Name: ________________________

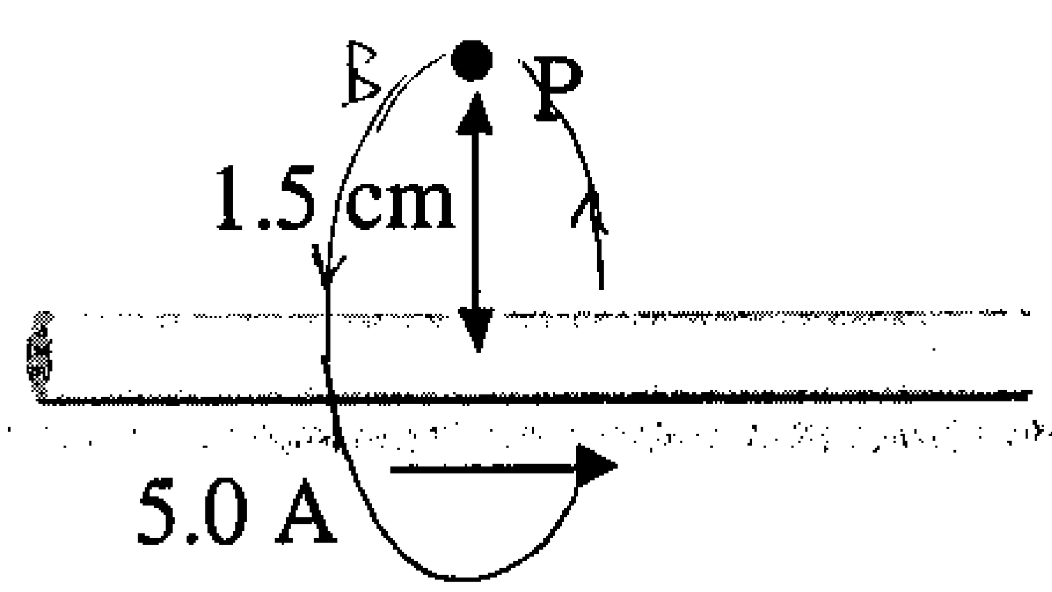
## Physics 2020 – Fall 2001

## Quiz #2

$e = 1.602 \times 10^{-19}\,C \qquad \mu_0 = 4\pi \times 10^{-7}\,T\,m / A$

*You must show your working and/or explain your answers to receive full credit.*

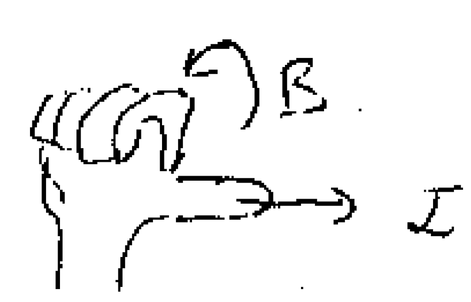
1. A long straight horizontal wire carries a current I = 5.0 A from left to right, as shown.



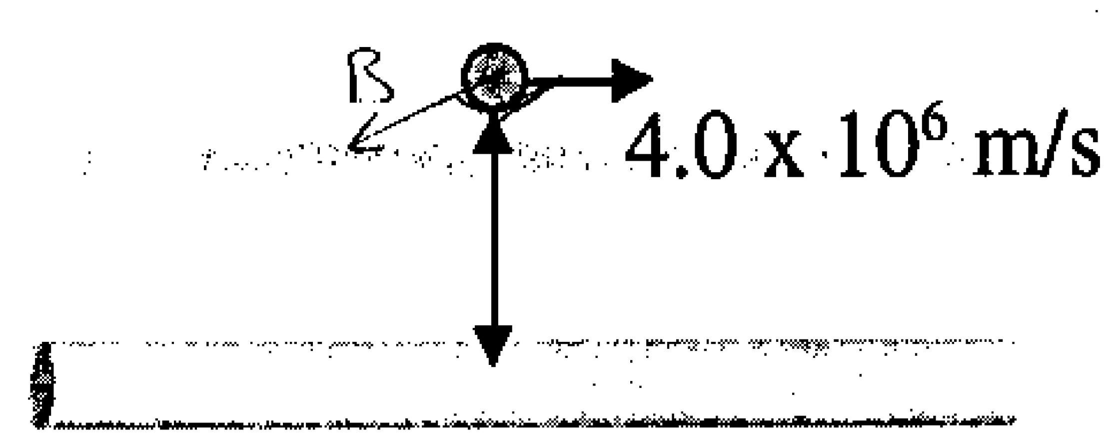

4. What is the magnitude and direction of the magnetic field at point P, a vertical distance z = 1.5 cm directly above the axis of the wire? (5 points)

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7}\,Tm/A) \times (5.0A)}{2\pi \times (0.015m)} = \underline{\underline{6.67 \times 10^{-5}\,T}}$$

Direction from RHR #2 is <u>out</u> of the paper at point P



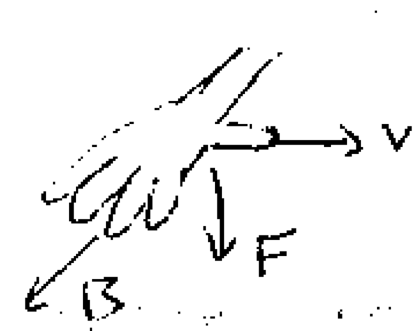

b) An proton moves through point P traveling at a speed of 4.0 x $10^6$ m/s in a direction parallel to that of the current in the wire. (That is, it is moving horizontally from left to right a distance 1.5 cm above the wire.) What is the magnitude and direction of the magnetic force on the electron? (6 points)




$F = qvB\sin\theta$, here $\theta = 90°$ so $\sin\theta = 1$

$$F = (1.602 \times 10^{-19}\,C) \times (4.0 \times 10^{6}\,m/s) \times (6.67 \times 10^{-5}\,T) = \underline{\underline{4.27 \times 10^{-17}\,N}}$$

Direction from RHR #1 is toward wire at P

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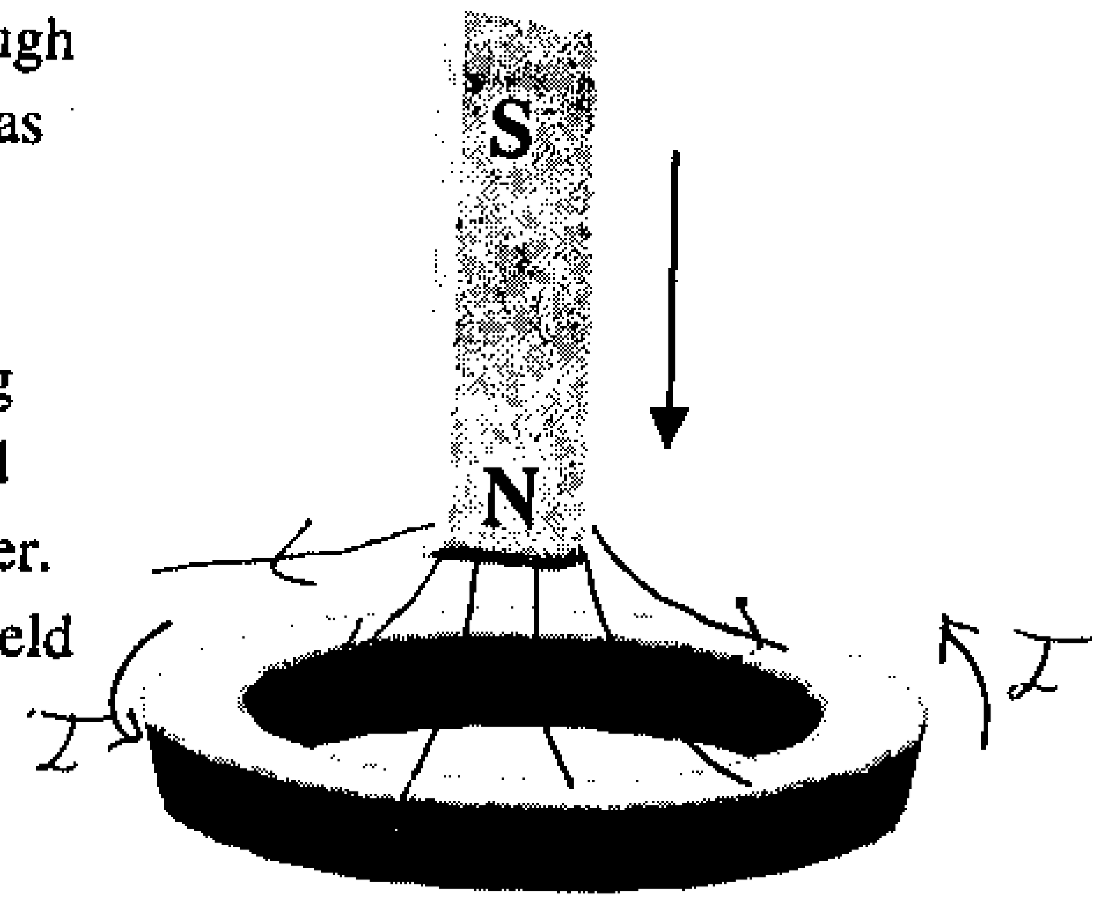
Useful equations:

$F = qvB\sin\theta \qquad F = ILB\sin\theta \qquad B = \frac{\mu_o I}{2\pi r} \qquad B = N\frac{\mu_o I}{2R} \qquad B = \mu_0 nI$

$\varepsilon = vBL \qquad \varepsilon = -N\frac{\Delta\Phi}{\Delta t}$

Name: ______________________

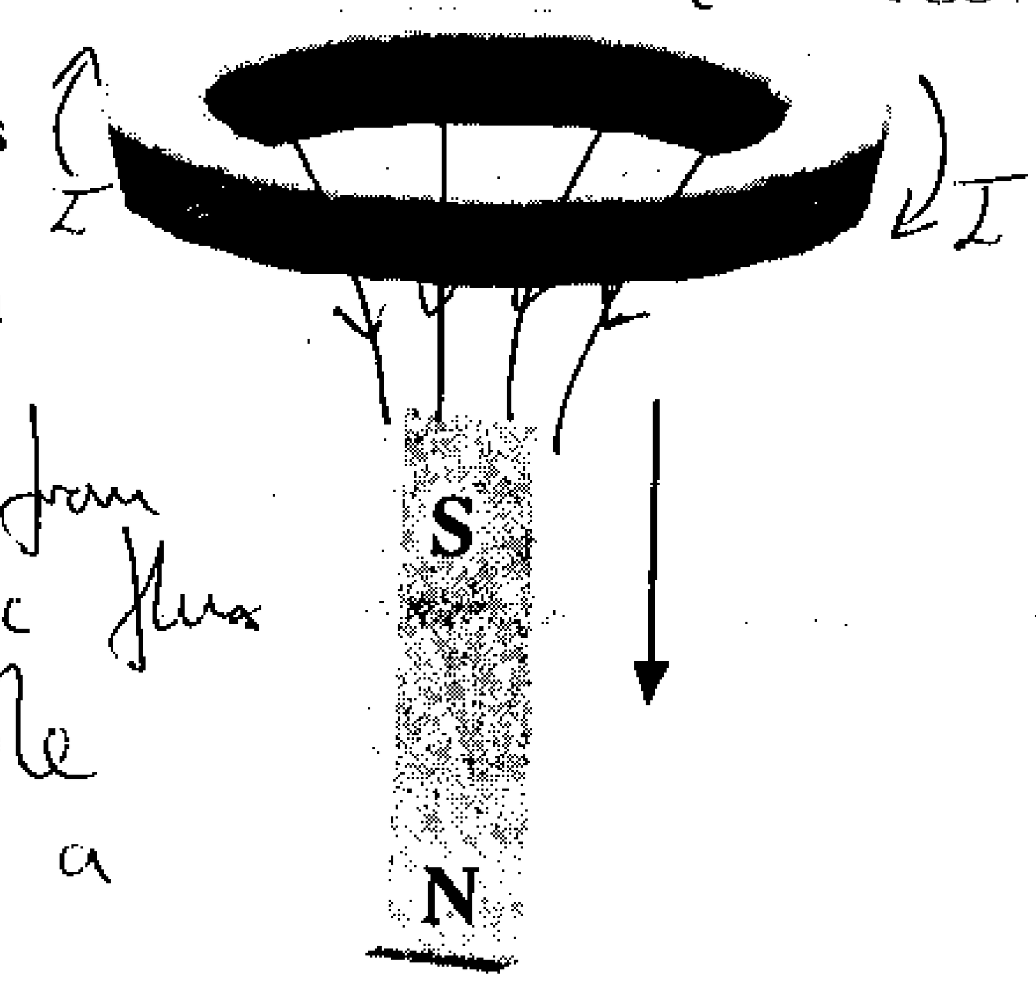
2. A permanent magnet is dropped vertically through a stationary metal ring (North pole downward) as shown.




a) As the N pole of the magnet approaches the ring from above, in which direction does the induced current flow round the ring? Explain your answer. (Hint: it might be useful to draw the magnetic field lines around the magnet, and figure out what changes as the magnet approaches the ring.) (3 pts.)

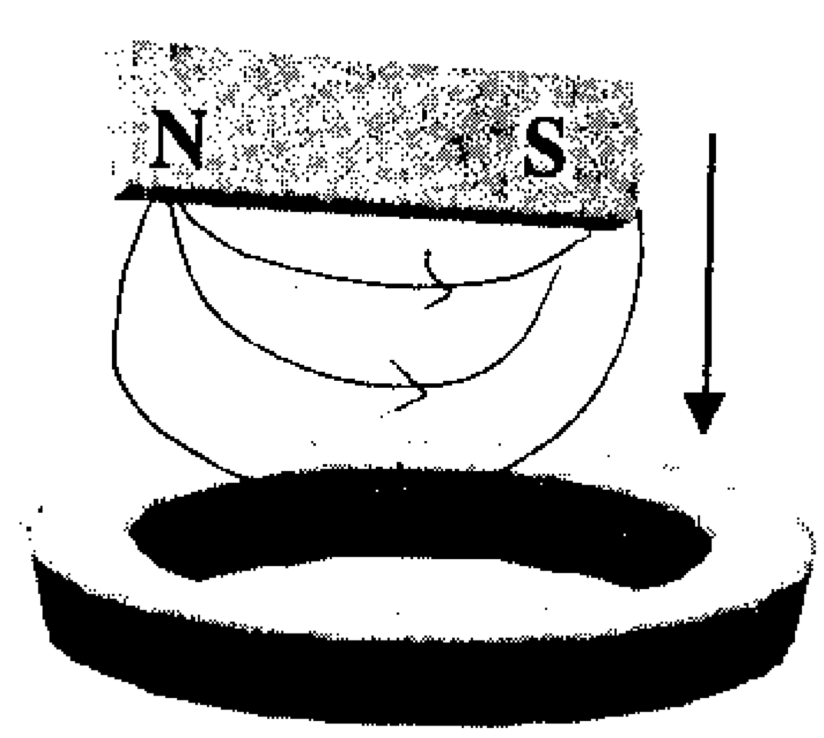
As magnet approaches ring the number of B-field lines going through the ring increase. Since the N pole is downward these lines represent an increasing downward magnetic flux.
The induced current will flow round the ring in such a way as to oppose this downward increase – that is to produce an upward flux. (Lenz's Law)
To do this it must flow counter-clockwise (as seen from above)

b) The magnet passes through the ring and continues to fall, as shown. In which direction does the induced current flow round the ring now? Explain your answer. (3 pts)




As the S pole falls away from the ring the downward magnetic flux through the ring decreases. The induced current will flow in a direction to try and maintain the downward flux, so it will flow clockwise (as seen from above)

c) If you repeated the experiment, but dropped the magnet in a horizontal orientation, how would your answers to a) and b) change and why? (3 pts)




As the magnet falls the magnetic flux through the ring remains zero (each line that goes down also comes back up)
So there are no induced currents.