Practice Problem Sheet-2

Course Code: PHY 2105/PHY 105 Spring 2024

Course Title: Physics Content: DHM+Travelling Wave+Wave Equation

1. Draw displacement vs time graph for $\omega/\gamma = 10$, $\omega/\gamma = 0.5$, and $\omega/\gamma = 0.03$.

2. In oscillatory circuit L= 0.4h, C = 0.0020μF. (i) What is maximum value of resistance (R) for the circuit to be oscillatory? and (ii) What is its resonant frequency?

3. Find whether the discharge of capacitor through the following inductive series circuit is oscillatory or not. Given, C = 0.1μF, L = 10mh, and R 200 Ω. If oscillatory, find the frequency of oscillation and resonant frequency. If it is parallel circuit, then find out the similar characteristics of that circuit.

4. For a damped oscillator m =250gm, k = 85N/m and b = 70gm/s. (i) What is the period of the motion? (ii) How long does it take for the amplitude of the damped oscillations to drop to half its initial value? (iii) How many oscillations does it complete in life time? (iv) What is its life time? (v) The maximum displacement of undamped oscillator is 35 cm. If the damping is stopped after 20 cycles, what is the damping energy? (vi) How long does it take for the mechanical energy to drop to one-half its initial value? and (vii) What is the ratio of the oscillation amplitude to the initial oscillation amplitude at this cycle?

5. At time t=0 the displacement of a particle in a medium is $y = 4.0\sin 2\pi(\frac{x}{100})$ and the velocity of wave is 30cm/s. Find the displacement equation when t = 3s.

6. When a simple harmonic wave is propagated through a medium, the displacement of the particle at any instant of time is given by $y = 5.0sin\,\pi(360t - 0.15x)$. Calculate (i) the amplitude of the vibrating particle, (ii) wave velocity, (iii) wave length, (iv) frequency (v) maximum velocity, and (vi) time period.

7. The equation of a progressive wave is given by y=5 sin (100πt−0.4πx). Calculate the (i) amplitude, (ii) wave length, (iii) frequency, (iv) time period, (v) wave velocity, (vi) angular frequency, (vii) maximum velocity, (viii) maximum acceleration, (viii) phase velocity, and (viii) instantaneous velocity, at t=3 s and x=2 m.

8. A simple harmonic wave of amplitude 8units travels a line of particles in the direction of positive X axis. At any instant for a particle at a distance of 10cm from the origin, the displacement is +6units and at a distance a particle from the origin is 25units, the displacement is +4units. Calculate the wavelength.

9. Determine the length and frequency of a simple pendulum that will swing back and forth in simple harmonic motion with a period of 5.00 s.

10. Suppose the displacement of a DHM is expressed as $x = Ae^{-\alpha t}\cos(\omega_d t + \delta)$. Show that total energy of DHM is $E = E_o e^{-2\alpha t}$.

11. Draw displacement vs time graph for a signal up to 3 cycles if the signal is $y(t) = 7e^{-\alpha t}\cos(6t + \phi)$.

12. A block of mass 1 kg attached to a spring is made to oscillate with an initial amplitude of 12 cm. After 2 minutes the amplitude decreases to 6 cm. Determine the value of the damping constant for this motion.

13. The mass of the block and the spring constant of a damped spring-mass system is 400 gm and 100 N/m, respectively. If the damping constant is 10 kg/sec, then find the time taken for its amplitude of vibrations to drop to half of its initial value.

14. 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 (i) the spring constant *k* and (ii) Time period of the DHM, and (iii) the damping constant *b* for the spring and shock absorber system of one wheel, assuming each wheel supports the mass of 500 kg. Consider, $\omega_d = \omega$.

15. A mobile phone tower transmits a wave signal of frequency 900MHz. Calculate the length of the waves transmitted from the mobile phone tower.

16. For a travelling wave the displacement is y=5sin30π[t−(x/240)]. Find the frequency of the wave.

17. Find out the resultant amplitude, node and antinode points of a standing wave in terms of λ of the following equations: y_1=A cos($\frac{1}{3}kx$+ωt) and y_2=A cos($\frac{1}{3}kx$−ωt).

18. Find out the resultant amplitude, node and antinode points of a standing wave in terms of λ of the following equations: $y_{1,2} = A\sin(2kx \pm \omega t)$.