Practice Problem Sheet-2

Course Code: PHY 2105/PHY 105 Spring 2025

Course Title: Physics I Content: DHM+Progressive Wave+Wave Motion

1. The equation of a travelling wave is $y = 4.0\sin(0.10x - 2t)$. Find (i) amplitude, (ii) wavelength, (iii) speed, and (iv) frequency of the wave.
2. When a simple harmonic motion (SHM) 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.
3. The equation of a progressive wave is given by, y =5sin (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.
4. A mobile phone tower transmits a wave signal of frequency 900 MHz. Calculate the length of the waves transmitted from the mobile phone tower.
5. For a travelling wave the displacement is y = 5sin 30π [t−(x/240)]. Find the frequency of the wave.
6. A wave from SHM 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 10 cm from the origin, the displacement is +6 units and at a distance a particle from the origin is 25 cm, the displacement is +4units. Calculate the wavelength.
7. Draw displacement vs. time graph of a DHM for ω/γ = 10, ω/γ = 0.5, and ω/γ = 0.03.
8. 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.
9. For a damped oscillator m = 200 gm, k = 80 N/m and b = 65 gm/s. (i) What is the period of the motion? (ii) Which type of oscillation it is? (iii) How long does it take for the amplitude of the damped oscillations to drop to half its initial value? (iv) How many oscillations does it complete in life time? (v) How long does it take for the mechanical energy to drop to one-half its initial value? (vi) What is its life time or relaxation time? (vii) The maximum displacement of an undamped oscillator is 35 cm. If the damping is stopped after 20 cycles, What is the damping energy? What is the (viii) ratio of the oscillation amplitude to the initial oscillation amplitude at this cycle? (ix) damping angular frequency? (x) damping frequency? (xi) damping amplitude? (xii) damping energy at t=3.5s? (xiii) damping amplitude at t=3 s? (xiv) displacement equation? (xv) damping displacement at t=4 sec? (xvi) damping period? (xvii) natural frequency? (xviii) damping factor? (xix) displacement of the particle after 2 cycle? (xx) damping force if v=6 m/s?
10. The displacement of a particle with mass 500 gm following DHM is $y = 6e^{-0.07t}\cos(4\pi t + \delta)$. What is the (i) damping constant? (ii) damping frequency? (iii) natural frequency? (iv) damping displacement at t=2 sec? (v) damping energy at t=5 sec? and (vi) resonance frequency?
11. Draw the DHM for displacement vs time graph : $y(t) = 5e^{-\alpha t}\cos(6t + \phi)$ up to 2 cycles.
12. If the amplitude of a damped oscillator becomes 1/27th of its initial value after 6 minutes, what was the amplitude after 2 minutes?

13. In oscillatory circuit L= 0.4 h, C = 0.0020 μF. (i) What is the maximum value of resistance (R) for the circuit to be oscillatory? and (ii) What is its resonant frequency?
14. 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. (i) If oscillatory, find the frequency of oscillation and resonant frequency. (ii) If it is parallel circuit, then find out the similar characteristics of that circuit, and (iii) If 200 Ω is removed from the circuit, then what will be the resistance required for getting a critical damping C_d?

15. In a spring mass system, the block has a mass of 1.50 kg and the spring constant is 8.00 N/m and b = 230 g/s. The block is pulled down 12.0 cm and released. (i) What is the amplitude of the damped oscillations at the end of 10 oscillations? and (ii) Find the total energy at that time.
16. A wave has an angular frequency of 110 rad/s and a wavelength of 1.80 m. Calculate (i) the wave number and (ii) the speed of the wave.
17. A transverse wave travels along a medium. The time for a particular point to move from a maximum placement to zero is 0.170 s. The wavelength is 1.40 m and amplitude is 0.25 m. What are the (i) period? (ii) frequency? (iii) wave speed? and (iv) maximum speed of a particle of the medium.
18. Equation of a travelling wave is given by $y = 0.3 \sin(27.1x\text{-}2.72t)$ m. (i) What is the particle velocity of the medium at x = 22.5 cm and at the time t =18.9 s? and (ii) What is the maximum speed of the particle at origin?
19. A wave traveling in the positive x direction has a frequency of f = 24 Hz and wave length 20 cm. If the amplitude of the wave is 18 cm, (i) draw the wave and (ii) find out the speed of the wave.
20. Find the displacement of an air particle from origin of disturbance at t = 0.55 s when a wave of amplitude 0.2 mm and frequency 500 Hz travels along it with a velocity of 350 m/s.
21. A sinusoidal wave of frequency 500 Hz has a speed of 350 m/s. (i) How far apart are two points that differ in phase by π/3 rad? (ii) What is the phase difference between two displacements at a certain point at times 1.00 m apart?
22. A transverse wave of frequency 50 Hz has a speed of 250 m/s is propagating +x axis. If amplitude of wave is 25cm, find out the maximum speed of the particle at origin.