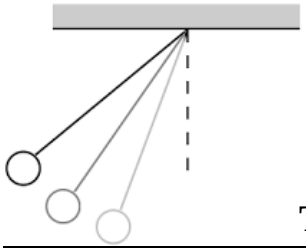

Practice Problem sheet – 2

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Course: PHY 2105/PHY105

Trimester: Fall 2024

Topic: Damped Simple Harmonic Motion

1. A capacitor 1.0μF, an inductor 0.2h and a resistance 800Ω are joined in series. Is the circuit oscillatory?

2. For a damping spring the spring constant is 196 N/m and the angular frequency is 5 rad/sec. if the constant b=0.5 kg/sec. What will be the life time for this wave?

3. For a damped oscillator m = 580 gm, k = 240 N/m and b = 72 gm/s. The oscillator is stretched up to 8 cm from the equilibrium and released at t = 0.
   (i) What is the period of the motion? (ii) How long does it take for the amplitude of the damped oscillations to drop to one third of its initial value?
4. Find whether the discharge of capacitor through the following inductive circuit is oscillatory.
   C = 0.1μF, L = 10mh, R 200 Ω.
   i. If Oscillatory, find the frequency of oscillation.
   ii. Find the approximate wave life time.

5. Calculate the value of L that is required to construct a critically damped RLC circuit with R = 50 Ω, C = 0.2μF. Construct the equation of charge if the initial charge in the capacitor is Q_0 = 5 C and L = 0.3 mH, R = 50 Ω, C = 0.2μF.

6. A mass spring system in DHM with m = 500 g, b= 80 N/m.
   (i) What must be the spring constant of the spring for the system to be oscillatory.
   (ii) If the time period of the undamped oscillator is 2 $rads^{-1}$ and the initial amplitude of the oscillator is 2 m, what will be the displacement at t = **M** sec? Here M is the last digit of your Student ID. Here **M** is the last digit of your student ID. If the last digit of your ID is 0 then use **M** = 7.

7. For a damped oscillator m = 200 gm, k = 90 N/m and b = 68 gm/s.
   i. How long does it take for the amplitude of the damped oscillations to drop to one fifth of its initial value?
   ii. The maximum displacement of undammed oscillator is 35 cm. If the damping is stopped after ***Z*** cycles, what is the damping energy? Here ***Z*** is the last digit of your student ID. If the last digit of your ID is 0 then use ***Z*** = 5.

8. For a damped oscillator, m = 380 gm, k = 19.6 N/m, and b = 82 gm/s. The oscillator is released at t = 0 and the amplitude is 5 cm.

(i) How long does it take for the amplitude of the damped oscillations to drop to one fourth of its initial value?
(ii) How may complete cycle of oscillations be found after t = 6 s?

9. Labid wants to construct an RLC circuit that produces critical damping. He has a capacitor and inductor with value, C = 0.05 μF, L = 0.2 mH, respectively.
(i) What is the value of resistance he must connect to make his desired circuit?
(ii) If R = 500 Ω, is the circuit oscillatory? If oscillatory, find the frequency of oscillation.

10. Karim want to construct a RLC circuit that produces critical damping. He has a capacitor and inductor with value, C = 0.003 mF, L = 0.0001 H respectively.
(i) What is the value of resistance he must connect to make his desired circuit?
(ii) If R = 800 Ω, is the circuit oscillatory? If oscillatory, find the frequency of oscillation.

11. 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?

12. 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.

13. 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 undammed 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?

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

15. When a simple harmonic motion is propagated through a medium, the displacement of the particle at any instant of time is given by $y = 2sin\ (t - 0.0035x)$.
Calculate the (i) wave velocity, (ii) wavelength, (iii) amplitude and (iv) frequency.

16. 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.

17. 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.

18. 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.

19. 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, $\omega_d = \omega$.

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

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

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

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