KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

EE340-Lab [151] sec **#52**	**Lab Quiz: #2**	**9 Nov 2015**
Name: ***SOLUTION***	**ID:**	**Grade**:

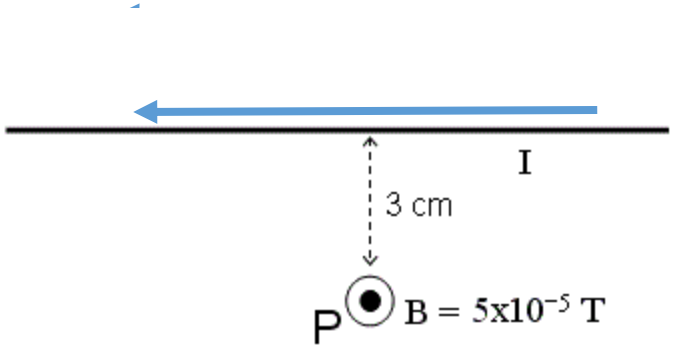
Problem 1).

a) A long conductor wire is placed on the y-axis as shown in the picture below. The magnetic field B at point P (3 cm below the wire) is measured to be $5 \times 10^{-5}\ T$ and points out of the page. Determine:

1. The magnitude and direction of the current I in the wire?

$$|\bar{B}| = \frac{\mu_0 I}{2\pi r} \Rightarrow I = \frac{|\bar{B}|2\pi r}{\mu_0}$$
$$= \frac{5 \times 10^{-5}(2\pi)(3 \times 10^{-2})}{4\pi \times 10^{-7}} = 7.5\ A$$

Direction: by right hand rule (left)

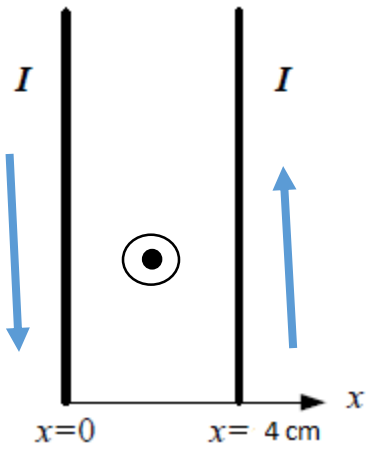


b) Two long parallel wires, carrying the same magnitude of current I, are 4 cm apart as shown in the picture below. The magnetic field B at $x = 2\ cm$ measured to be $4 \times 10^{-5}\ T$ and points out of the page. Determine:

1. The Magnitude of the current I,
2. Plot the direction of the currents on the plot

$$|\bar{B}| = \frac{\mu_0 I}{2\pi x} - \frac{\mu_0 I}{2\pi(x-a)} = \frac{2\mu_0 I}{2\pi(2cm)} = \frac{\mu_0 I}{\pi(2cm)}$$
$$I = \frac{|\bar{B}|\pi(2cm)}{\mu_0} = \frac{4 \times 10^{-5}(\pi)(2 \times 10^{-2})}{4\pi \times 10^{-7}} = 2\ A$$

Opposite direction, right hand rule.



Problem 2).

a) A wire carrying current is bent in the form of a circular loop of diameter$12\ cm$, the number of turns is 2 and the measured magnetic field at the center when the directions of the current clockwise and counterclockwise was: $0.03\ mT\ , -0.07 mT$ respectfily.
Calculate the magnitude of the current in the circular loop.

$$|\overline{B}(0)| = \frac{|B^+|+|B^-|}{2}\ "avarege" = \frac{0.03+0.07}{2} = 0.05 mT$$

$$|\overline{B}(0)| = \frac{\mu_0 NI}{2b} \quad \Rightarrow \quad I = \frac{|\overline{B}(0)|2b}{\mu_0 N} = \frac{(0.05\times 10^{-3})(2*6\times 10^{-2})}{4\pi\times 10^{-7}(2)} = 2.39\ A$$

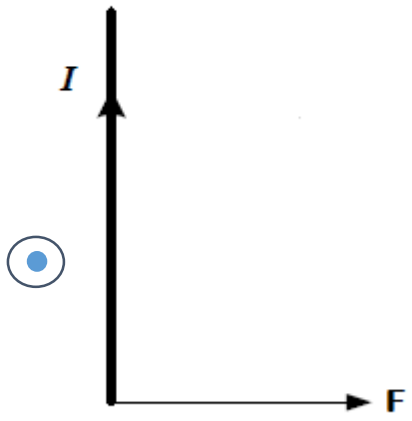
b) A uniformly wound coil having $160\ mm$ lenghth and diameter of $40\ mm$. If the current passing through the coil was $1.5\ A$ and the magnetic field measured at $z = 0.002\ mm$ was $1.4137\ mT$. Calculate the number of turns.

$$z = 0.002\ mm \ll L = 160\ mm \implies |\overline{B}(z)| \cong \frac{\mu_0 NI}{L}$$

$$N = \frac{|\overline{B}(z)|L}{\mu_0 I} = \frac{(1.4137\times 10^{-3})(16\times 10^{-3})}{4\pi\times 10^{-7}(1.5)} = 119.999 = 120$$

Problem 3)

a) A straight conductor of length $50\ mm$ and carrying a current of $4\ A$ is placed in region of uniform magnetic field. The magnetic force on the conductor was $50\ mN$ with a direction given in picture below.



1. Calculate the magnitude of magnetic field.

$$F = IBL \quad \Rightarrow \quad B = \frac{F}{IL} = \frac{50 \times 10^{-3}}{4(50 \times 10^{-3})} = 0.25\ T$$

2. Specify the direction of the magnetic field on the figure.

Right hand rule:

$a_F = a_I \times a_B$ the magnetic field point out of the page

Formula Sheet

$$\varepsilon_0 = 8.85 \times 10^{-12}\ F/m$$
$$\mu_0 = 4\pi \times 10^{-7}\ H/m$$

$$|\overline{B}| = \frac{\mu_0 I}{2\pi r}$$
$$|\overline{B}| = \frac{\mu_0 I}{2\pi x} + \frac{\mu_0 I}{2\pi (x-a)}$$
$$|\overline{B}| = \frac{\mu_0 I}{2\pi x} - \frac{\mu_0 I}{2\pi (x-a)}$$

$$|\overline{B}| = \frac{\mu_0 I b^2}{2(z^2+b^2)^{3/2}}$$
$$|\overline{B}(0)| = \frac{\mu_0 N I}{2b}$$
$$|\overline{B}(z)| = \frac{\mu_0 N I}{2L}\left(\frac{a}{\sqrt{b^2+a^2}} - \frac{c}{\sqrt{b^2+c^2}}\right)$$
$$a = z + \frac{L}{2} \quad ; \quad c = z - \frac{L}{2}$$
$$|\overline{B}(z)| \cong \frac{\mu_0 N I}{L}$$

$$F = IBL$$
$$a_F = a_I \times a_B$$