Units?
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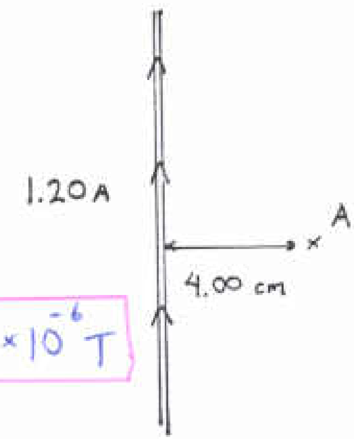
Name________________

Phys 2020, Section 2
Quiz #3 — Spring 2002

**1.** A very long straight wire in the plane of the page carries a current of 1.20 A in the direction shown.




**a)** Find the magnitude of the magnetic field at point A (located 4.00 cm from the wire.

At a distance of 4.00 cm, the magnetic field has magnitude

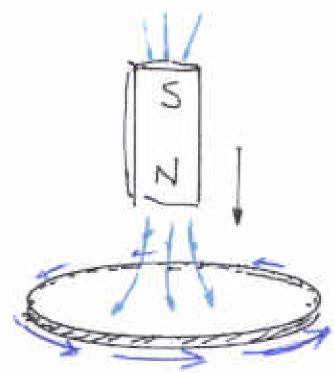
$$B = \frac{\mu_0 I}{2\pi r} = \frac{(\cancel{4}^{2}\pi \times 10^{-7} \frac{T\cdot m}{A})(1.20\ A)}{\cancel{2}\pi\ (4.00\times10^{-2}\ m)} = \boxed{6.00\times10^{-6}\ T}$$

**b)** What is the direction of the magnetic field at point A?

Using RHR-2, , field goes $\boxed{\text{into the page}}$ at point A

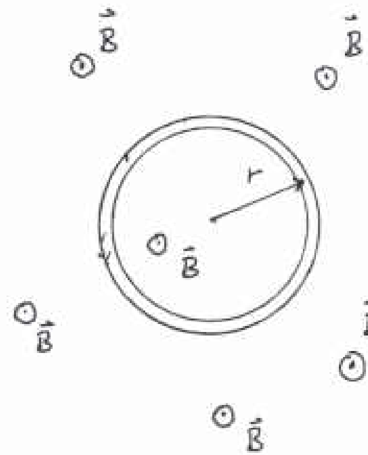
**2.** A magnet has its North pole pointing toward the middle of a circular loop of wire as shown at the right. The magnet is moved *toward* the loop, generating a current in the loop.

Use Lenz's Law to find the direction of the current induced in the loop. Show its direction *clearly* on the diagram and explain in words how you used Lenz's Law to arrive at your answer.




The magnet gives a flux going downward and it is increasing. To oppose this change the induced current in the loop must produce a flux directed upward. From RHR-2 we see that if the induced current goes in the direction shown it will produce the needed flux.

**3.** A circular loop of radius 6.50 cm has a resistance of $2.00\,\Omega$. The loop is in the plane of the page and a uniform magnetic field of magnitude 0.300 T is directed out of the page. The magnetic field decreases to zero in a time of 0.350 s.




Initially, $B = 0.300\,\text{T}$

a) What is the area of the loop?

$$A = \pi r^2 = \pi \left(6.50\times10^{-2}\,\text{m}\right)^2$$
$$= \boxed{1.33\times10^{-2}\,\text{m}^2}$$

b) What is (magnitude of) the change in magnetic flux in the loop?

Magnitude of the initial flux is

$$\Phi = BA\cos\phi = (0.300\,\text{T})(1.33\times10^{-2}\,\text{m}^2)(1)$$
$$= \boxed{3.98\times10^{-3}\,\underbrace{\text{T}\cdot\text{m}^2}_{=\text{weber!}}}$$

This is the same as the mag. of $\Delta\Phi$ because the final flux is zero.

c) What is the (average) induced emf in the loop?

(magnitude of $\mathcal{E}$):

$$\mathcal{E} = N\frac{\Delta\Phi}{\Delta t} = (1)\frac{(3.98\times10^{-3}\,\text{weber})}{(0.350\,\text{s})} = \boxed{1.14\times10^{-2}\,\text{V}}$$

d) What is the (average) induced current in the loop?

Using Ohm's law for loop,

$$I = \frac{\mathcal{E}}{R} = \frac{(1.14\times10^{-2}\,\text{V})}{(2.00\,\Omega)} = \boxed{5.7\times10^{-3}\,\text{A}}$$

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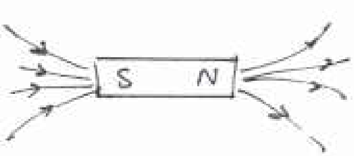
**You must show all your work and include the right units with your answers!**

$$V = IR \qquad \mu_0 = 4\pi\times10^{-7}\,\frac{\text{T}\cdot\text{m}}{\text{A}} \qquad B_{\text{wire}} = \frac{\mu_0 I}{2\pi r} \qquad B_{\text{sol}} = \mu_0 n I$$

$$\mathcal{E} = vBL \qquad \Phi = BA\cos\phi \qquad \mathcal{E} = -N\frac{\Delta\Phi}{\Delta t} \qquad \mathcal{E} = -L\frac{\Delta I}{\Delta t}$$




$$\lambda f = c \qquad \overline{S}_{\text{pol}} = \tfrac{1}{2}\overline{S}_{\text{unpol}} \qquad \overline{S} = \overline{S}_0\cos^2\theta$$