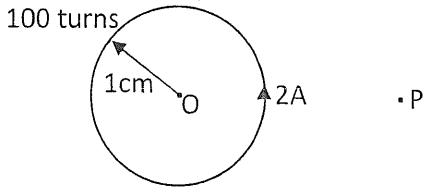
Name: _____

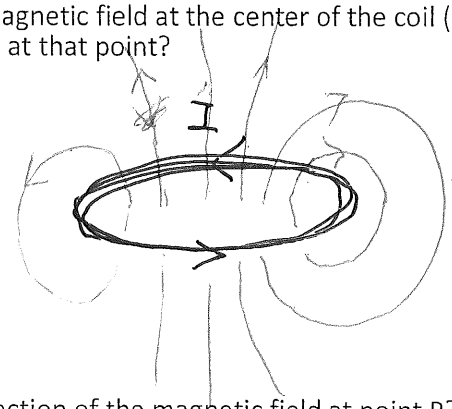
PHY 232 Summer 2016 Class Work

Class 29. Biot-Savart Law

Consider a 100 turn coil of 1cm in radius, and a current of 2A is passing through the coil.

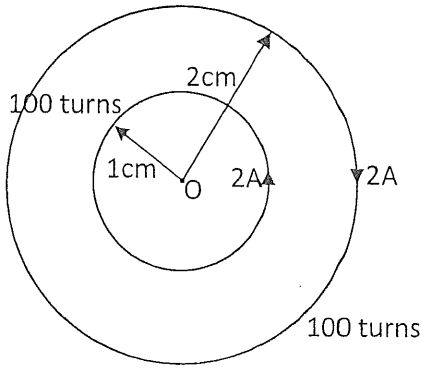


(a) Calculate the magnetic field at the center of the coil (point O). What is the direction of the magnetic field at that point?



(b) What is the direction of the magnetic field at point P?

(c) Another ring (also 100 turns) of 2cm in radius is placed concentrically to the original ring. The outer ring carries the same magnitude of current (2A) but in opposite direction, as shown in the diagram. Calculate the magnetic field at the center of the two coils (point O). What is the direction of the magnetic field at that point?



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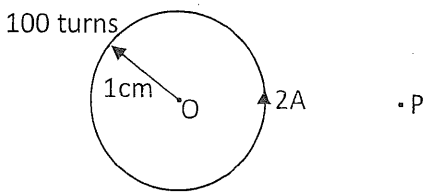

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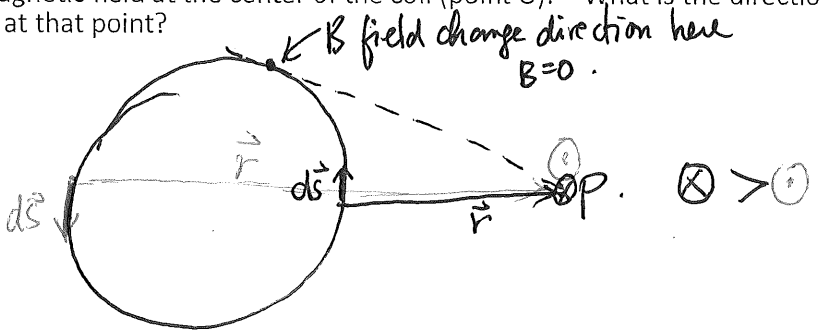

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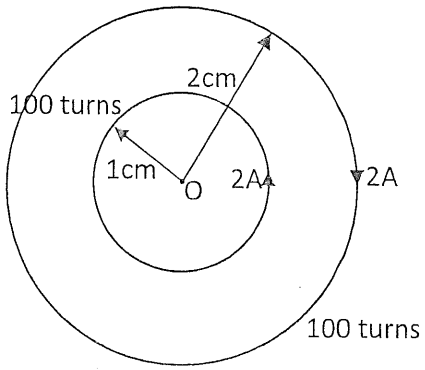
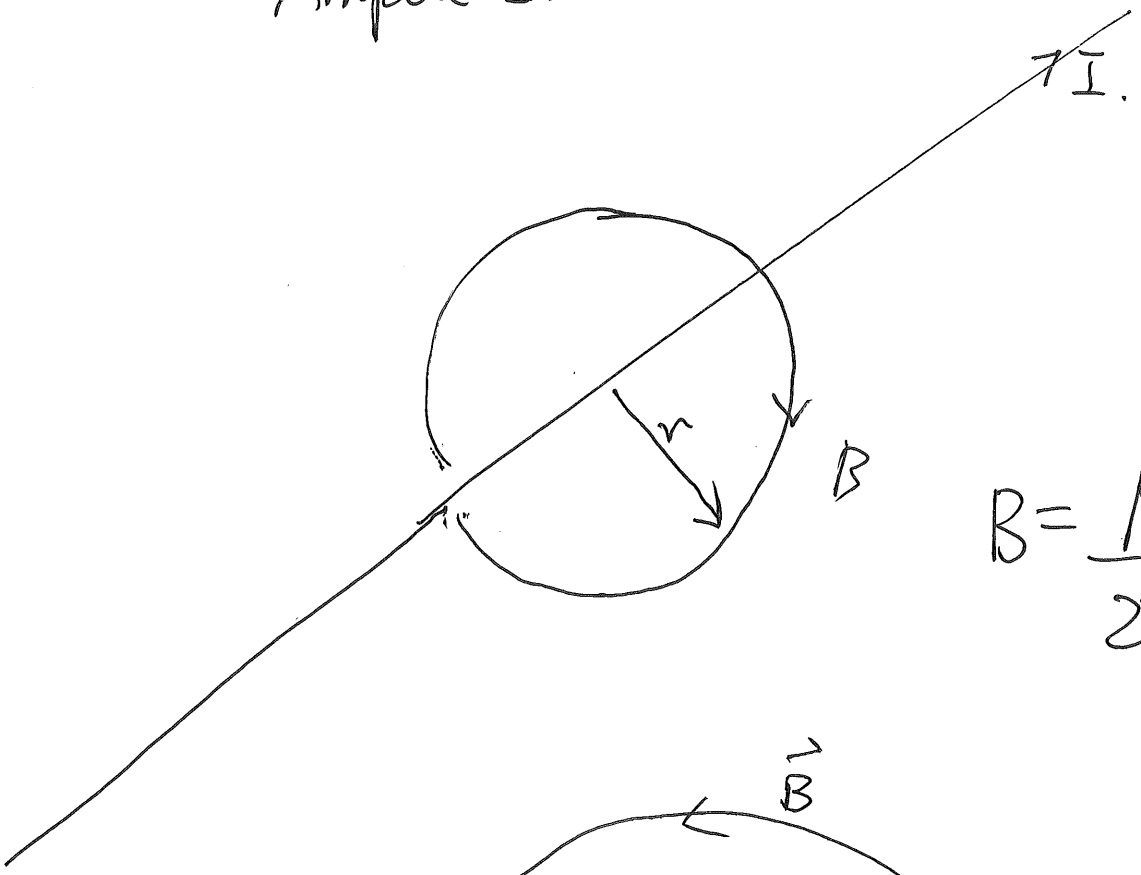
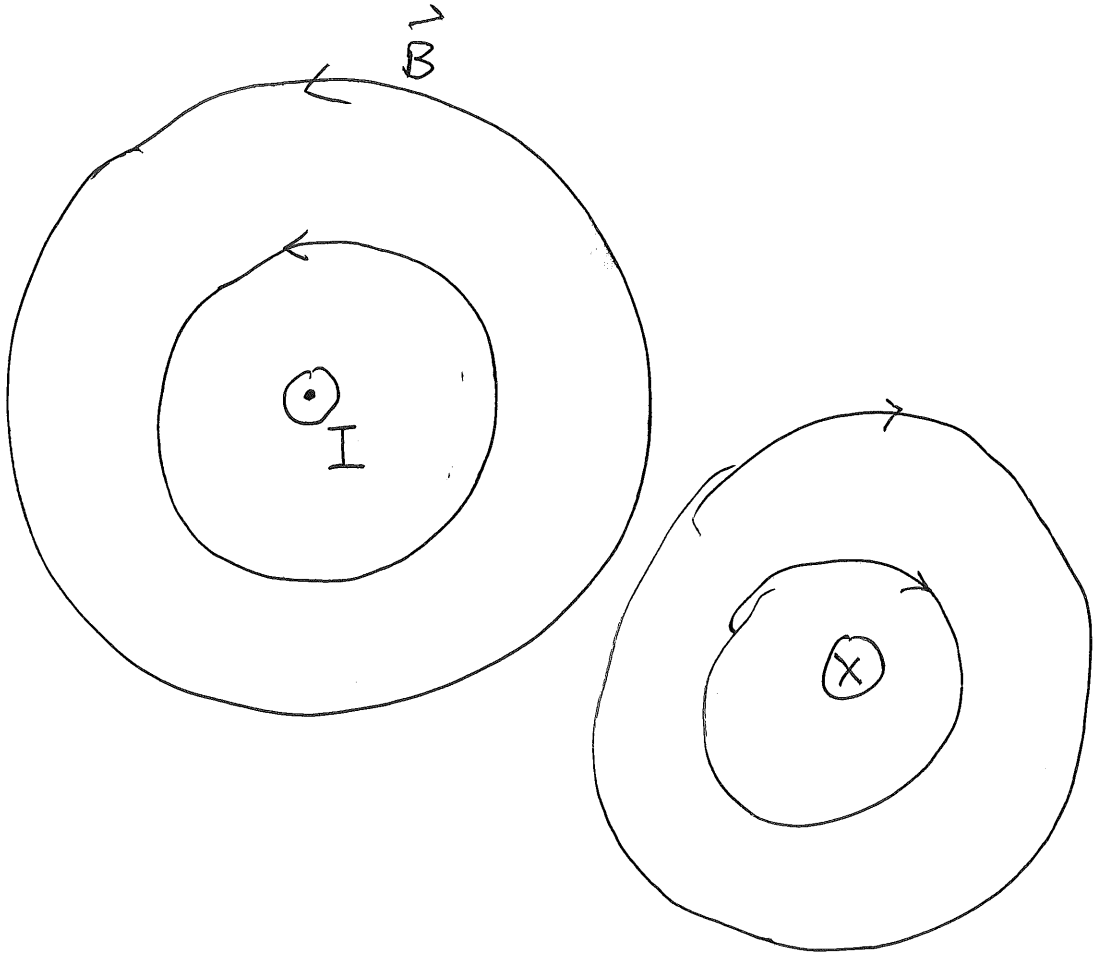
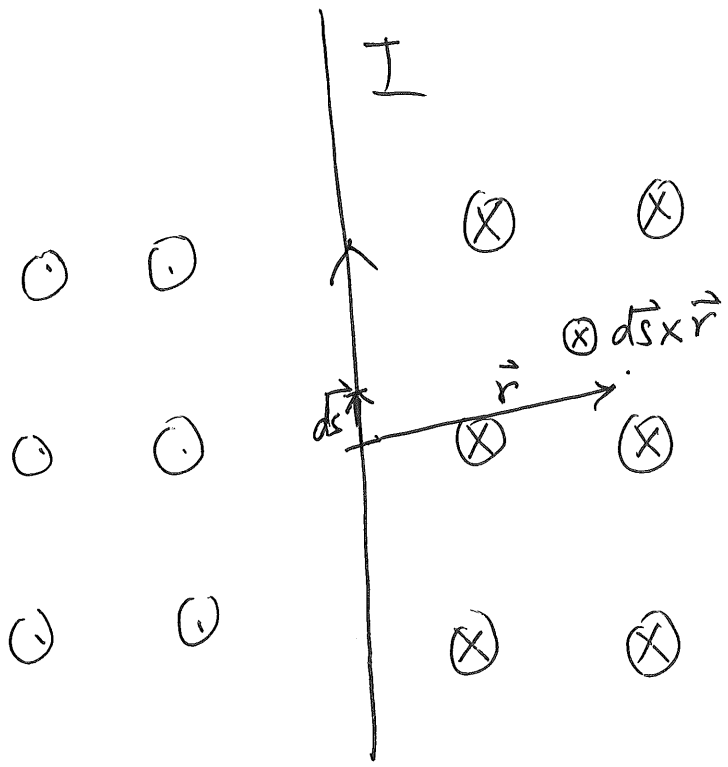


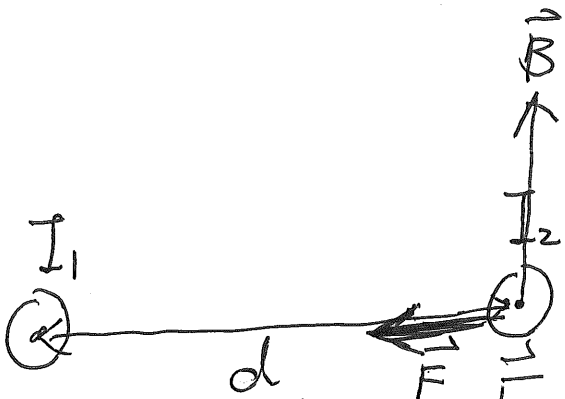
Ampere's Law



$$B = \frac{\mu_0 I}{2\pi r}$$




I
$d\vec{s}\times\vec{r}$
$\vec{r}$
$d\vec{s}$



$$B = \frac{\mu_0 I_1}{2\pi d}$$

$$\vec{F} = I\vec{L} \times \vec{B}$$

$$F = I_2 \cdot L \cdot \left(\frac{\mu_0 I_1}{2\pi d}\right).$$

$$= L \cdot \frac{\mu_0 I_1 I_2}{2\pi d}.$$

$$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi d}.$$

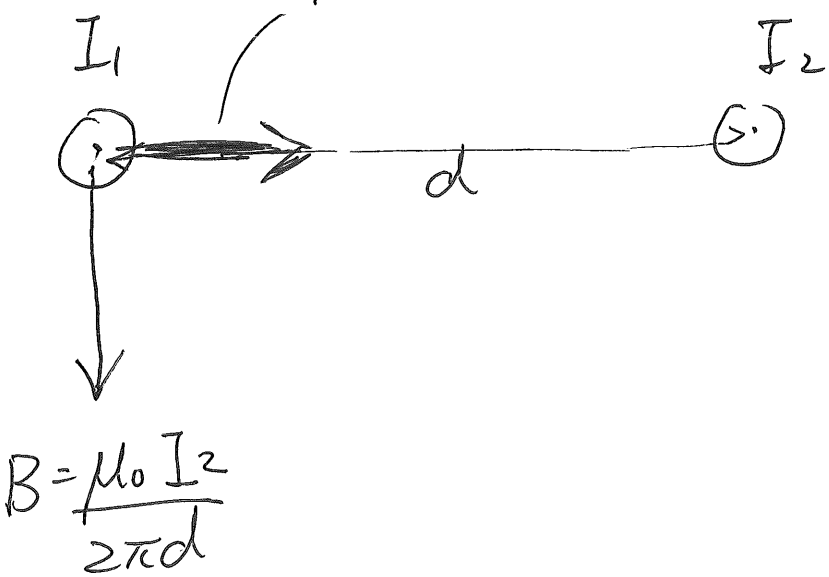
Force per unit length.

Newton's Third law:

$$|\vec{F}'| = |\vec{F}|$$

$$B = \mu n I$$

$$\vec{F} = I\vec{L} \times \vec{B} = I_1 \cdot L \cdot \left(\frac{\mu_0 I_2}{2\pi d}\right) = L \cdot \left(\frac{\mu_0 I_1 I_2}{2\pi d}\right)$$



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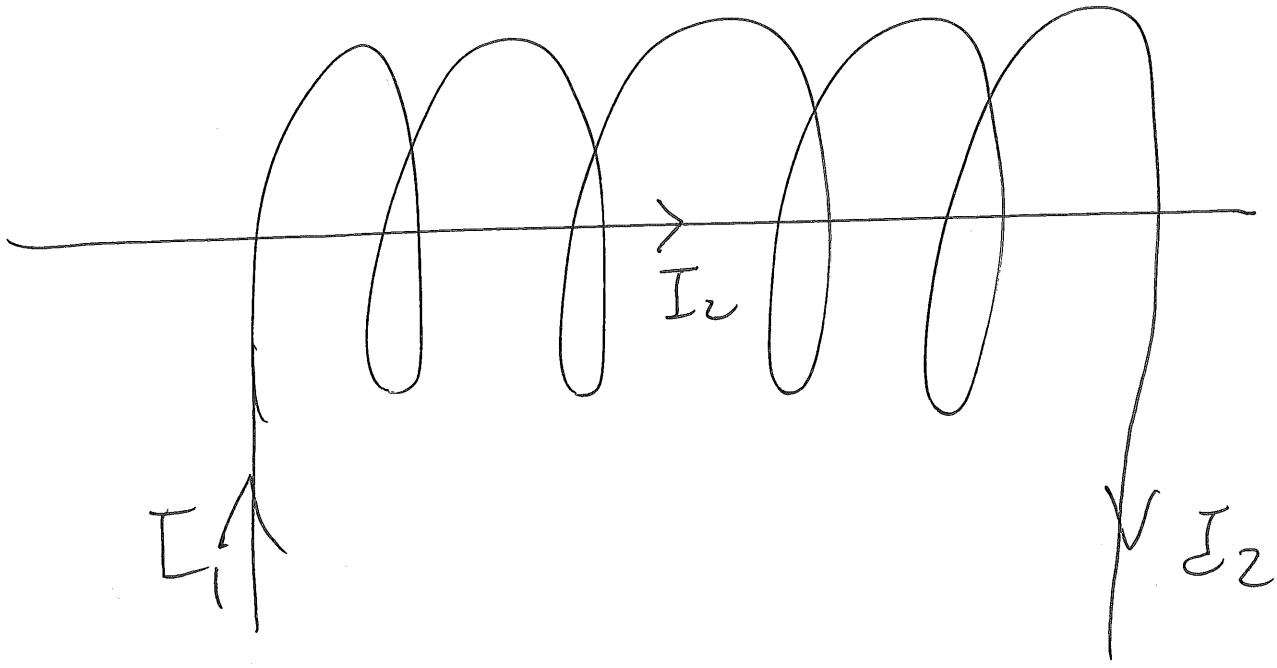

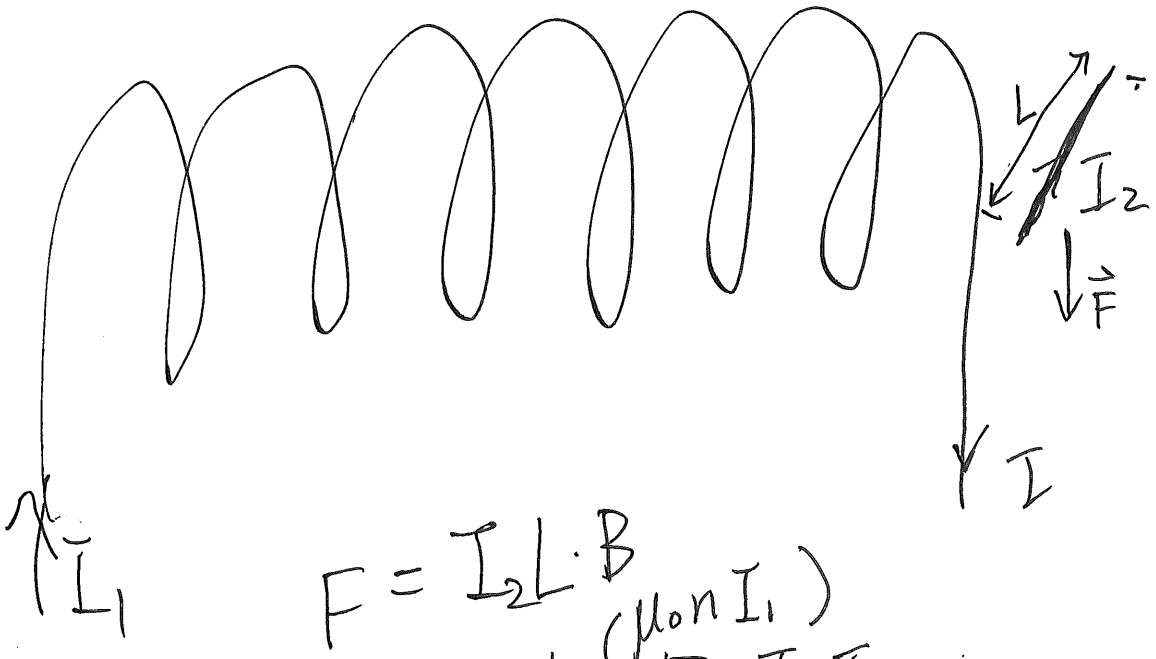

$$F = I_2 L \cdot B$$

$$= I_2 \cdot L \cdot (\mu_0 n I_1)$$

~~$F = I_1 I_2$~~