Answer on Question #74476, Physics / Electromagnetism

Two long, straight, parallel wires A and B, separated by a distance of 30 cm, carry currents IA = 10A and IB = 30A. The currents in both the wires flow in the same direction. Calculate the net magnetic field at the midpoint of the line joining the two wires and perpendicular to them.

Solution:

The magnitude of the magnetic field can be calculated using the formula:

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

with

B= magnetic field magnitude (Tesla, T)

$\mu_0 = 4\pi \cdot 10^{-7}\, T \cdot m/A$ = permeability of free space

I = magnitude of the electric current (Amperes, A)

r = distance (m)

The magnetic field of wires A and B at the midpoint of the line joining the two wires and perpendicular to them respectively are

$$B_A = \frac{\mu_0 I_A}{2\pi r} = \frac{4\pi \cdot 10^{-7} \cdot 10}{2\pi \cdot 0.15} = 1.33 \cdot 10^{-5} T,$$

$$B_B = \frac{\mu_0 I_B}{2\pi r} = \frac{4\pi \cdot 10^{-7} \cdot 30}{2\pi \cdot 0.15} = 4 \cdot 10^{-5} T.$$

Since the magnetic fields of wires A and B are oppositely directed, the net magnetic field is

$$B = B_B - B_A = 4 \cdot 10^{-5} T - 1.33 \cdot 10^{-5} T = 2.67 \cdot 10^{-5} T.$$

Answer: $B = 2.67 \cdot 10^{-5} T$