Assignment 2: Chapter 15 and 16

Deadline

Wednesday, November 25th, 2020 … before 1:30 pm

Notes

1. Attempt all the questions given for each chapter in an A4 Size Paper.
2. Clear mention on the title page your assignment no.,Section, name and registration id.
3. Submit your assignments in Google Classroom by scanning your assignments in a single PDF using Cam scanner or MS Lens and submit the same to Engr. Abdul Saboor Khan in EE faculty through your respective CR's.
4. Plagiarism will result in zero marks as well as black listing of the student.

Chapter 15: Oscillations

P1. In Figure 1, a block weighing 14.0 N, which can slide without friction on an incline at angle θ=40.0°, is connected to the top of the incline by a massless spring of unstretched length 0.450 m and spring constant 120 N/m. (a) How far from the top of the incline is the block's equilibrium point? (b) If the block is pulled slightly down the incline and released, what is the period of the resulting oscillations?

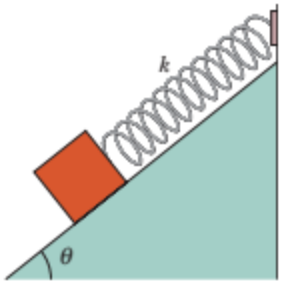

Figure 1

P2. An oscillator consists of a block attached to a spring (k=400 N/m). At some time t, the position (measured from the system's equilibrium location), velocity, and acceleration of the block are x =0.100 m, v =13.6 m/s, and a= -123 $\frac{m}{s^2}$. Calculate (a) the frequency of oscillation, (b) the mass of the block, and (c) the amplitude of the motion

P3. A massless spring hangs from the ceiling with a small object attached to its lower end. The object is initially held at rest in a position y_i such that the spring is at its rest length. The object is then released from y_i and oscillates up and down, with its lowest position being 10 cm below yi. (a) What is the frequency of the oscillation? (b) What is the speed of the object when it is 8.0 cm below the initial position? (c) An object of mass 300 g is attached to the first object, after which the system oscillates with half the original frequency. What is the mass of

the first object? (d) How far below y_i is the new equilibrium (rest) position with both objects attached to the spring?

P4. A 5.00 kg object on a horizontal frictionless surface is attached to a spring with k=1000 N/m. The object is displaced from equilibrium 50.0 cm horizontally and given an initial velocity of 10.0 m/s back toward the equilibrium position. What are (a) the motion's frequency, (b) the initial potential energy of the block–spring system, (c) the initial kinetic energy, and (d) the motion's amplitude?

P5. The balance wheel of an old-fashioned watch oscillates with angular amplitude π rad and period 0.500 s. Find (a) the maximum angular speed of the wheel, (b) the angular speed at displacement π/2 rad, and (c) the magnitude of the angular acceleration at displacement π/4 rad.

P6. Suppose that a simple pendulum consists of a small 60.0 g bob at the end of a cord of negligible mass. If the angle θ between the cord and the vertical is given by

$$\theta = (0.0800\ \text{rad})\cos[(4.43\ \text{rad/s})t + \phi],$$

what are (a) the pendulum's length and (b) its maximum kinetic energy?

P7. In Figure 2, a physical pendulum consists of a uniform solid disk (of radius R =2.35 cm) supported in a vertical plane by a pivot located a distance d =1.75 cm from the center of the disk. The disk is displaced by a small angle and released. What is the period of the resulting simple harmonic motion?

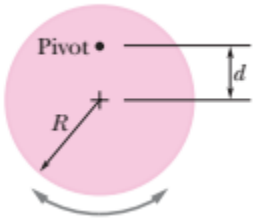

Figure 2

P8. A pendulum is formed by pivoting a long thin rod about a point on the rod. In a series of experiments, the period is measured as a function of the distance x between the pivot point and the rod's center. (a) If the rod's length is L =2.20 m and its mass is m=22.1 g, what is the minimum period? (b) If x is chosen to minimize the period and then L is increased, does the period increase, decrease, or remain the same? (c) If, instead, m is increased without L increasing, does the period increase, decrease, or remain the same?

P9. For the damped oscillator system shown in Figure 3, with m= 250 g, k =85 N/m, and b=70 g/s, what is the ratio of the oscillation amplitude at the end of 20 cycles to the initial oscillation amplitude?

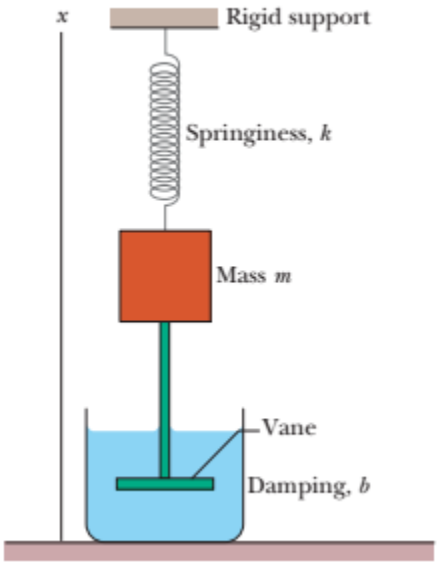

Figure 3

P10. The suspension system of a 2000 kg automobile "sags" 10 cm when the chassis is placed on it. Also, the oscillation amplitude decreases by 50% each cycle. Estimate the values of (a) the spring constant *k* and (b) the damping constant *b* for the spring and shock absorber system of one wheel, assuming each wheel supports 500 kg.

Chapter 16: Waves-I

P11. Transverse waves with a speed of 50.0 $\frac{m}{s}$ are to be produced in a taut string. A 5.00 m length of string with a total mass of 0.0600 kg is used. What is the required tension?

P12. Transverse waves travel with a speed of 20 $\frac{m}{s}$ in a string under a tension of 6.00 N. What tension is required to produce a wave speed of 30 $\frac{m}{s}$ in the same string?

P13. (a) Write the expression for y as a function as a function of x and t for a sinusoidal wave traveling along a rope in the negative x direction with the following characteristics: A=8 cm , λ=80.0 cm , f= 3 Hz , and y(0,t) =0 at t=0

(b) Write the expression for y as a function of x and t for the wave in part(a) assuming that y(x,0) =0 at the point x= 10 cm

P14. A sinusoidal wave train is described by the equation

$$y = (0.25m) \sin (0.30x-40t)$$

where x and y are in meters and t is in seconds. Determine for this wave the (a) Amplitude, (b) Angular frequency, (c) Angular wave number ,(d) Wavelength , (e) Wave speed and (f) Direction of motion

P15. A sinusoidal wave on a string is described by the equation

$$y = (0.51cm)\sin(kx-\omega t)$$

where k= 3.10 $\frac{rad}{cm}$ and ω = 9.30 $\frac{rad}{s}$. How far does a wave crest move in 10 s ? Does it move in the positive or negative x direction?

P16. A wave is described by y = (2 cm) sin (kx-ωt) , where k = 2.11 $\frac{rad}{m}$, ω = 3.62 rad/s, x is in meters and t is in seconds. Determine the amplitude, wavelength, frequency & the speed of the wave?

P17. A sinusoidal wave on a string is described by the equation

$$y = (0.15m)\sin(0.80x - 50t)$$

Where x and y are in meters and t is in seconds. If the mass per unit length of this string is 12 $\frac{g}{m}$ determine

(a) The speed of the wave
(b) The wavelength
(c) The frequency
(d) The power transmitted to the wave

Avoiding Issues When Solving Physics Problems

(Taken from Physics Workbook for Dummies)

If you get stumped working on physics formulas, take a deep breath, and recheck your work. Go through these common physics problem issues to make sure you have avoided them:

- Mixing units
- Getting the answer in the wrong units
- Swapping radians and degrees
- Getting sines and cosines mixed up
- Failing to treat vectors as vectors