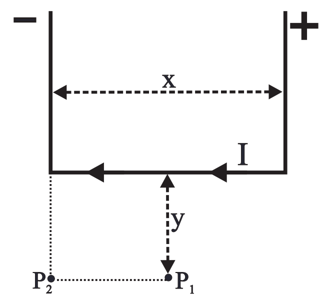
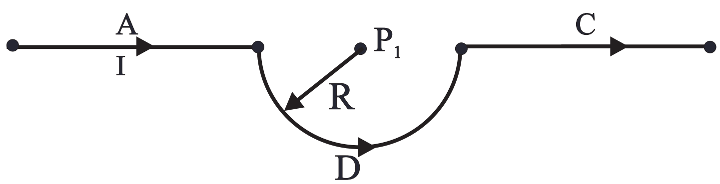
PHYSICS HOMEWORK #125 MAGNETISM
MAGNETIC FIELD AND THE BIOT-SAVART LAW

Use the Biot-Savart Law to solve the following problems! ⟶

$$dB = k_m \cdot \frac{I \cdot d\vec{l} \times \hat{r}}{r^2} \qquad k_m = \frac{\mu_o}{4\pi} = 10^{-7} \cdot \frac{N}{A^2} \qquad \mu_o = 4\pi \times 10^{-7}\ N/A^2$$

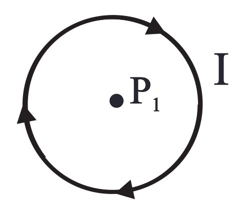
1. Consider conductor bent into the shape shown to the right. The conductor has a current of I = 5.00 Amperes flowing through it from right to left as shown. The horizontal segment of the conductor is x = 12.0 cm long. There is a point P_1 located a distance y = 8.00 cm from the segment as shown and there is a second point P_2 located y from the segment and perpendicular to the corner of the segment. [Ignore any contribution to the magnetic field caused by the vertical wire segments!] Using the Biot-Savart Law determine:
   a. the direction and magnitude of the magnetic field B at point P_1.
   b. the direction and magnitude of the magnetic field B at point P_2.

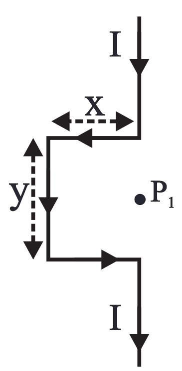




2. A current of I = 8.00 Amperes is flowing from left to right through the wire shown above. The central segment D of the wire is in the shape of a semi-circular loop, as shown, with a radius of R = 12.0 cm. while segments A and C are straight.
   a. What is the direction and magnitude of the magnetic field B_A at point P_1 as caused by wire segment A?
   b. What is the direction and magnitude of the magnetic field B_D at point P_1 as caused by wire segment D?
   c. What is the direction and magnitude of the magnetic field B_C at point P_1 as caused by wire segment C?
   d. What will be the direction and magnitude of the magnetic field B at point P_1?

3. A current of I = 3.50 Amperes is flowing in a circular, closed conducting path which has a radius of R = 6.00 cm. as shown to the right.
   a. What will be the direction of the magnetic field at point P_1?
   b. What will be the strength of the magnetic field at the center P_1 of this closed conducting loop?
   c. What will be the strength of the magnetic field B at point P_1 if this loop of wire is actually a coil of wire with N = 20 turns, each turn of which has a current of I = 3.50 Amperes?





4. A segment of wire is bent into the shape shown to the left. A current of I = 10.0 Amperes is flowing through the wire from top to bottom as shown. The segment x = 4.00 cm and y = 8.00 cm.
   a. What will be the direction of the magnetic field B at point P_1?
   b. What will be the magnitude of the magnetic field B at point P_1?

Answers to opposite side: 5a. out of the paper b. 3.46×10^{-5} Tesla 6a. 9550 A/m^2 6b. down & left c. 3.00×10^{-5} Tesla d. toward the right e. 6.00×10^{-5} Tesla 6f. 2.82 Amperes g. 5.64×10^{-5} Tesla 7a. 3570 turns/m b. none, perpendicular 7c. very little, weak d. none, perpendicular e. B•l f. n•I•l g. 1.57×10^{-2} Tesla 8. -6.00×10^{-5} Tesla out of the paper

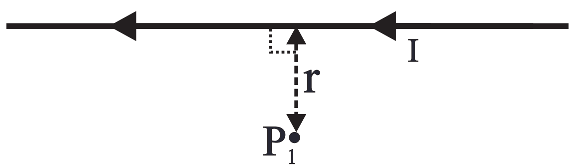
PHYSICS HOMEWORK #126 — MAGNETISM

MAGNETIC FIELD AND AMPERE'S LAW

Use Ampere's Law to solve each of the following problems! →

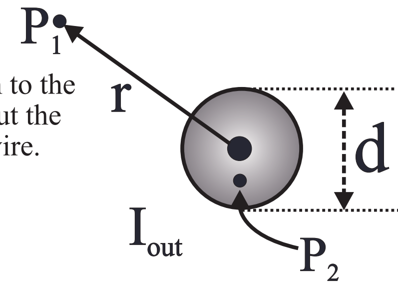
$$\oint \vec{B} \cdot d\vec{l} = \mu_o I_{enclosed}$$

5. A current of I = 3.80 Amperes is flowing through a long straight conductor as shown below. Point $\mathbf{P_1}$ is located a distance r = 2.20 cm from the wire.



a. What will be the **direction** of the magnetic field **B** at point $\mathbf{P_1}$?
b. What will be the **magnitude** of the magnetic field **B** at point $\mathbf{P_1}$?

6. Current of I = 12.0 Amperes is flowing through a wire directed out of the paper as shown to the right. The wire has a diameter of d = 4.00 cm. and current density J is uniform throughout the interior of the wire. Point P_1 is located a distance of r = 8.00 cm from the center of the wire.

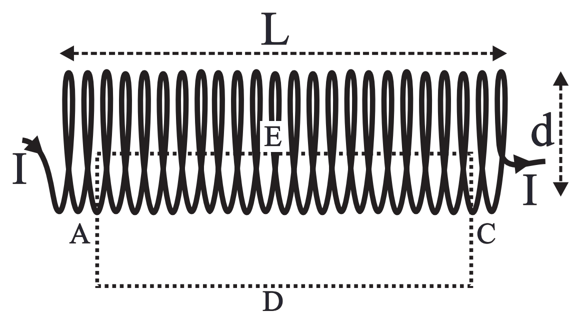


a. What is the **current density J** within this wire?
b. What will be the **direction** of the magnetic field strength $\mathbf{B_1}$ at point $\mathbf{P_1}$?
c. What will be the **magnitude** of the magnetic field strength $\mathbf{B_1}$ at point $\mathbf{P_1}$?
d. What will be the **direction** of the magnetic field $\mathbf{B_2}$ at point $\mathbf{P_2}$ within the wire?
e. What will be the **magnitude** of the magnetic field strength $\mathbf{B_2}$ at a second point $\mathbf{P_2}$ located only r = 1.00 cm from the center of the wire?

Suppose that the current density within this wire varies with distance from the center of the wire according to the relationship J = (8400 + 86,200r) Amperes/m^2.

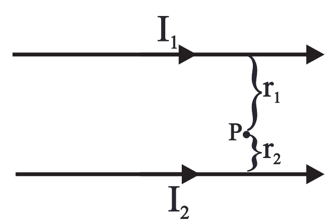
f. What will be the total current $\mathbf{I_{enclosed}}$ within the appropriate Ampere's closed path for point $\mathbf{P_2}$?
g. What will be the magnetic field strength $\mathbf{B_2}$ located at point $\mathbf{P_2}$ within this wire?

7. Consider a **solenoid** which contains N = 500 turns, has a diameter of d = 2.50 cm and is L = 14.0 cm. long. An Ampere's closed path is set up according to the diagram to the right. A current of I = 3.50 Amperes is flowing through the solenoid.



a. What is the number of turns per unit length **n** for this solenoid?
b. Based on Ampere's Law, what contribution does segment **A** of the designated Ampere's closed path contribute to the integral? Explain!
c. What contribution does segment **D** make to the integral? Explain!
d. What contribution does segment **C** make to the integral? Explain!
e. What contribution does segment **E** make to the integral? Explain!
f. What is the **total current** enclosed by the Ampere's closed path?
g. What is the magnetic field strength **B** within the solenoid?

8. Two parallel wires are carrying currents of I_1 = 6.00 Amperes and I_2 = 9.0 Amperes respectively as shown in the diagram to the right. There is a point **P** between the two wires which is r_1 = 4.00 cm from the wire carrying the current I_1 and r_2 = 2.00 cm from the wire carrying the current I_2. What will be the **direction** and **magnitude** of the magnetic field $\mathbf{B_P}$ at point **P**?



Answers to opposite side: 1a. 7.50 x 10^{-5} Tesla - out b. 5.20 x 10^{-6} Tesla - out 2a. zero b. 2.09 x 10^{-5} Tesla - out 2c. zero d. 2.09 x 10^{-5} Tesla - out 3a. in b. 3.67 x 10^{-5} Tesla c. 7.33 x 10^{-4} Tesla 4a. out b. 3.54 x 10^{-5} Tesla