PHYS 2102-01

Exam 3

Fall 2001

Dr. Aktas

Name :_____

SS # : _____

You have five questions, 20 points each.

This is a closed book exam. I understand I am not to use any notes or information other than on this exam sheet. I may use a pocket calculator but only for the purpose of numerical calculation. I accept the responsibility to know and observe the requirements of the UNC-Charlotte Code of Student Academic Integrity.

_____

___

Signature

Good luck

Show all of your work. Do not skip steps. First write down the relevant equations then substitute the numbers if necessary.

1. A body oscillates with simple harmonic motion according to the equation

$$x = (8.0\,m)\cos[(4\pi \;\; rad/s)t + \frac{2\pi}{3} \;\; rad].$$

At t = 2.0 s, what are (a) the displacement, (b) the velocity, (c) the acceleration, and (d) the phase of the motion? Also, what are (e) the frequency and (f) the period of the motion?

2. A standing wave pattern on a string is described by

$$y(x,t) = 0.040 \sin 5\pi x \cos 40\pi t,$$

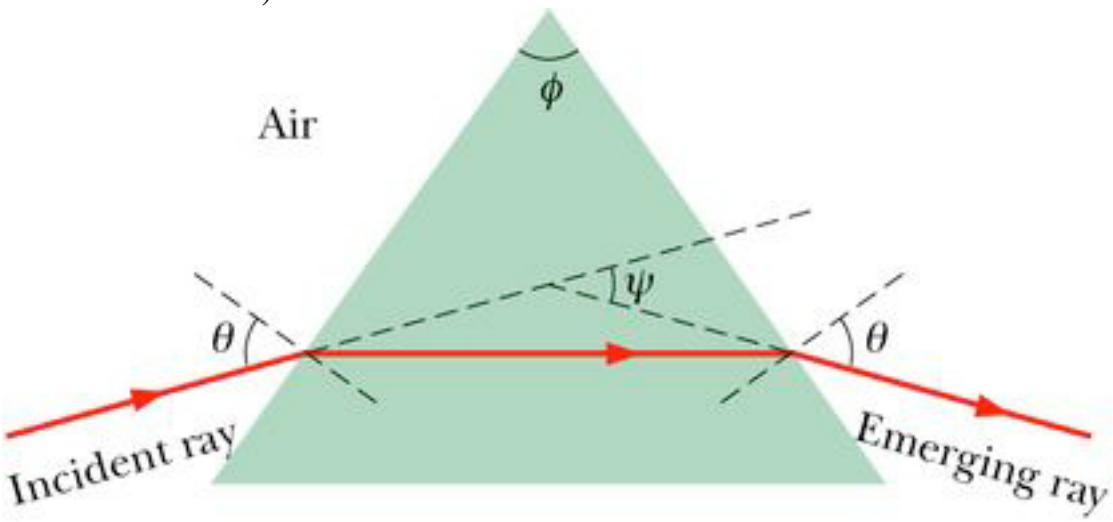
where x and y are in meters and t is in seconds. (a) Determine the location of all nodes for $0 \le x \le 0.40$ m. (b) What is the period of the oscillatory motion of any (nonnode) point on the string? What are (c) the speed and (d) the amplitude of the two traveling waves that interfere to produce this wave? (e) At what times for $0 \le t \le 0.050$ s will all the points on the string have zero transverse velocity?

3. The maximum electric field at a distance of 10 m from an isotropic point light source is 2.0 V/m. What are (a) the maximum value of the magnetic field and (b) the average intensity of the light there? (c) What is the power of the source?

4. In Fig. below , a ray is incident on one face of a triangular glass prism in air. The angle of incidence θ is chosen so that the emerging ray also makes the same angle θ with the normal to the other face. Show that the index of refraction n of the glass prism is given by

$$n = \frac{\sin \frac{1}{2}(\psi + \phi)}{\sin \frac{1}{2}\phi},$$

where ϕ is the vertex angle of the prism and ψ is the deviation angle, the total angle through which the beam is turned in passing through the prism. (Under these conditions the deviation angle ψ has the smallest possible value, which is called the angle of minimum deviation.)



□□□□In Fig. below, a real inverted image I of an object O is formed by a certain lens (not shown); the object–image separation is d = 40.0 cm, measured along the central axis of the lens. The image is just half the size of the object. (a) What kind of lens must be used to produce this image? (b) How far from the object must the lens be placed? (c) What is the focal length of the lens?