PHYS 350 E&M
Exam 5

March 29, 2017

Name J. CLAY

1. The rectangular loop carring a current, I_1, is close to a long straignt wire carring a current I_2 as shown in Figure 1. Find the force on the loop.

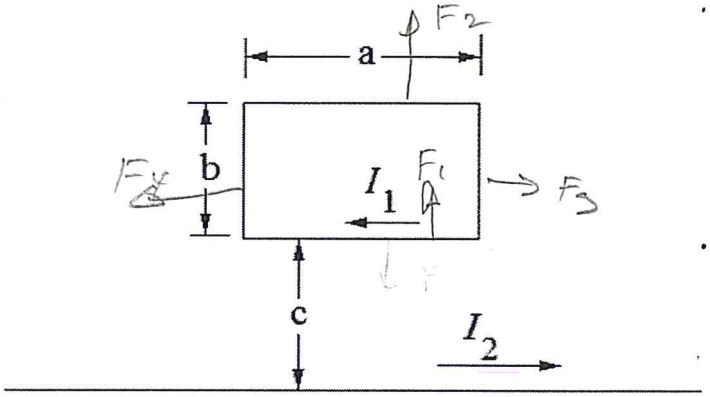

Figure 1

$\vec{B} = \frac{\mu_0 I_2}{2\pi r}(-\hat{\theta})$ OUT of PAGE

GRADES

100, 100

$\vec{F} = F_1 + F_2$

$F_3 + F_4$ on the sides cancel

92

$F = ILB$

84

$\vec{F}_1 = \frac{\mu_0 I_1 I_2 a}{2\pi c}\hat{r}$

82

$\vec{F}_2 = -\frac{\mu_0 I_1 I_2 a}{2\pi (c+b)}\hat{r}$

55

$\vec{F} = \frac{\mu_0 I_1 I_2 a}{2\pi}\left[\frac{1}{c} - \frac{1}{(c+b)}\right]\hat{r}$ up away from I_2

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2. A current, *I*, flows along a long straight horizontal wire, then around a circular arc, and then up a long straight wire. Find the magnetic field at center of curvature of the circular arc, point P, in Figure 2.

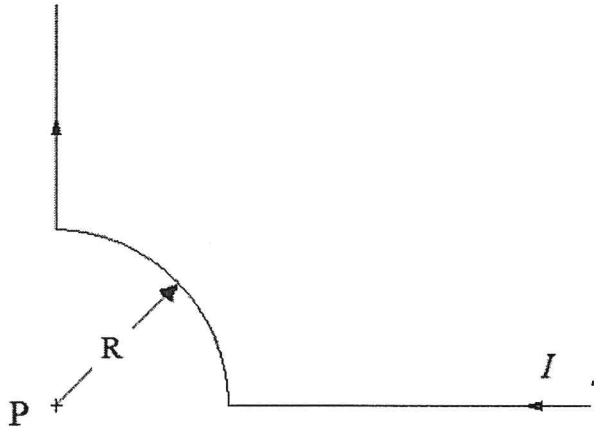

Figure 2

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\hat{r}}{r^2}$$

The B field produced by the straight section is zero at P since $I\,d\vec{l}\times\hat{r} = 0$

The circular arc produces a magnetic field at P.

$$dB = \frac{\mu_0}{4\pi}\frac{I\,dl}{R^2}$$

$$dl = R\,d\theta$$

$$B = \int dB = \frac{\mu_0 I}{4\pi R}\int_0^{\pi/2} d\theta$$

$$\vec{B} = \frac{\mu_0 I}{8R}\hat{n}$$ out of page

By RHR

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3. A current, *I*, flows in the inner conductor and out the outer conductor of the coaxial cable shown in Figure 3. Find the magnetic field in the region between the conductors ($a < r < b$).

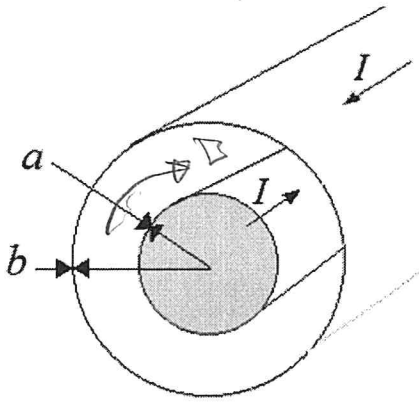

Figure 3

$$\oint B \cdot dl = \mu_0 I_{enc}$$

$$\oint B \cdot dl = 2\pi r B_\theta$$

For $a < r < b$

$$I_{enc} = I$$

$$\vec{B} = \frac{\mu_0 I}{2\pi r}\hat{\theta}$$