Physics 110

Review #3

Monday, November 21, 2005

This is a closed-book in-class review. You will have 50 minutes to complete it. There are 16 problems worth a total of 100 points. The value of each problem is marked. Make sure that you have all seven pages of the review including this cover page. This page is only a cover page with equations and constants. Feel free to tear it off in order to use it to solve the problems.

Constants

\[ q_{\text{proton}} = 1.6 \times 10^{-19} \text{C} = -q_{\text{electron}} \]
\[ k = 9.0 \times 10^9 \text{N} \cdot \text{m}^2/\text{C}^2 \]
\[ k' = 1 \times 10^{-7} \text{N}/\text{A}^2 \]
\[ c = 3.0 \times 10^8 \text{m/s} \]

Equations

\[ \frac{F}{l} = \frac{2k'I_1I_2}{r} \]
\[ F = qvB \]
\[ F = llB \]
\[ F = qE \]

\[ E = \frac{\Delta \Phi}{\Delta t} \]
\[ \Phi = B \perp A \]
\[ \frac{\Delta V_2}{\Delta V_1} = \frac{N_2}{N_1} \]
\[ \frac{I_2}{I_1} = \frac{N_1}{N_2} \]

\[ f = \frac{1}{T} \]
\[ v = f\lambda \]
\[ v = \sqrt{\frac{F}{\mu}} \]
\[ f_1 = \frac{v}{2L} \]

\[ f_n = nf_1 \]

path difference = \( d \frac{y}{x} \)

path difference = \( 2nt \)

\[ \theta_{\text{incident}} = \theta_{\text{reflected}} \]
\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]
\[ v = \frac{c}{n} \]
\[ i = o\left(\frac{n_u}{n_w}\right) \]

\[ \frac{1}{f} = \frac{1}{o} + \frac{1}{i} \]
\[ m = \frac{h_i}{h_o} = -\frac{i}{o} \]
1. (5 pts) Define **Diffuse Reflection**:

2. (5 pts) State the **Law of Refraction**:

3. (5 pts) State the **Principle of Superposition**:

4. (5 pts) Define **Magnetic Flux**:

5. (6 pts) A light ray traveling in glass for which the critical angle is $42^\circ$ strikes a surface between the glass and air at an angle of $45^\circ$ to the surface normal. Is the ray refracted into the air at this surface? Explain.
6. (6 pts) When you mix red and green light from separate projectors, you get a yellow spot on the wall. However, if you mix red and green paint, you get a muddy brown color. How do you account for this difference?

7. (8 pts) A convex mirror has a focal length of 60 cm.
   a) Draw a ray diagram to find the location and magnification of the image of an object located 30 cm from the mirror.
   b) Verify using the lens and magnification equations.
8. (7 pts) A waterproof electric buzzer has a membrane that vibrates at a constant frequency of 440 Hz. The buzzer is placed in a bucket of water.

   a) Knowing that the speed of sound is much greater in water than in air, will the frequency of the sound heard in the air be greater than, equal to, or less than 440 Hz? Explain.

   b) Will the wavelength of the sound in air be greater than, equal to, or less than what is was in the water? Explain.

9. (6 pts) A conducting loop is lying flat on the ground. The south pole of a bar magnet is brought down toward the loop. As the magnet approaches the loop, will the magnetic field created by the induced current point up or down? Explain.
10. (7 pts) An ink drop with charge $q = 3 \times 10^{-9} \text{ C}$ is moving in a region containing both an electric field and a magnetic field. The strength of the electric field is $3 \times 10^5 \text{ N/C}$, and the strength of the magnetic field is $0.2 \text{ T}$. At what speed must the particle be moving perpendicular to the magnetic field so that the magnitudes of the electric and magnetic forces are equal?

11. (6 pts) Green light ($\lambda = 500 \text{ nm}$) is incident upon a double slit with a separation of 0.3 mm. A screen is located 1.5 m from the double slit. At what distance from the center of the screen will the second bright fringe appear?

12. (6 pts) A fish swimming in a pond looks up at an object lying a couple of feet above the surface of the water. Does this object appear to the fish to lie nearer to the surface or farther from the surface than its actual distance? Explain.
13. (7 pts) Use a right-hand rule to find the direction of the conventional current in a wire in a magnetic field that results in the force on the wire shown for each below.

![Diagram](image)

a) Current Direction: ______________________________

b) Current Direction: ______________________________

c) Current Direction: ______________________________

14. (6 pts) Many microwaves use microwaves with a frequency of $2.45 \times 10^9$ Hz. What is the wavelength of this radiation, and how does it compare with the size of a typical oven?
15. (8 pts) A piece of rubber tubing with a linear mass density of 0.125 kg/m is stretched by a force of 9.00 N.

a) What will be the wave speed along the tubing?

b) If the stretched tubing has a length of 10.0 m, what are the frequencies of the first three harmonics?

16. (7 pts) Billy and Elaine are holding electric buzzers that sound at slightly different frequencies. When both stand still, the two buzzers produce a beat frequency of 4 Hz. Elaine begins to run away, and Billy hears the beat frequency gradually increase. Whose buzzer has the higher frequency? Explain.