Home Assignment-1 : Spring 2021

1. A body of mass 25 gm is attached with a spring of spring constant 400 dynes/cm. The body is displaced by 10cm from its equilibrium position and released. Then the body executes simple harmonic motion. Calculate (i) the time period, (ii) frequency, (iii) angular frequency, (iv) maximum velocity, and (v) maximum acceleration.

2. In an electric shaver, the blade moves back and forth over a distance of 2.0mm in simple harmonic motion, with a frequency 120Hz. Find (a) the amplitude, (b) the maximum blade speed and (c) the magnitude of the maximum acceleration of blade.

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

4. A hydrogen atom has a mass of 1.68×10^{-27}kg, when it attach to a certain massive molecule, it oscillate as classical oscillator with frequency of 10^{14} Hz and with amplitude of 10^{-10}m. Calculate force acting on the hydrogen atom.

5. 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.

6. 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 (iii) Maximum velocity.

7. 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.

8. A body oscillates with SHM according to the equation $x = 10\cos(3\pi t + \frac{\pi}{3})$. Calculate (i) displacement at t=2.5s, (ii) velocity at t=3.0s, and (iii) acceleration when t=2s.

9. In oscillatory circuit L= 0.4h, C = 0.0020μF. What is maximum value of resistance(R) for the circuit to be oscillatory? Considering the resistance, find the frequency of oscillation and resonant frequency.

10. For a damped oscillator m =250gm, k = 85N/m and b = 70gm/s. (a) What is the period of the motion? (b) How long does it take for the amplitude of the damped oscillations to drop to half its initial value?

11. The equation of a traveling wave is $y = 4.0\sin(0.10x - 2t)$. Find (i) amplitude, (ii) wavelength, (iii) speed, (iv) frequency of wave, and (v) time period of wave.

12. 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.

13. Let the mass of the body is 25 gm, the force constant *k* be 400 dynes/cm, and let the motion be started by displacing the body 10 cm to the right of its equilibrium position and imparting to it a velocity toward the right of 40 cm/s. Compute (a) the period, *T*, (b) the frequency *f*, (c) the angular frequency ω, (d) the total energy E, (e) the amplitude *A*, (f) the angle θ_o, (g) the maximum velocity v_{max} ,(h) the maximum acceleration a_{max} , (i) the coordinate equations, velocity, and acceleration, and (j) the displacement, velocity, acceleration at a time $\pi/8$ sec after the start of the motion.

14. Draw the following Lissajoue's figure: (i) $x = a\sin(\omega t + \frac{2\pi}{6})$ and $y = b\sin\omega t$, (ii) $x = a\sin(\omega t + \frac{5\pi}{4})$ and $y = b\sin\omega t$, (iii) $x = a\sin(\omega t + \frac{11\pi}{8})$ and $y = b\sin\omega t$, (iv) $x = a\sin(\omega t + \frac{14\pi}{8})$ and $y = b\sin\omega t$, and (v) $x = a\sin(\omega t + 45)$ and $y = b\cos(\omega t + 270)$.