Assignment-1 Course Code: PHY 2105/PHY 105 Spring: 2024

Course Title: Physics Content: SHM

1. An object undergoing simple harmonic motion takes 0.25 s to travel from one point of zero velocity to the next such point. The distance between those points is 36 cm. Calculate the (i) period, (ii) frequency, and (iii) amplitude of the motion.

2. A 0.12 kg body undergoes simple harmonic motion of amplitude 8.5 cm and period 0.20 s. (i) What is the magnitude of the maximum force acting on it? (ii) If the oscillations are produced by a spring, what is the spring constant?

3. 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 m/s^2. Calculate (i) the frequency of oscillation, (ii) the mass of the block, and (iii) the amplitude of the motion.

4. A body executes SHM such that its velocity at mean position is 1m/s and acceleration at one extremity is 1.57m/s^2. Calculate time period of oscillation.

5. A particle executes SHM of amplitude 5m when the particle is 3m from its mean position, its acceleration is found to be 48m/s^2. Find (i) velocity (ii) time period and (iii) maximum velocity.

6. Particle executes harmonic motion about the point x= 0; at t= 0 it has displacement x= 0.37cm and zero velocity. The frequency of the motion is 0.25Hz, determine, (i) the period, ii) the angular frequency, (iii) the amplitude, (iv) the displacement at t= 3.0s, and (v) the velocity at t= 3.0s.
7. A body of mass 500 gm is suspended from a spring of negligible mass and it stretches the spring by 7 cm. For a displacement of 3 cm it is given a downward velocity 40 cm/s. Calculate (i) the spring constant, (ii) the angular frequency, (iii) the time period (iv) the initial potential energy, (v) the initial kinetic energy, and (vi) the amplitude of the ensuing motion of the spring.

8. Draw the phase difference diagram for the waves: (i) $y_2 = A \sin(\omega t - \frac{\pi}{3})$, $y_1 = A \sin \omega t$; (ii) $y_2 = A \sin(\omega t + \frac{\pi}{4})$, $y_1 = A \sin\omega t$; (iii) $y_1 = A \sin(\omega t + \frac{2\pi}{3})$, $y_2 = A \sin(\omega t + \frac{\pi}{3})$; (iv) $y_1 = A \sin(\omega t + \frac{3\pi}{4})$, $y_2 = A \sin(\omega t - \frac{\pi}{4})$ and (v) $y_1 = A \sin(\omega t - \frac{\pi}{3})$, $y_2 = A \sin(\omega t + \frac{\pi}{3})$.

9. The shock absorbers in an old car with mass 1000 kg are completely worn out. When a 980 N person climbs slowly into the car to its center of gravity, the car sinks 2.8 cm. When the car with the person abroad, hits a bump, the car starts oscillating up and down in simple harmonic motion. Find out the force constant, period, and frequency of the oscillation.

10. A spring is mounted horizontally with its left-end stationery. The spring constant is k=200 N/m and mass m=0.5 kg. This time we give the body an initial displacement of 0.015 m/s and an initial velocity of 0.40 m/s. (i) Find out the period, amplitude, and phase constant of the motion. (ii) Write equations for the displacement, velocity, and acceleration as a function of time.

11. A simple harmonic oscillator consists of a block of mass 2.00 kg attached to a spring of spring constant 100 N/m. When t =1.00 s, the position and velocity of the block are x=0.129 m and v=3.415 m/s. (i) What is the amplitude of the oscillations? (ii) What were the position at t=0 s? and (iii) what were the velocity of the block at t=0 s?

12. At a certain harbor, the tides cause the ocean surface to rise and fall a distance d (from highest level to lowest level) in simple harmonic motion, with a period of 12.5 h. How long does it take for the water to fall a distance 0.250d from its highest level?