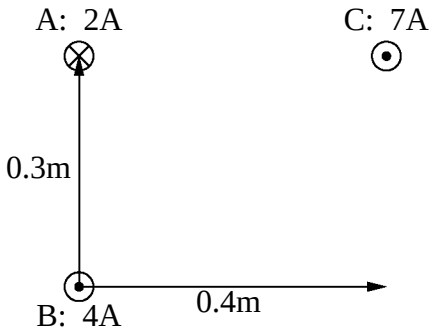
2. (20 pts.) Three long parallel wires are arranged as shown. Wire A has a current of 2A headed into the page, wire B has a current of 4A headed out of the page, and wire C has a current of 7A headed out of the page, as shown. Find the magnitude and direction of the net magnetic force per unit length on wire C.



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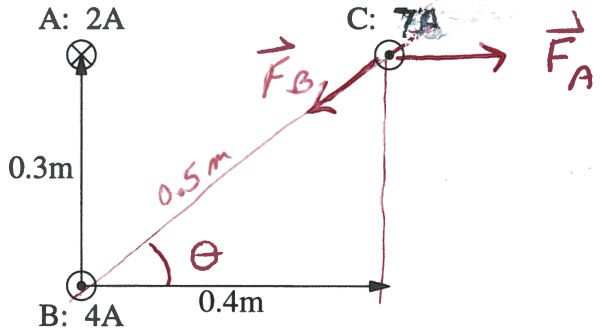

$\tan\theta = \frac{.3}{.4}$

$\theta = 36.9°$

$|\vec{F}_A| = \frac{\mu_0 I_A I_C}{2\pi r_{AC}}$ @ $0°$, $I_A = 2$, $I_C = 7$, $r_{AC} = 0.4$,

$\vec{F}_B = \frac{\mu_0 I_B I_C}{2\pi r_{BC}}$ @ $(180° + 36.9° = 216.9°)$.

$I_B = 4A$, $I_C = 7A$, $r_{BC} = 0.5$

$\vec{F}_{TOT} = \vec{F}_A + \vec{F}_B$

x - components

$F_{TOT,x} = F_{Ax} + F_{Bx} = \frac{\mu_0 I_A I_C}{2\pi r_{AC}} + \frac{\mu_0 I_B I_C}{2\pi r_{BC}} \cos 216.9$

$= \frac{\mu_0}{2\pi} I_C \left[\frac{I_A}{r_{AC}} + \frac{I_C}{r_{BC}} \cos 216.9 \right]$

$= \frac{(4\pi \times 10^{-7})(7)}{2\pi} \left[\frac{2}{.4} + \frac{4}{.5} \cos 216.9 \right] = -1.96 \times 10^{-6}$ N

$F_{TOT,y} = F_{Ay} + F_{By} = 0 + \frac{\mu_0 I_B I_C}{2\pi r_{BC}} \sin 216.9 = \frac{(4\pi \times 10^{-7})(4)(7)}{2\pi(.5)} (-0.6)$

$= -6.72 \times 10^{-6}$ N

$F_{TOT} = 7.0 \times 10^{-6}$ N @ $-106°$