Name: _____

PHY 106 *Final Exam* July 29, 2004 120 minutes

La Salle University
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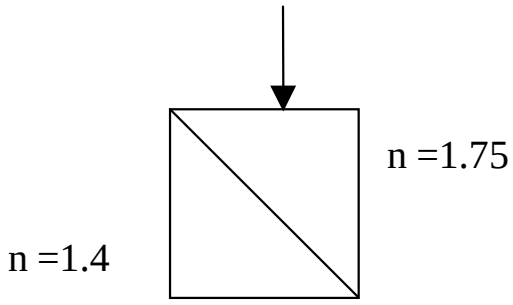
ALL WORK MUST BE DONE IN BLUE BOOK!

1. [10 pts] A siren blaring out a tone of 1250 Hz accidentally falls off the roof. If the building is 125 m tall: (assume v = 343 m/s)
   a) What frequency does someone on the ground hear when the siren is halfway down?
   b) Suppose you were falling from the building and the siren were on the ground. What frequency would now be heard?

2. [10 pts] A rectangular block is made of two types of glass. If light is incident normal to the top surface, with what angle (with respect to the normal) will it leave the bottom surface?



3. [8 pts] A cosmic ray proton impinges on the Earth near the equator with a vertical velocity of 2.8×10^7 m/s. Assume that the horizontal component of the Earth's magnetic field at the equator is 30 μT
   a) Draw a sketch of the situation, labeling appropriate vectors. Assume that the B field goes from right to left in your figure. In what direction does the magnetic force on the proton act? Explain!
   b) Calculate the ratio of the magnetic force on the proton to the gravitational force on it.

4. [8 pts] A concave shaving mirror has a radius of curvature of 35 cm. It is positioned so that the image of a man's face is 2.7 times the size of his face. The image is right side up.
   a) Sketch the situation using arrows for object and image and appropriate rays. Label your figure carefully. Is this a real or virtual image and why?
   b) How far is the man's face from the mirror?

5. [20 pts] A 6.0 μF capacitor is connected in series with a 4.0 μF capacitor; a potential difference of 200 V is applied across the pair.
   a) Calculate the total charge that leaves the battery
   b) Calculate the total energy stored in each capacitor
   c) Re-do part (a), only with both capacitors connected in parallel.

6. [12 pts] An electron moving at 0.5c enters a region of constant E. Within 10 cm it has slowed to 0.1c
    a) Sketch the situation, i.e. draw an electric field vector and indicate how the electron is moving with respect to this vector. Describe why you have drawn the picture this way, incorporating concepts of electrostatic force, potential energy, and potential.
    b) Calculate the magnitude of E.

7. [20 pts] A sinusoidal wave travels along a string of linear mass density 0.29 g/m. The time for a particular point on the string to move from maximum displacement to zero displacement is 0.17 sec
    a) Calculate the period and frequency of the wave
    b) If the wavelength is 1.4 m, calculate the velocity of the wave
    c) Write down the wave equation for the wave
    d) Calculate the tension in the string
    e) Assuming constant frequency, determine the new wavelength if the tension is tripled.

8. [12 pts] A violin string is 50 cm long and has a mass of 2.0 g. It's fundamental frequency is 440 Hz
    a) What is the wave speed and tension along the string?
    b) Where should you put your finger along the same string to have it produce a C note of 528 Hz?

$$f' = f\left(\frac{v \pm v_0}{v \pm v_s}\right) \qquad \frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$e = 1.602 \times 10^{-19}$ C
$m_p = 1.673 \times 10^{-27}$ kg
$v_{sound} = 343$ m/s
$c = 3 \times 10^8$ m/s

Lab Test 2:

1. [5 pts] For an experiment you need to devise a system of plane mirrors that will let you see the back of your head. Sketch a possible set-up of mirrors, and trace a few rays to prove your point. Explain your diagram!!

2. In a Snell's law lab using a piece of glass you measure incidence and refracted angles of 47º and 34º, respectively
    a. Calculate the experimental value for the index of refraction of the glass
    b. If your angle measurements are only known to a precision of ±2º, what range of n-values should you report?

3. Calculate the equivalent resistance of the following configuration of resistors (in which all resistors have the same value R). Your final answer must be in terms of R

4. In the magnetic force experiment, you did not need to measure the *vertical* portions of the current-carrying circuit board. Explain why. Use appropriate drawing(s) and formulas in your answer.

5. For the following circuit, label currents in each resistor, identify loops, and write down Kirchoff node and voltage equations for the circuit.