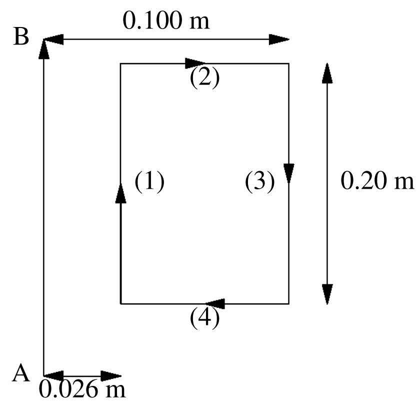
Problem 2: (30 pts.) The long, straight wire AB shown in the figure carries a current of 14.0 A. The rectangular loop whose long edges are parallel to the wire carries a current of 5.00 A.



a. (10 pts.) Find the magnitude and direction of the force on segment (1) of the loop.

b. (10 pts.) Find the magnitude and direction of the force on segment (2) of the loop.

c. (5 pts.) Find the magnitude and direction of the force on segment (3) of the loop. You may simply re-use earlier parts of this problem, if appropriate.

d. (5 pts.) Find the magnitude and direction of the force on segment (4) of the loop. You may simply re-use earlier parts of this problem, if appropriate.

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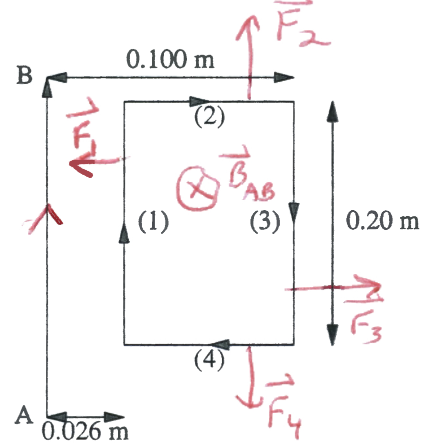

14.0A

$L_1 = 0.20\text{m} = L_3$

$L_2 = L_4 = 0.100\text{m} - 0.026\text{m}$

$\vec{B}_{AB}$ due to current AB is into the page at the loop.

$I_{AB} = 14.0\text{A}$

$I_{loop} = 5.00\text{A}$

a. (10 pts.) Find the magnitude and direction of the force on segment (1) of the loop.

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d. (5 pts.) Find the magnitude and direction of the force on segment (4) of the loop. You may simply re-use earlier parts of this problem, if appropriate.

a) $\vec{F}_1 = I_{loop} B_{AB} L_1 (-\hat{\imath}) = (5.00)\left(\frac{\mu_0 I_{AB}}{2\pi(0.026)}\right)(0.20)(-\hat{\imath}) = \boxed{-1.077\times10^{-4}\ \text{N}\hat{\imath}}$

b) $\vec{F}_2 = \int_{0.026}^{0.100} I_{loop}(\hat{\imath}\,dx)\frac{\mu_0 I_{AB}}{2\pi x}\times(-\hat{k}) = \frac{\mu_0 I_{AB} I_{loop}}{2\pi}\ln\left(\frac{0.100}{0.026}\right)\hat{\jmath} = \boxed{1.886\times10^{-5}\ \text{N}\ \hat{\jmath}}$

c) $\vec{F}_3 = I_{loop} B_{AB} L_3 \hat{\imath} = (5.00)\frac{\mu_0 I_{AB}}{2\pi(0.100)}(0.20)\hat{\imath} = \boxed{2.80\times10^{-5}\ \text{N}\hat{\imath}}$

d) Same as $\vec{F}_2$, except down $\boxed{\vec{F}_4 = -1.886\times10^{-5}\ \text{N}\hat{\jmath}}$