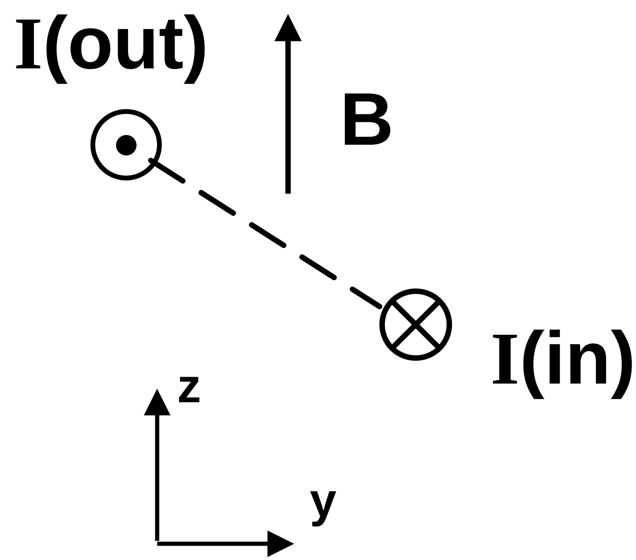
A current-carrying wire loop is in a constant magnetic field **B** = B **z_hat** as shown.

What is the direction of the torque on the loop?

A) Zero B) +x C) +y D) +z

E) None of these

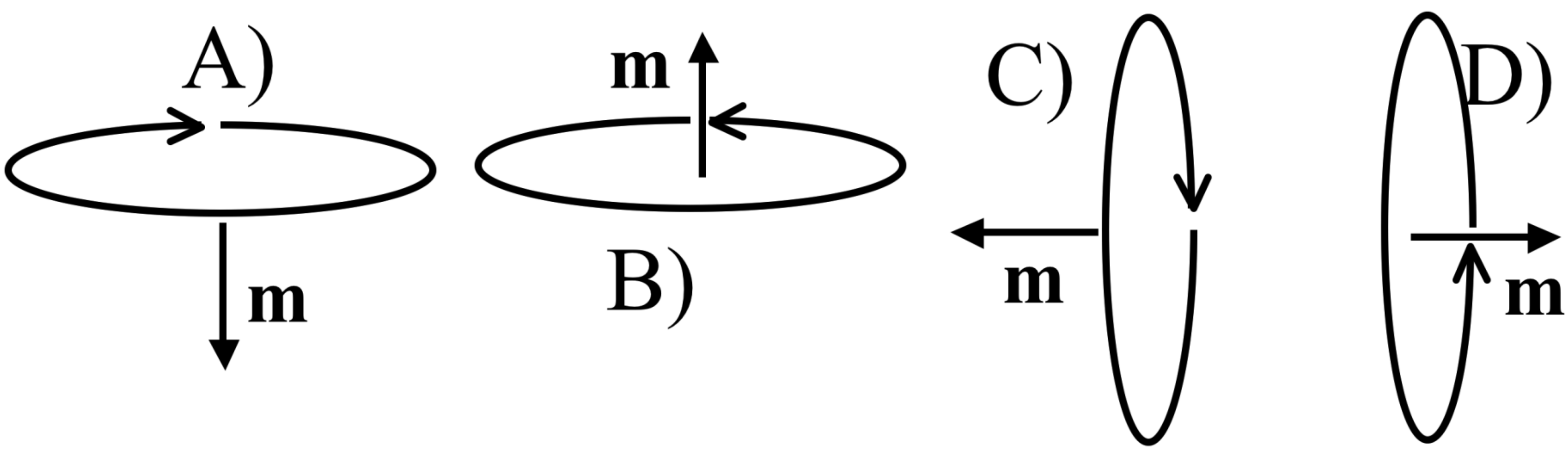




Griffiths argues that the torque *on* a magnetic dipole in a B field is:

$$\vec{\tau} = \vec{\mathbf{m}} \times \vec{\mathbf{B}}$$

How will a small current loop line up if the B field points uniformly up the page?

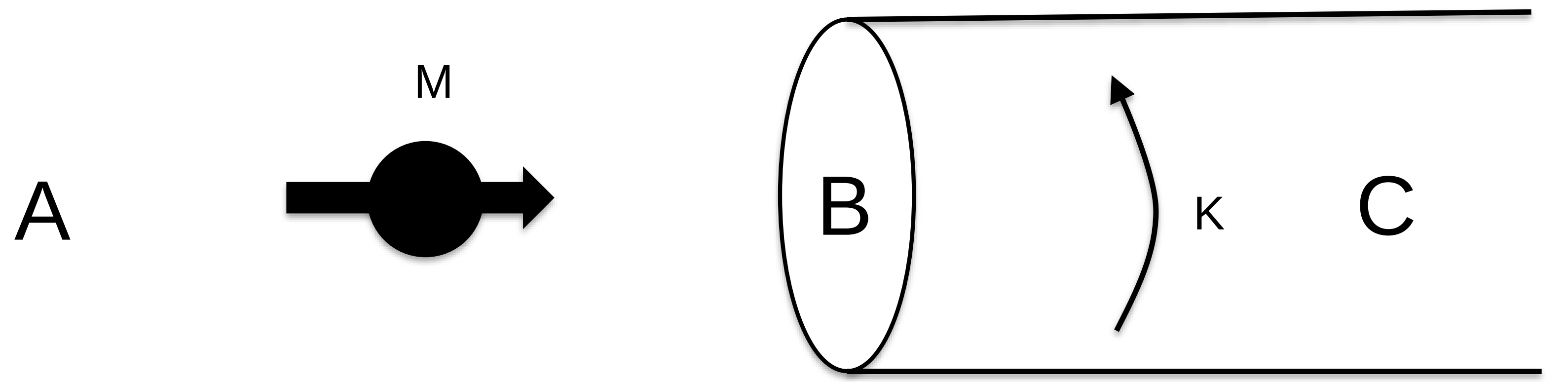


Griffiths argues that the force *on* a magnetic dipole in a B field is: $\vec{\mathbf{F}} = \vec{\nabla}(\vec{\mathbf{m}} \bullet \vec{\mathbf{B}})$

If the dipole **m** points in the z direction, what can you say about **B** if I tell you the force is in the x direction?

A) **B** simply points in the x direction
B) Bz must depend on x
C) Bz must depend on z
D) Bx must depend on x
E) Bx must depend on z

Suppose I place a small dipole M at various locations near the end of a large solenoid. At which point is the magnitude of the force on the dipole greatest?



D) Not enough information to answer

E) There is no net force on a dipole

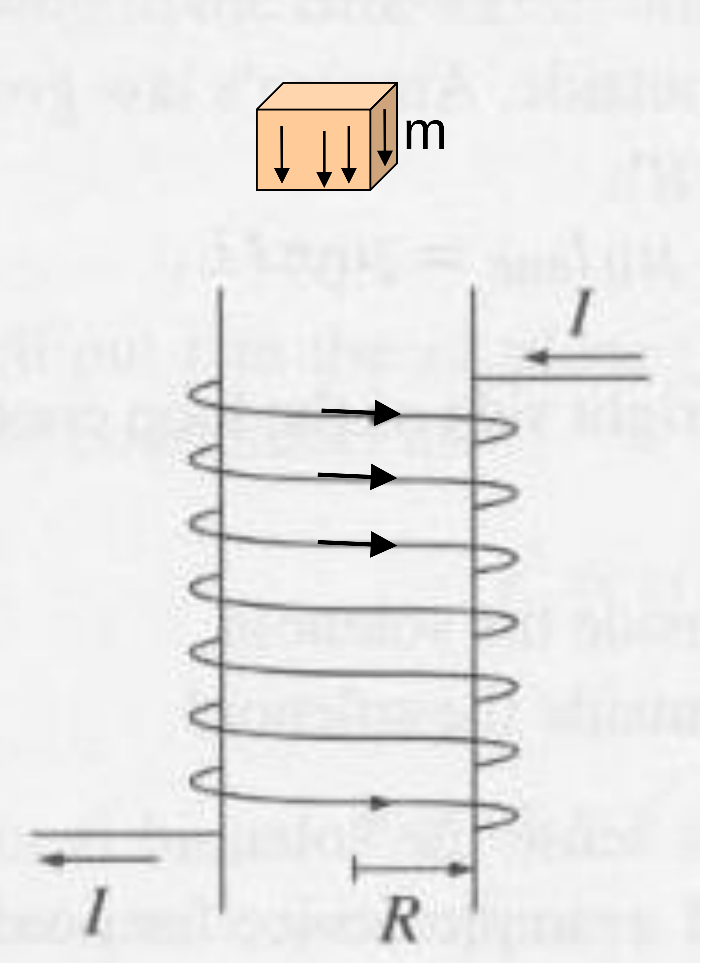
Which type of magnetic material has the following properties:

1) The atoms of the material have an odd number of electrons
2) The induced atomic magnetic dipoles align in the same direction as an applied magnetic field
3) Thermal energy tends to randomize the induced dipoles

A. Ferromagnetic
B. Diamagnetic
C. Paramagnetic

A small chunk of material (the "tan cube") is placed above a solenoid. It magnetizes, weakly, as shown by small arrows inside. What kind of material must the cube be?

A) Dielectric
B) Conductor
C) Diamagnetic
D) Paramagnetic
E) Ferromagnetic



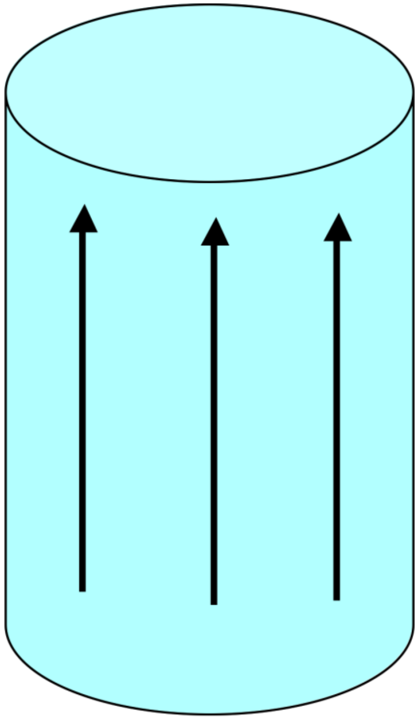
Predict the results of the following experiment: a paramagnetic bar and a diamagnetic bar are put just inside of a solenoid.

a) The paramagnet is pushed out, the diamagnet is sucked in
b) The diamagnet is pushed out, the paramagnet is sucked in
c) Both are sucked in, but with different force
d) Both are pushed out, but with different force

FIELDS FROM MAGNETIZED OBJECTS + BOUND CURRENTS

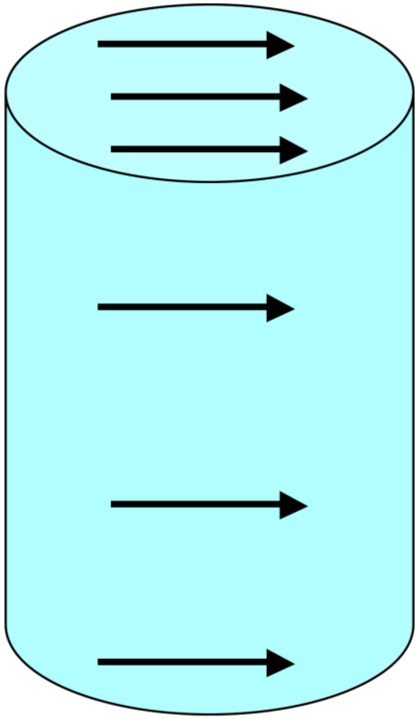
A solid cylinder has uniform magnetization **M** throughout the volume in the z direction as shown. Where do bound currents show up?

A) Everywhere: throughout the volume and on all surfaces
B) Volume only, not surface
C) Top/bottom surface only
D) Side (rounded) surface only
E) All surfaces, but not volume



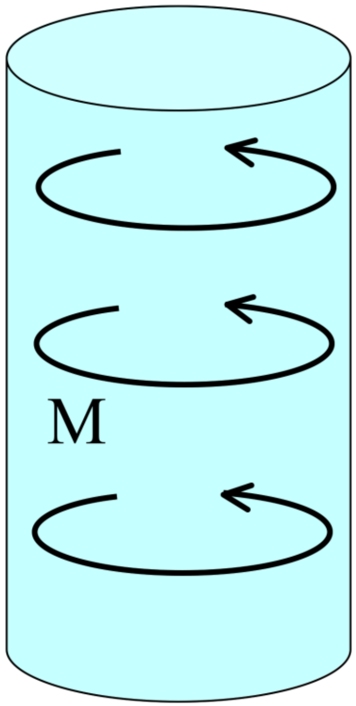
A solid cylinder has uniform magnetization **M** throughout the volume in the x direction as shown. Where do bound currents show up?

A) Top/bottom surface only
B) Side (rounded) surface or
C) Everywhere
D) Top/bottom, and parts of (but not all of) side surface (but not in the volume)
E) Something different/other combination!



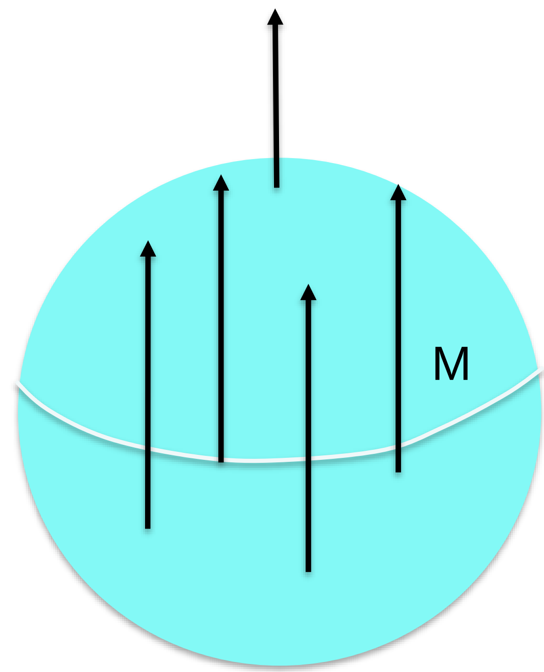
A solid cylinder has uniform magnetization **M** throughout the volume in the φ direction as shown. In which direction does the bound surface current flow on the (curved) sides?

A. There is no bound surface current.
B. The current flows in the $\pm\varphi$ direction.
C. The current flows in the $\pm s$ direction.
D. The current flows in the $\pm z$ direction.
E. The direction is more complicated tha the answers B, C, or D.



A sphere has uniform magnetization M in the z direction.

Which formula is correct for this surface current?



A) $M \sin q \, \hat{q}$

B) $M \sin q \, \hat{j}$

$M \cos q \, \hat{q}$

C) $M \cos q \, \hat{j}$

D)