Physics 112
Sample Exam Questions #3
November 19, 1999

1. A current is flowing along a straight wire in the z direction. There is a uniform magnetic field present. Based on the given information, which of these is ***true***?
   A. There must be a force on the wire, and the force might be pointed in the z direction.
   B. There may or may not be a force on the wire, and the force might be pointed in the z direction.
   C. There will never be a force on the wire.
   D. There must be a force on the wire, but the force could not be pointed in the z direction.
   E. There may or may not be a force on the wire, but the force could not be pointed in the z direction.

2. Which statement concerning electromagnetic waves is ***false***?
   A. Electromagnetic waves carry energy.
   B. Microwaves have shorter distance between peaks in their electric field pattern than do ultraviolet waves.
   C. In vacuum, all electromagnetic waves travel at the same speed.
   D. Lower frequency electromagnetic waves can be produced by oscillating circuits (i.e., electric charges oscillating in wires).
   E. E-M waves consist of mutually perpendicular electric and magnetic fields that oscillate perpendicular to the direction of propagation.
   F. If you view an oncoming e-m wave through a polarizing filter, the electric field would always seem to oscillate up and down along just one axis (e.g., pointing toward positive x, then negative x, etc.)

3. When a 4-ohm resistor is connected to a particular battery, 9 joules of energy are supplied every second by that battery. If only a ***2-ohm*** resistor is connected to the ***same*** battery, how much current will flow through that 2-ohm resistor?
   A. 1 A
   B. 2 A
   C. 3 A
   D. 4 A
   E. 6 A
   F. 8 A
   G. 9 A
   H. 12 A
   I. 16 A
   J. 24 A
   K. 32 A
   L. 48 A
   M. 64 A
   N. none of the above.

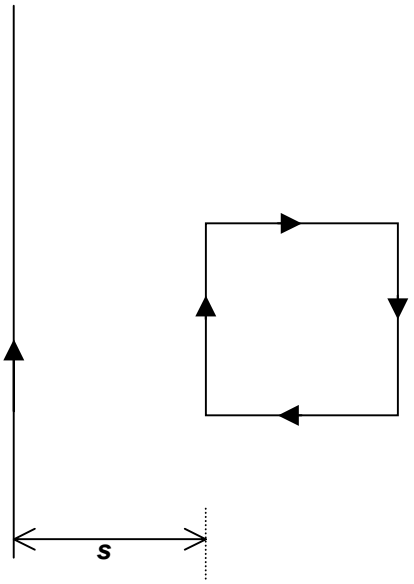
4. An electron in an empty room was sitting at rest, and then suddenly starts to move upwards. This means that:
   A. An upward pointing electric field was turned on.
   B. A downward pointing electric field was turned on.
   C. A sideways pointing electric field was turned on.
   D. An upward pointing magnetic field was turned on.
   E. A downward pointing magnetic field was turned on.
   F. A sideways pointing magnetic field was turned on.

5. In a particular electromagnetic wave, the electric field magnitude becomes zero 1000 times every second. What is the distance between points where the electric field is zero?
   A. About 3 micrometers.
   B. About 3 mm.
   C. About 3 m.
   D. About 3 km.
   E. About 300,000 m.

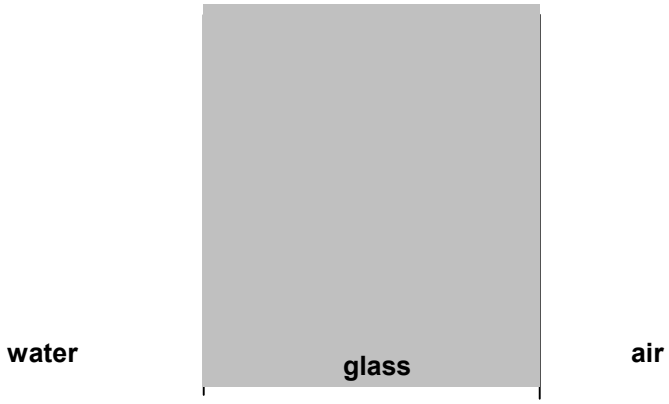
6. Light is propagating from water (n = 1.33) into glass (n = 1.5). What is the critical angle for total internal reflection for the beam?
   A. 62°
   B. 49°
   C. 42°
   D. Critical angle is not defined for this case
   E. 90°

7. Three identical bulbs are connected in a parallel circuit to a 120 V battery. Each bulb consumes 60 W when connected by ***itself*** to a 120 V battery. What is the ***combined*** power consumption of the three bulbs in the circuit?
   A. 40 W
   B. 60 W
   C. 80 W
   D. 120 W
   E. 180 W

8. A long, straight wire carries a current I in the direction shown in the figure. Next to the wire is a square copper loop that carries a current $2I$ as shown. The length of each side of the square is s. What is the magnitude of the ***net force*** that acts on the loop?
   A. $(\mu_0/2\pi)\ ¼\ I^2$
   B. $(\mu_0/2\pi)\ ½\ I^2$
   C. $(\mu_0/2\pi)\ 2/3\ I^2$
   D. $(\mu_0/2\pi)\ ¾\ I^2$
   E. $(\mu_0/2\pi)\ I^2$
   F. $(\mu_0/2\pi)\ 2I^2$
   G. zero



9. A light ray traveling in water in a fish tank strikes the (flat) glass wall of the tank at an incidence angle of 45°, passes through the glass, then out into air. ***Sketch*** the path of the ray all the way through to the air. Put arrows on your rays. You don't have to measure the angles, *but the relative magnitudes of the angles must be correct.* (That is, it must be possible to rank the size of all relevant angles just by looking at your sketch.) Index of refraction for water is 1.33, for glass it is 1.50.



10. A loop of wire is fixed in position in the presence of a magnetic field. The magnetic field has constant direction. The graph shows the magnitude of the magnetic field as a function of time. On the answer sheet, graph the current in the loop as a function of time***. Positive values mean "clockwise flow," negative values mean "counterclockwise flow."*** *The current flowing during $0 < t < 2$ seconds is shown*.