Physics 172
Winter Quarter 1988
March 4, 1988
George Williams

N = 253
Ave. = 15.48/25.00

2

FOURTH EXAM

Name (print) MING ZHAO Name (signed) Solution

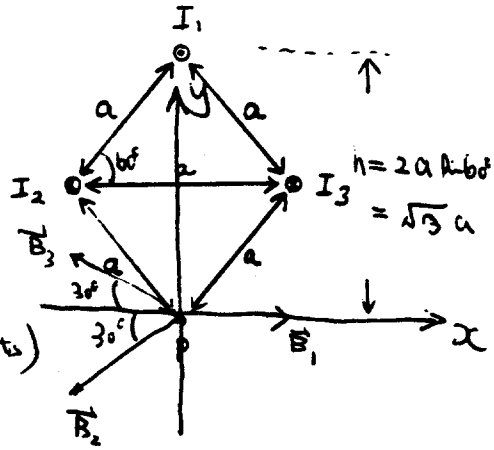
Discussion Instructor (circle one): Cady McAllister Molina Stone

Discussion Section #:_____

SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

The drawing shows the cross section of three very long straight wires. They are arranged in the form of an equilateral triangle of sides a. + means a current out of the paper and - is a current into the paper. Calculate the magnetic field, both magnitude and direction at point P. Show on a clear drawing how you define any angle used to indicate the direction of the field.

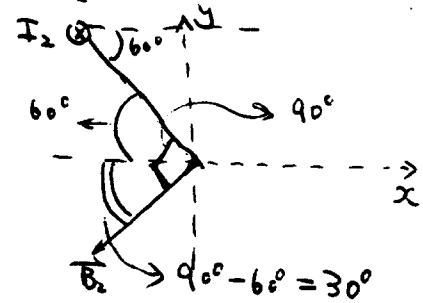
I_1 = + 5.00 A
I_2 = - 3.25 A
I_3 = - 2.75 A
a = 1.25 cm



$B_i = \frac{\mu_0 I_i}{2\pi r_i}$ —(2 points)

Angle: (2-point each) 2×2 = 4 points

e.g.: $\vec{B}_2$



3-point $\begin{cases} B_1^x = \frac{\mu_0 I_1}{2\pi h} = \frac{\mu_0 I_1}{2\pi\sqrt{3}a} \\ B_1^y = 0 \end{cases}$

3-point $\begin{cases} B_2^x = -\frac{\mu_0 I_2}{2\pi a}\cos 30^\circ = -\frac{\mu_0 I_2}{4\pi a} \\ B_2^y = -\frac{\mu_0 I_2}{2\pi a}\sin 30^\circ = -\frac{\mu_0 I_2}{4\pi a} \end{cases}$

3-point $\begin{cases} B_3^x = -\frac{\mu_0 I_3}{2\pi a}\cos 30^\circ = -\frac{\mu_0 I_3\sqrt{3}}{4\pi a} \\ B_3^y = \frac{\mu_0 I_3}{2\pi a}\sin 30^\circ = \frac{\mu_0 I_3}{4\pi a} \end{cases}$

(no sin or cos: -1 each.)

6-point (2×3.)

$B_x = B_1^x + B_2^x + B_3^x = \frac{\mu_0}{2\pi a}\left\{\frac{I_1}{\sqrt{3}} - \frac{\sqrt{3}}{2}I_2 - \frac{\sqrt{3}}{2}I_3\right\}$
$= -3.70 \times 10^{-5}$ (T)

$B_y = B_1^y + B_2^y + B_3^y = \frac{\mu_0}{4\pi a}(I_3 - I_2) = -0.4 \times 10^{-5}$ (T)

magnitude: $B = \sqrt{B_x^2 + B_y^2} = 3.72 \times 10^{-5}$ (T)

4-point ⇐ direction: $\theta = \tan^{-1}\frac{B_y}{B_x} = \tan^{-1}\frac{0.4}{3.70} = 6.17^\circ$

or: 186.17° = θ

18