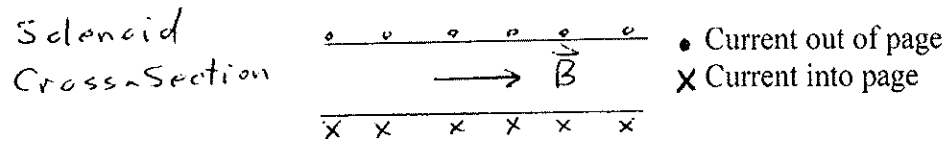


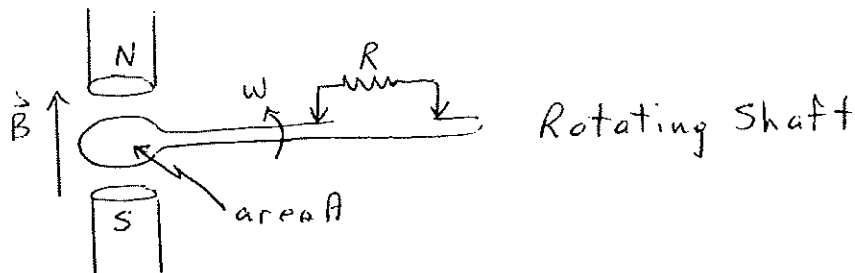
Assignment 9

1. A proton travels around a loop of radius R with a speed of 10% of the speed of light. The proton motion is circular due to a magnetic field of 100 Gauss.
 - a) What is the radius of the proton path?
 - b) What is the kinetic energy of the proton?

2. A solenoid consists of a hollow tube of length 5 meters around which 1000 turns of wire are wrapped as shown below. A current I flowing in the wire generates a magnetic field whose direction is given by the right hand rule. (Point fingers of right hand in direction of current and right hand thumb points along magnetic field.) It can be shown the magnetic field in a long narrow tube is uniform and given by $B(\text{tesla}) = 1.26 \times 10^{-6} N I(\text{amp})$ where N is number of wire loops/meter. Assuming solenoid is aligned along the Earth's magnetic field, how much current is needed to cancel the Earth's field?



3. Electricity is generated by having a circular loop of wire enclosing area A spin through a uniform magnetic field B at an angular frequency ω as shown below.



The magnetic flux going through the loop is given by $\Phi(t) = B A \cos \omega t$. The voltage across the resistor is then found to be $V = - d\Phi / dt$.

- a) Evaluate the voltage if $B = 1$ tesla, $A = 1 \text{ m}^2$ and $\omega = 377 \text{ rad/sec}$.
 - b) How is the answer in a affected if there are 5 loops of wire?
4. Consider a current and voltage across a resistor are given by $I(t) = I_0 \cos(\omega t + \phi)$ and $V(t) = V_0 \cos(\omega t)$.
 - a) Sketch the current and voltage.
 - b) Find the time averaged power dissipated.

5. Consider an object of height 1 cm in front of a convex lens having a focal length of 5 cm. Describe the image size, type and position if the object is at the following positions from the lens.
 - a) 20 cm
 - b) 10 cm
 - c) 5 cm
 - d) 2 cm

6. What are the approximate wavelengths and frequencies of the following photons.
 - a) Red light
 - b) Yellow light
 - c) Blue light
 - d) X ray
 - e) Infrared light
 - f) Ultraviolet light
 - g) Gamma ray

7.
 - a) Explain using diagrams of light entering the eye, what farsightedness is.
 - b) How can glasses correct this problem.

8. Explain the origin of the rainbow.

9. A light ray is incident at 45° on a surface. Find the angle of refraction if the reflecting surface is:
 - a) water
 - b) glass

10. Young's Double slit experiment is done using blue light. How does it differ from using red light?

11. Sketch the electric and magnetic fields for a light wave propagating in the z direction that is linearly polarized in the y direction.