

PHYS 306 Spring 2010
Wave Motion and Electromagnetic Radiation

Homework Assignment

HW#1

Assignment Date: Jan. 26, 2010

Due Date: Feb. 02, 2010

1. (Problem 7.3 in Ghatak book). A tunnel is dug through the earth as shown in Fig. 7.15. A mass is dropped at the point A along the tunnel. Show that it will execute simple harmonic motion. What will the time period be?

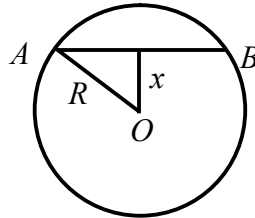


Fig. 7.15 For Problem 7.3

2. (Problem 7.4 in Ghatak book). A 1 g mass is suspended from a vertical spring. It executes simple harmonic motion with period 0.1 sec. By how much distance had the spring stretched when the mass was attached?

3. In the simplest model of the atom, the electrons are assumed to be bound elastically to their rest position. The equation of motion for the electron, in the presence of an external electric field E and assuming zero damping, would be

$$m \frac{d^2 \vec{x}}{dt^2} + k_0 \vec{x} = -q \vec{E}$$

(1) Show that the refractive index n of a dielectric medium is

$$n^2 = 1 + \frac{Nq^2}{m\epsilon_0\omega_0^2} \left(1 - \frac{\omega^2}{\omega_0^2}\right)^{-1}$$

(2) Derive the Cauchy relation

$$n^2 = A + \frac{B}{\lambda_0^2}$$

Note: refer to CH7.5 of Ghatak book. Adopt the convention of symbols, and also use the assumptions provided in the book.