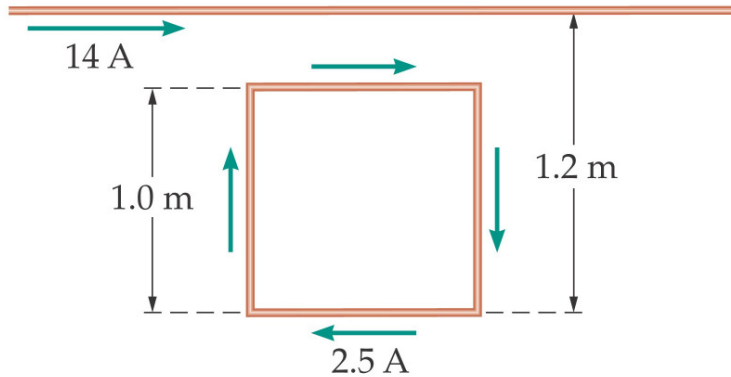


Answer on Question #43866-Physics-Electromagnetism

A long wire carries a current of 14 ampere. Next to the wire is a square loop with sides 1.0m in length. The loop carries a current of 2.5 ampere in direction indicated, a) what is the direction of the net force exerted on the loop? explain, b) calculate the magnitude of the net force acting on the loop.

Solution



a) The current-carrying wire generates a magnetic field that is directed into the page, perpendicular to all four sides of the square loop. The force on each side of the loop is directed away from the center of the loop, perpendicular to each side, and in the plane of the loop. Because the force is stronger closer to the wire, the net force is towards the wire.

b) Due to symmetry, the forces due to the sides of the loop cancel.

$$\begin{aligned} F_{net} &= ILB_{close} - ILB_{far} = IL \left(\frac{\mu_0 I'}{2\pi r_{close}} - \frac{\mu_0 I'}{2\pi r_{far}} \right) = \frac{\mu_0 L I I'}{2\pi} \left(\frac{1}{r_{close}} - \frac{1}{r_{far}} \right) \\ &= \frac{\left(4\pi \cdot 10^{-7} \frac{\text{Tm}}{\text{A}} \right) (1.0 \text{ m})(2.5 \text{ A})(14 \text{ A})}{2\pi} \left(\frac{1}{0.2 \text{ m}} - \frac{1}{1.2 \text{ m}} \right) = 3 \cdot 10^{-5} \text{ N}. \end{aligned}$$

Answer: a) towards the wire; b) $3 \cdot 10^{-5} \text{ N}$.