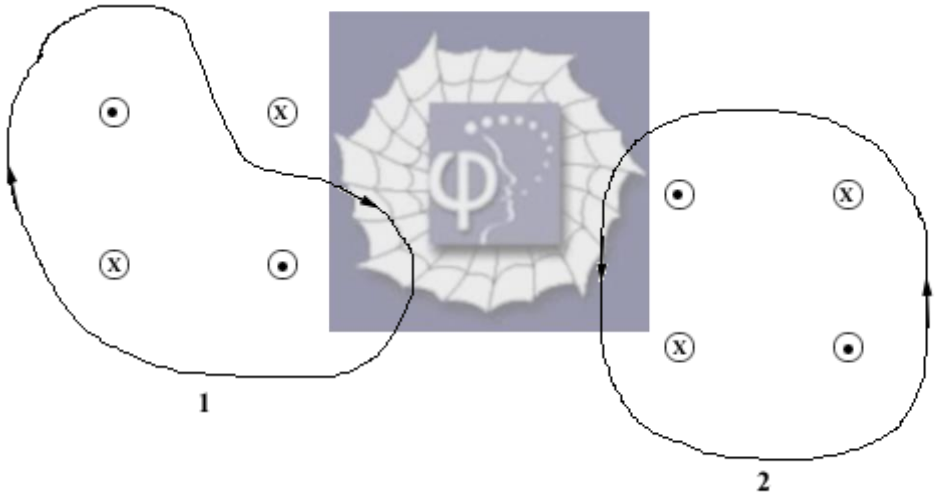
472.

Problem 35.39 (RHK)

In the figure shown each of the indicated eight conductors carries 2.0 A *of current into or out of the page. Two paths are indicated for the line integral* $\int \vec{B}.d\vec{s}$. *We have to find the value of the integral for path* 1 *and for the path* 2.



Solution:

We will use the Ampere's law for answering this problem. The Ampere's law states that for an Amperian loop

$$\int \vec{B}.d\vec{s} = \mu_0 \times \begin{pmatrix} \text{sum of the currents enclosed by the Amperian} \\ \text{loop, added with appropriate signs.} \end{pmatrix}.$$

A right-hand rule is used to assign signs to currents: with

the fingers of the right-hand in the direction in which the loop is travelled, currents in the direction of the thumb are taken as positive, while the currents in the opposite direction are taken as negative.

(a)

As the loop 1 is traversed in the clockwise direction and three currents are enclosed; one with positive sign and two with negative signs, we have

$$\oint_1 \vec{B}.d\vec{s} = \mu_0 (2-2-2) \text{ T m} = -2\times 4\pi \times 10^{-7} \text{T m}$$

$$= -2.5\ \mu\text{T m}.$$

(b)

As the loop 2 is traversed in the counter-clockwise direction and all the four currents are enclosed; two with positive signs and two with negative signs, we have

$$\oint_1 \vec{B}.d\vec{s} = 0.$$