Physics 112
Exam #3 ANSWERS

1. ***Answer is "A."*** The largest magnitude electric field will be located where the equipotential lines are closest together. This is because a positive charge will gain an amount of kinetic energy (equal to $q\Delta V$) in the ***shortest*** distance there, which means that the force on it must be stronger than it is elsewhere. *(Chapter 4 Notes, page 3.)*

2. ***Answer is that force "points along the z axis because the magnetic field is along the x axis."*** There is no force when the wire is aligned along the x axis, which means that the magnetic field must be along the x axis. The force is perpendicular to ***both*** the field and the current, so when the current is along the y axis the force must be along the z axis. *(Chapter 9 Notes, page 1.)*

3. ***Answer is that Maxwell discovered that "A changing electric field creates a magnetic field (which then creates an electric field)."*** E-M Waves are emitted by ***changing*** currents, not steady ones, so that statement is false. The other four items (speed of light, Coulomb's law, Faraday's law, and the discovery of magnetic forces) were already known by Maxwell as he worked out the theory of e-m waves. *(Chapter 11 Notes, pages 1-3.)*

4. ***Answer is that the current loops will attract each other.*** The "south" pole of the top loop is nearest to the "north" pole of the bottom loop, so they will attract each other in the same way as two bar magnets would if oriented in that fashion. *(Chapter 9 Notes, page 8.)*

5. ***Answer is that only the #4 ray inside the diamond would be totally internally reflected.*** Total internal reflection only occurs for angles of incidence equal to or greater than the critical angle, and only when traveling from a higher-n medium ***to*** a lower-n medium. *(Chapter 12 Notes, page 4.)*

6. ***Answer is that both the north pole of the bar magnet, and the normal to the plane of the current loop, will "point" in the direction of the magnetic field.*** In all the other orientations shown there will be a net torque either on the current loop or on the bar magnet which will tend to make them rotate into the "aligned" position. *(Chapter 9 Notes, page 6.)*

7. ***Answer is that the current in the series circuit will be equal to x/9.*** The total current in the series circuit is equal to $\Delta V \div R_{equiv} = \Delta V \div 3R$ where R is the resistance of one resistor. The total current in the parallel circuit is equal to $(\Delta V \div R) + (\Delta V \div R) + (\Delta V \div R) = 3(\Delta V \div R)$, which is nine times as much as the current in the series circuit. *(Chapter 8 Notes, page 1.)*

8. ***Answer at time t_1 is that there is no current and no flux*** (no current flows in ***either*** coil or loop); ***at time t_2 there is <u>both</u> current <u>and</u> flux in the loop*** (because the suddenly changing current in the coil creates a ***changing*** magnetic field, which produces a changing flux within the loop and so creates an induced current in the loop); ***at time t_3 there <u>is</u> flux within the loop (produced by the coil's magnetic field) but there is <u>no</u> induced current in the loop (because the magnetic flux is steady, not changing).*** *(Chapter 10 Notes, page 3-4.)*

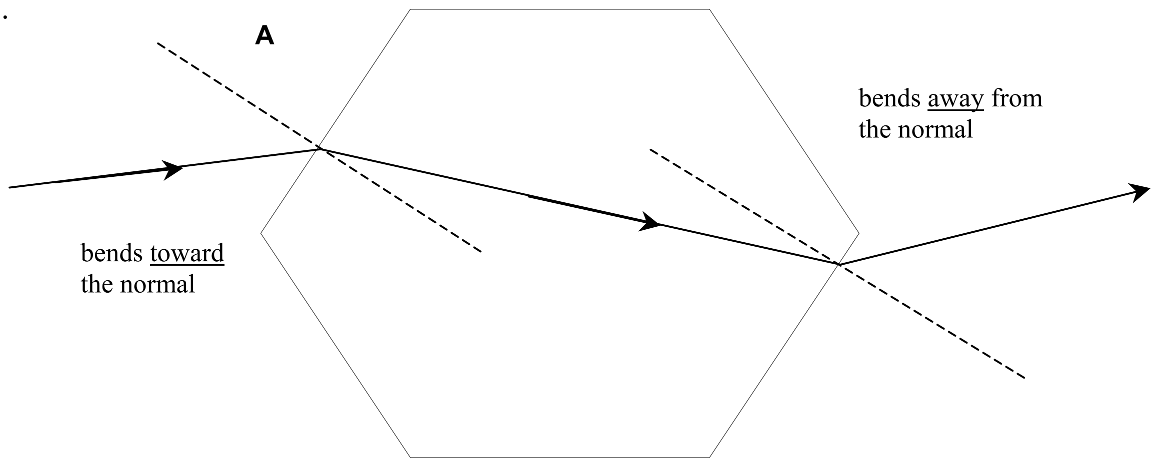
9. ***Answer at t = 3 s is that there is <u>zero</u> induced current (direction is "none") since at that time the magnetic field is not changing; at t = 5 s the induced current is <u>half</u> of what it was at t = 1 s, and in the <u>opposite</u> direction, because the <u>rate</u> of change of magnetic field is now only half of what it was at t = 1 s, and now it is <u>decreasing</u> instead of increasing. ($\Delta B/\Delta t$ = +2 T/s at t = 1 s, but –1 T/s at t = 5 s.) So at t = 5 s the current is 3 A clockwise.*** *(Chapter 10 Notes, page 5.)*

10. ***A) Answer is that the period is given by this equation: $T = \lambda/c$; We can see from the diagram that the wavelength λ equals the distance "d," and we know that $c = 3 \times 10^8$ m/s. If d = 3 m, then $T = 10^{-8}$ s; if d = 6 m, then $T = 2 \times 10^{-8}$ s.*** *(Chapter 11 Notes, page 5.)*

B) Answer is that one period T is required to travel one wavelength.

C) Answer is that one-half of a period is required for the electric field to go from a maximum in one direction to a maximum in the other direction. *(One full period required to go from a maximum in one direction to another maximum in the same direction.)*

11.



(Chapter 12 Notes, page 4.)

12. Ray from top of object converges to same point as other two rays from the top; ray from the center of the object passes halfway between horizontal axis and the convergence point for the top rays. (This is because the image of the object is inverted.) *(Chapter 12 Notes, page 8.)*