

Physics 3204
Unit 2: Electromagnetism
Worksheet3: Biot Law



Biot's Law is used to calculate the **magnetic field strength** at some point in space away from a straight conductor. Note the μ is the magnetic permeability of the substance the wire is suspended in, typically air $\mu_{\text{air}} = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$

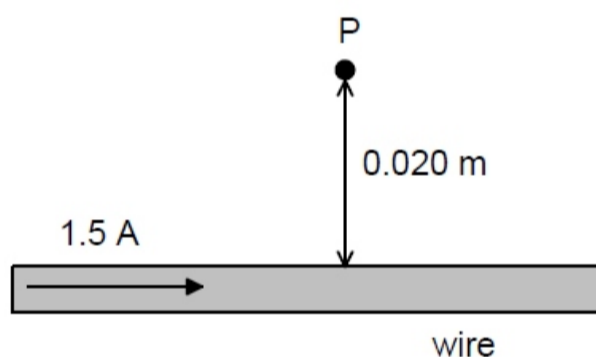
$$B = \frac{\mu I}{2\pi r}$$

PART A: Multiple Choice

1. At what distance from a wire carrying 3.5 A of current will the magnetic field strength be $9.2 \times 10^{-3} \text{ T}$?
- (A) $7.6 \times 10^{-7} \text{ m}$
(B) $1.5 \times 10^{-6} \text{ m}$
(C) $7.6 \times 10^{-5} \text{ m}$
(D) $1.5 \times 10^{-4} \text{ m}$

2. What is the magnetic field strength at point P, 0.020 m away from a wire carrying a 1.5 A current?

- (A) $2.7 \times 10^{-9} \text{ T}$
(B) $6.0 \times 10^{-9} \text{ T}$
(C) $3.0 \times 10^{-5} \text{ T}$
(D) $1.5 \times 10^{-5} \text{ T}$



3. What is the current in a straight conductor if it produces a magnetic field of $1.5 \times 10^{-5} \text{ T}$ at 0.15 m from the conductor?

- (A) 0.028 A
(B) 0.089 A
(C) 11 A
(D) 35 A

4. What is the magnetic field strength in air, 0.15 m from a straight conductor, carrying an 11 A current?

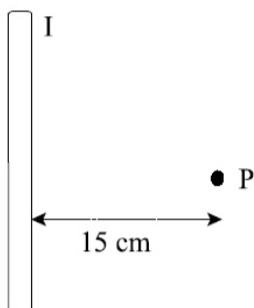
- (A) $2.7 \times 10^{-9} \text{ T}$
(B) $5.5 \times 10^{-7} \text{ T}$
(C) $1.5 \times 10^{-5} \text{ T}$
(D) $1.2 \times 10^1 \text{ T}$

5. At what distance from a power line carrying $1.0 \times 10^2 \text{ A}$ will the magnetic field be $1.3 \times 10^{-4} \text{ T}$?

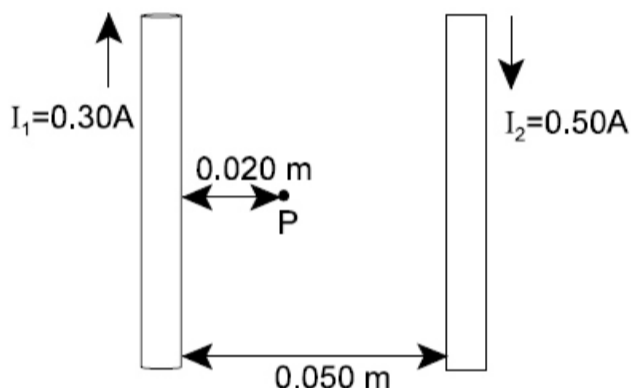
- (A) 0.15 m
(B) 0.31 m
(C) 0.39 m
(D) 0.94 m

PART B: Written Response

1. The magnetic field surrounding the current-carrying wire shown below has magnitude 2.9×10^{-5} T, and is directed into the page at point P. Calculate the magnitude and direction of the current in the wire. JUNE 2007



2. Calculate the magnitude and direction of the magnetic field strength at point P in the diagram provided. JUNE 2009



3. What is the magnetic field 2.5 cm away from a long straight conductor carrying 7.6 A of current?
4. What current is necessary to generate a magnetic field of 3.0×10^{-6} T at a distance of 1.6 cm?
5. What is the magnitude of the magnetic field midway between two wires spaced 1.6 cm apart if both wires are carrying a current of 3.5 A in opposite directions?