Feb 18

Exam next Wednesday covering Chapters 15-17

Practice Exam on Website

Jana review tomorrow, Damon review Monday

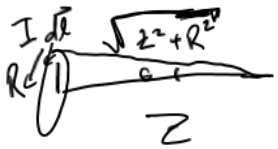
Get Clickers, electric kit, meter stick, ruler

MiniLab: Magnetic field of current carrying wires

Turn in by Friday

Demo: Field of wire loop

B_z on axis



$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\hat{r}}{r^2}$$

$$dB_z = \frac{\mu_0}{4\pi}\frac{I\,dl\sin\theta}{z^2+R^2} = \frac{\mu_0}{4\pi}\frac{I\,dl\,R}{(R^2+z^2)\sqrt{z^2+R^2}}$$

$$= \frac{\mu_0}{4\pi}\frac{I R\,dl}{(z^2+R^2)^{3/2}} \rightarrow \text{const} \Rightarrow \text{integrate around circle}$$

$$B_z = \frac{\mu_0}{4\pi}\frac{2\pi R^2 I}{(z^2+R^2)^{3/2}} \quad \text{on axis only}$$

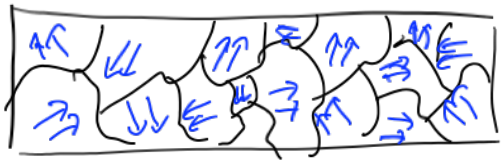
$$\sim \frac{\mu_0}{4\pi}\frac{2\pi R^2 I}{z^3} \quad \text{for } z \gg R$$

$$B_z \sim \frac{\mu_0}{4\pi}\frac{2\mu}{z^3}$$

μ = magnetic dipole moment
= Area × current

Discussion: Bar Magnets

$$B_z = \frac{\mu_0}{4\pi}\frac{2\mu}{z^3}$$



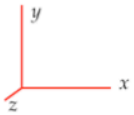
$\Longrightarrow B$

magnetic dipole moments from spinning electrons tend to point in same direction

Different domains have dipole moments pointing in different dir.

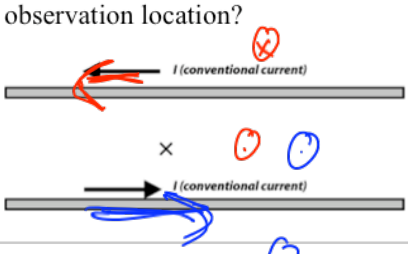
Clickers

Q17.7b

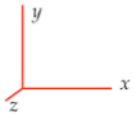
Direction of magnetic field at the observation location?  ×	A) +y B) −y C) +z D) −z E) zero magnitude	

Q17.7c

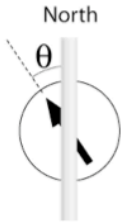
Direction of magnetic field at the observation location?



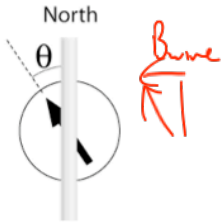
A) +y
B) –y
C) +z
D) –z
E) zero magnitude



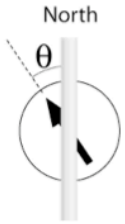
Q17.7e

A wire lies on top of a compass.  Top view, looking down on the table.	The compass deflects 12 degrees West. What is the direction of the magnetic field due to the current in the wire, at the location of the compass? A) North B) South C) East D) West

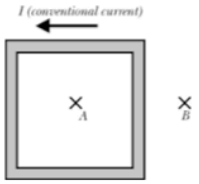
Q17.7f

Top view, looking down on the table:  	The compass deflects 12 degrees West. What is the direction of ***electron current*** in the wire? A) North B) South C) East D) West

Q17.7g

Top view, looking down on the table:  Horiz. component of Earth's magnetic field: 2e–5 tesla	The compass deflects 12 degrees West. What is the magnitude of the magnetic field made by the moving electrons in the wire? A) 9.4e–5 tesla B) 2.0e–5 tesla C) 2.1e–6 tesla D) 4.3e–6 tesla

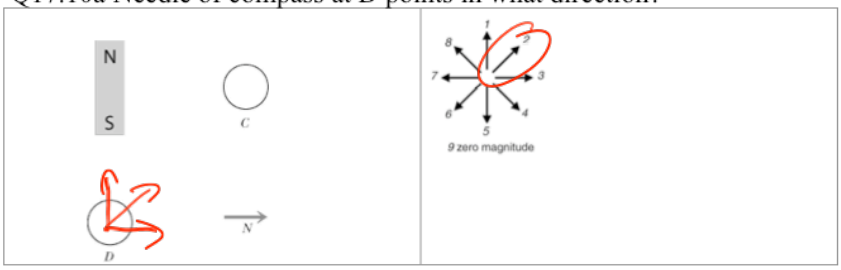
Q17.9a

I = 3 amperes, width of side = 6 cm  	What is the magnetic dipole moment of this current-carrying loop? A) 3 A m^2 B) 3.6e-3 A m^2 C) 1.08e-2 A m^2 D) 0 A m^2

$\mu = I \cdot A$

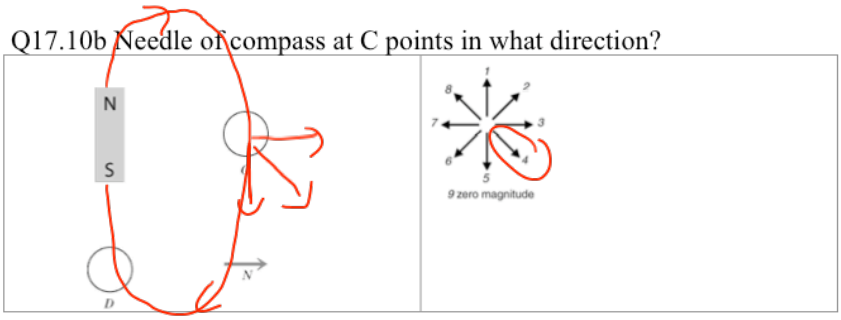
$= 3A \times (0.6m)^2$

Q17.10a Needle of compass at D points in what direction?



A) 1
B) 2
C) 3
D) 4
E) 5

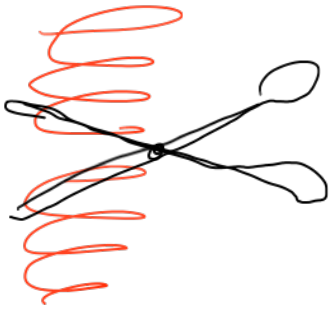
Q17.10b Needle of compass at C points in what direction?



A) 1
B) 2
C) 3
D) 4
E) 5

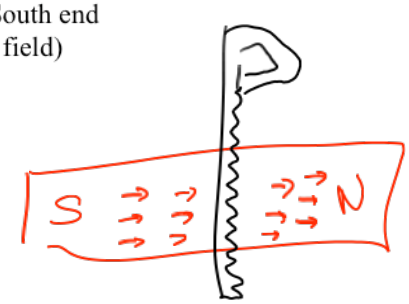
Q17.10c If we cut a coil in half, so that each new coil has half as many turns as the original coil, what do you think we would get?

A. One coil with a North pole and one coil with a South pole
B. Two weaker coils, each with a North end and a South end
C. Two coils that don't make any magnetic field when current runs through them



Q17.10d If we cut a bar magnet in half, so that each new magnet is half as long as the original magnet, what do you think we would get?

A. One North piece and one South piece
B. Two weaker magnets, each with a North end and a South end
C. Two pieces that are not magnets (make no magnetic field)



No such thing as a magnetic charge

Q17.11a We estimated μ_{1atom} to be about 1 x 10^{-23} Am^2. The mass of the magnet is 13 g.
The atomic mass of iron is 56. How do we predict the magnetic dipole moment of the
entire magnet?

A) μ_{1atom} * 0.013 kg
B) μ_{1atom} /0.013 kg
C) μ_{1atom} * 6.02e23
D) μ_{1atom} * 13g * 6.02e23 / 56 g
E) μ_{1atom} *56 g / [13g * 6.02e23]

VPython: B field of moving proton

Flying Protons