Practice Questions for April Examination Physics 100

April 9, 2012

This is just a draft! There might be problems!
Give your answers to 3 significant figures.

1. A wave on a string can be described by the equation

$$y(x,t) = A\cos\left(\frac{2\pi}{0.32}x - 2\pi(330)t\right) + A\cos\left(\frac{2\pi}{0.32}x + 2\pi(330)t\right) \tag{1}$$

(x is in metres and t is in seconds). $A = 5.00 \times 10^{-4}$ m.

   (a) Describe this wave in the form that is currently given. Give the wavelength, frequency, and speed.

   (b) With a little bit of mathematics you can show that

$$y(x,t) = 2A\cos\left(\frac{2\pi}{0.32}x\right)\cos(2\pi(330)t) \tag{2}$$

   (c) Although it is identical mathematically this wave is described in a different way; what kind of wave is this? Make a quick set of snapshot graphs to show this. (Choose a reasonable range for x.)

   (d) Find x for the first node to the right.

   (e) If the string is stretched between $x = -0.24$ m and $x = 0.24$ m and these points are nodes (like a guitar string) what harmonic would this wave represent? What would be the frequency of the fundamental?

2. Consider the following problems in ray optics.

   (a) Calculate the critical angle for glass with $n = 1.55$. Make a quick sketch to show the path of the ray just before the critical angle is reached.

   (b) A converging lens has a $f = 15$ cm and an object 5.0 cm tall is 45 cm away.

      i. Calculate the position and size of the image. Is it a real image or virtual image?

      ii. Draw the ray diagram that shows how the image is formed. Make your scale at least roughly correct (you can take the lens radius to be 8 cm but that doesn't enter into any of the calculations).

      iii. Give an example of where converging lenses are used for image formation.

3. For the following give explanations of the phenomena. One of the phenomena listed is unphysical; identify which one and explain what is incorrect.

   (a) I rub the end of a plastic rod with wool and the end of a glass rod with silk. I then find that the two rod ends are attracted to each other.

   (b) I rub the end of a plastic rod with wool and then touch the rod to an electroscope. The leaves of the electroscope moves apart.

   (c) I touch the same electroscope and the leaves are no longer repelled.

   (d) I hold a metal sphere on a plastic rod near a plastic rod that has been rubbed with wool. There is no force on either the rod or the sphere. (No special preparation was done to the metal sphere.)

4. You have a beam of particles that is moving in the positive-x direction. You would like to deflect the positively charged particles upward and the negatively charged particles downward. Give the direction of the magnetic field you would use to accomplish this.

5. An electric dipole consists of a postive and negative charge that are separated by some distance. Suppose that the positive charge is 1.0 nC and it is 0.50 cm above the origin. The negative charge is -1.0 nC and is -0.50 cm below the origin.

   (a) Make a sketch of the electric field (either electric field lines or a vector diagram).

   (b) Calculate the magnitude and direction of the electric field that is 3.0 cm to the right of the line connecting the charges. (this would be on the x-axis if the charges are on the y-axis).

   (c) Show that the electric potential at this location is 0.0 V. Doesn't this mean that the electric field is also zero?