5.12 Two infinitely long, parallel wires are carrying 6-A currents in opposite directions. Determine the magnetic flux density at point $P$ in Fig. P5.12.

![Figure P5.12](image-url) Arrangement for Problem 5.12.
Two parallel, circular loops carrying a current of 40 A each are arranged as shown in Fig. P5.14. The first loop is situated in the \( x \)-\( y \) plane with its center at the origin, and the second loop’s center is at \( z = 2 \) m. If the two loops have the same radius \( a = 3 \) m, determine the magnetic field at:

(a) \( z = 0 \)

(b) \( z = 1 \) m

(c) \( z = 2 \) m

Figure P5.14 Parallel circular loops of Problem 5.14.
A cylindrical conductor whose axis is coincident with the $z$-axis has an internal magnetic field given by

$$H = \frac{\Phi}{r} \frac{2}{r} \left[ 1 - (4r + 1)e^{-4r} \right] \quad (\text{A/m}) \quad \text{for } r \leq a$$

where $a$ is the conductor’s radius. If $a = 5$ cm, what is the total current flowing in the conductor?
5.32  The $x$–$y$ plane separates two magnetic media with magnetic permeabilities $\mu_1$ and $\mu_2$ (Fig. P5.32). If there is no surface current at the interface and the magnetic field in medium 1 is

$$H_1 = \hat{x}H_{1x} + \hat{y}H_{1y} + \hat{z}H_{1z}$$

find:

(a) $H_2$

(b) $\theta_1$ and $\theta_2$

(c) Evaluate $H_2$, $\theta_1$, and $\theta_2$ for $H_{1x} = 2$ (A/m), $H_{1y} = 0$, $H_{1z} = 4$ (A/m), $\mu_1 = \mu_0$, and $\mu_2 = 4\mu_0$

**Figure P5.32** Adjacent magnetic media (Problem 5.32).
5.40 The rectangular loop shown in Fig. P5.40 is coplanar with the long, straight wire carrying the current $I = 20\, \text{A}$. Determine the magnetic flux through the loop.

**Figure P5.40** Loop and wire arrangement for Problem 5.40.