CBSE

OSCILLATIONS WS 12

Class 11 - Physics

Section A

1. Two pendulums have time periods T and $\frac{5T}{4}$. They are in phase at their mean positions at some instant of time. What will be their phase difference when the bigger pendulum completes one oscillation? **[1]**

   a) 60^o b) 90^o

   c) 30^o d) 45^o

2. If a simple pendulum of length L has maximum angular displacement. Then the maximum kinetic energy of bob of mass M is **[1]**

   a) MgL sin $\frac{\alpha}{2}$ b) $\frac{Mg}{2L}$

   c) $\frac{1}{2}\frac{ML}{g}$ d) MgL(1 - cos α)

3. A simple pendulum is vibrating in an evacuated chamber. It will oscillate with **[1]**

   a) increasing amplitude b) Falling amplitude

   c) constant amplitude d) decreasing amplitude

4. A simple pendulum oscillates in a vertical plane. When it passes through the mean position, the tension in the string is 3 times the weight of the pendulum bob. What is the maximum displacement of the pendulum of the string with respect to the vertical? **[1]**

   a) 60^o b) 90^o

   c) 45^o d) 30^o

5. A particle is executing S.H.M with an amplitude of 4 cm and a time period 12 sec. The time taken by the particle in going from its mean position to a position of displacement equal to 2 cm is T_1. The time taken from this displaced position of 2 cm to reach the extreme position is T_2. Therefore, $\frac{T_1}{T_2}$ will be **[1]**

   a) 1 b) $\frac{1}{3}$

   c) 2 d) 0.5

6. The time period of a spring oscillating simple harmonically is: **[1]**

   a) $\mathrm{T} = 2\pi\sqrt{\left\{\frac{m}{2K}\right\}}$ b) $\mathrm{T} = 2\pi\sqrt{\left\{\frac{K}{m}\right\}}$

   c) $\mathrm{T} = 2\pi\sqrt{\left\{\frac{m}{K}\right\}}$ d) $T = 2\pi\sqrt{\left\{\frac{2m}{K}\right\}}$

7. A hollow spherical pendulum filled with mercury has time period T. If mercury is thrown out completely, then the new time period **[1]**

   a) same b) decreases

   c) Falling d) increases

8. A particle is executing S.H.M of amplitude A with a time period T sec. The time taken by it to move from a positive extreme position to half the amplitude is: **[1]**

a) $\frac{T}{12}$ sec

b) $\frac{6T}{12}$ sec

c) $\frac{3T}{12}$ sec

d) $\frac{T}{6}$ sec

9. A rubber ball with water, having a small hole in its bottom is used as the bob of a simple pendulum. The time period of such a pendulum: **[1]**

a) First increases and then decreases finally having the same value as at the beginning

b) Is constant

c) Increases with time

d) Decreases with time

10. The time period of a simple pendulum of length L at a place where the acceleration due to gravity is g is T. What is the period of a simple pendulum of the same length at a place where the acceleration due to gravity is 1.02 g. **[1]**

a) 1.01T

b) 0.99T

c) 1.02T

d) T

11. A mass M is suspended by two springs which are connected in series. If the spring constants are K_1 and K_2 then the time period of the vertical vibrations is: **[1]**

a) T = $2\pi\sqrt{\frac{M(k_1+k_2)}{(k_1k_2)}}$

b) T = $2\pi\sqrt{\frac{M(k_1k_2)}{(k_1+k_2)}}$

c) T = $2\pi\sqrt{\left\{\frac{M}{(k_1-k_2)}\right\}}$

d) T = $2\pi\sqrt{\left\{\frac{M}{(k_1+k_2)}\right\}}$

12. Two simple pendulums of time periods 2.0 s and 2.1 s are made to vibrate simultaneously. They are in phase initially. After how may vibrations, they will be again in the same phase? **[1]**

a) 25

b) 21

c) 30

d) 35

13. A simple pendulum has a time period T. The pendulum is completely immersed in a non-viscous liquid, whose density is $\frac{1}{10}$ th of that of the material of the bob. The time period of the pendulum immersed in the liquid is: **[1]**

a) $\sqrt{\frac{10}{9}}T$

b) $\sqrt{\frac{9}{10}}T$

c) $\frac{T}{10}$

d) T

14. A spring has a certain mass suspended from it and its period for vertical oscillations is T_1. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillations is now T_2. The ratio of $\frac{T_1}{T_2}$ is: **[1]**

a) $\frac{1}{2}$

b) $2\sqrt{2}$

c) $\sqrt{2}$

d) 1

15. A pendulum suspended from the roof of an elevator at rest has a time period T_1. When the elevator moves up with an acceleration a its time period becomes T_2, when the elevator moves down with an acceleration a, its time period becomes T_3, then **[1]**

a) $T_1 = \sqrt{T_2^2 + T_3^2}$

b) $T_1 = \sqrt{T_2T_3}$

c) $T_1 = \frac{T_2 T_3 \sqrt{2}}{\sqrt{T_2^2 + T_3^2}}$

d) $T_1 = \sqrt{T_2^2 - T_3^2}$

16. The bob of simple pendulum having length l, is displaced from mean position to an angular position θ with respect to vertical. If it is released, then velocity of bob at equilibrium position will be: **[1]**

a) $\sqrt{2gl(1 - \cos\theta)}$

b) $\sqrt{2gl}$

c) $\sqrt{2gl(1 + \cos\theta)}$

d) $\sqrt{2gl\cos\theta}$

17. **Assertion (A):** When a girl sitting on a swing stands up, the periodic time of the swing will increase. **[1]**
Reason (R): In standing position of girl, the length of the swing will increase.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

18. **Assertion (A):** If a pendulum is suspended in a lift and lift is falling freely, then its time period becomes infinite. **[1]**
Reason (R): Free falling body has acceleration equal to acceleration due to gravity.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

19. **Assertion (A):** If amplitude of simple pendulam increases, its time period also increases. **[1]**
Reason (R): The simple pendulum covers more distance in each vibration when its amplitude is large.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

20. **Assertion:** When a pendulum is made to oscillate on the surface of the Moon, its time period increases. **[1]**
Reason: Moon is much smaller as compared to earth.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

21. **Assertion:** If a pendulum is suspended in a lift and lift is falling freely, then its time period becomes infinite. **[1]**
Reason: Free falling body has acceleration equal to acceleration due to gravity.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

22. **Assertion:** The time period of a pendulum on a satellite orbiting the earth is infinity. **[1]**
Reason: The time period of a pendulum is inversely proportional to $\sqrt{g}$.

a) Assertion and reason both are correct

b) Assertion and reason both are correct

statements and reason is correct explanation for assertion.

b) Both A and R are true but R is not the correct explanation of A.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

23. **Assertion (A):** The bob of a simple pendulum is a ball full of water. If a fine hole is made at the bottom of the ball, then the time period will no more remain constant. **[1]**

Reason (R): The time period of a simple pendulum does not depend upon mass.

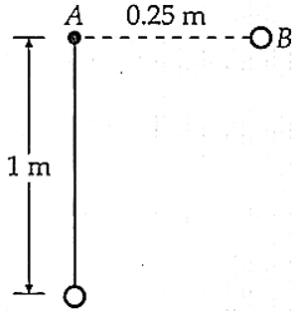
a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

24. A simple pendulum has a bob suspended by inextensible thread of length 1 metre from a point A of suspension. At the extreme position of oscillation, the thread is suddenly caught by the peg at a point B distant 0.25 m from A and the bob begins to oscillate in the new condition. The change in frequency of oscillation of the pendulum is approximately ($g = 10\ ms^{-2}$) given by **[1]**



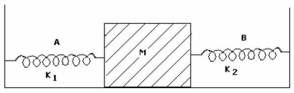
a) $\frac{1}{4\sqrt{10}}$ Hz

b) $\frac{1}{\sqrt{10}}$ Hz

c) $\frac{\sqrt{10}}{2}$ Hz

d) $\frac{\sqrt{10}}{3}$ Hz

25. In the arrangement shown in the figure, if the block of mass m is displaced, the frequency is given by: **[1]**



a) $f = \frac{1}{2\pi}\sqrt{\frac{k_1+k_2}{m}}$

b) $f = \frac{1}{2\pi}\sqrt{\frac{(k_1-k_2)}{m}}$

c) $f = \frac{1}{2\pi}\sqrt{[(k_1-k_2)m]}$

d) $f = \frac{1}{2\pi}\sqrt{[(k_1-k_2)m]}$

26. What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity? **[1]**

27. The bob of a simple pendulum of length l is negatively charged. A positively-charged metal plate is placed just below the bob and the pendulum is made to oscillate. What will be the effect on the time period of the pendulum? **[1]**

28. What will be the period of oscillation, if the length of a second's pendulum is halved? **[1]**

29. A girl is sitting in a swing. Another girl sits by her side. What will be the effect on the periodic time of the swing? **[1]**

30. What would be the effect on the time period, if the amplitude of simple pendulum increases? **[1]**

31. What will be the change in time period of a loaded spring, when taken to the moon? **[1]**

32. Can we use a pendulum watch in an artificial satellite? **[1]**

33. What is the length of a simple pendulum, which ticks seconds? **[1]**

34. How is the time period of the pendulum effected when pendulum is taken to hills Or in mines? **[1]**

35. What would be the time period of a simple pendulum at the centre of the earth? **[1]**

36. How will the time period of a simple pendulum change when its length is doubled? **[1]**

37. The time period of a body executing S.H.M is 1s. After how much time will its displacement be $\frac{1}{\sqrt{2}}$ of its amplitude? **[1]**

38. The amplitudes of oscillations of two simple pendulums similar in all respects are 2 cm and 5 cm respectively. Find the ratio of their energies of oscillations. **[1]**

39. The formula for time period T of a loaded spring is given as, $T = 2\pi\sqrt{\frac{\text{displacement}}{\text{acceleration}}}$. Does the time period depend on length of the spring? **[1]**

40. If the bob of a simple pendulum is made to oscillate in some fluid of density greater than the density of air (density of the bob density of the fluid), the time period of the pendulum increased or decrease. **[1]**

Section B

41. Derive an expression for the instantaneous velocity and acceleration of a particle executing S.H.M. **[2]**

42. A simple pendulum has time period T_1. The point of suspension is now moved upward according to the relation $y = Kt^2$ ($K = 1\ ms^{-2}$), where y is the vertical displacement. The time period now becomes T_2. What is the ratio $\frac{T_1^2}{T_2^2}$? Given g =10 ms^{-2}. **[2]**

43. If the length of a simple pendulum is increased by 25%, then what will be the change in its time period? **[2]**

44. Springs with spring constant K, 2K, 4K, K.... are connected in series. A mass M Kg is attached to the lower end of the last spring and system is allowed to vibrate. What is the time period of oscillation? **[2]**

45. A simple pendulum consisting of an inextensible length l and mass m is oscillating in a stationary lift. The lift then accelerates upwards with a constant acceleration of 4.5 m/s^2. Write expression for the time period of simple pendulum in two cases. Does the time period increase, decrease or remain the same, when lift is accelerated upwards? **[2]**

46. What will be the time period of the second's pendulum if its length is doubled? **[2]**

47. The bob of simple pendulum executes SHM in water with a period t, while the period of oscillation of the bob is t_0 in air. Neglecting frictional force of water and given that the density of the bob is $\frac{4000}{3}$ kg m^{-3}, find the relationship between t and t_0? **[2]**

48. Calculate the energy possessed by stone of mass 200 g executing S.H.M of amplitude 1cm and time period 4s. **[2]**

49. A simple pendulum is executing Simple harmonic motion with a time T. If the length of the pendulum is increased by 21%. Find the increase in its time period? **[2]**

50. The acceleration due to gravity on the surface of moon is 1.7 m/s^2. What is the time period of simple pendulum on moon if its time period on the earth is 3.5s? (g on the surface of earth is 9.8 ms^{-2}). **[2]**

51. The bob of a simple pendulum is a hollow sphere filled with water. How will the period of oscillation change if the water begins to drain out of the hollow sphere from a fine hole at its bottom? **[2]**

Section C

52. Show that for small oscillations the motion of a simple pendulum is simple harmonic. Derive an expression for its time period. Does it depend on the mass of the bob? **[3]**

53. A simple pendulum of length l and having a bob of mass M is suspended in a car. The car is moving on a circular track of radius R with a uniform speed v. If the pendulum makes small oscillations in a radial direction about its equilibrium position, what will be its time period? **[3]**

54. If the length of a second's pendulum is increased by 1 %, how many seconds will it lose or gain in a day? **[3]**

55. A simple pendulum is hung in a stationary lift and its periodic time is T. What will be the effect on its periodic time T if **[3]**

i. the lift goes up with uniform velocity v,

ii. the lift goes up with uniform acceleration a, and

iii. the lift comes down with uniform acceleration a?

56. A body of mass m is situated in a potential field $U(x) = U_0(1 - \cos \alpha x)$, where U_0 and α are constants. Find the time period of small oscillations. **[3]**

57. Consider an SHM as x(t) = 2cos($4\pi t + \pi/6$) where x is in metres and t in seconds. Determine the time period and initial velocity of the oscillating body. **[3]**

58. Determine the time period of oscillation of a simple pendulum. **[3]**

59. A pendulum clock shows accurate time. If the length increases by 0.1 %, deduce the error in time per day. **[3]**

60. Determine the time period of a simple pendulum of length 'l' when mass of bob is'm' Kg? **[3]**

Section D

61. **Fill in the blanks:** **[5]**

(a) The time period of a simple pendulum is _____ of the mass of the body. **[1]**

(b) The length of a simple pendulum is increased by 21%. The percentage increase in its time period will be _____%. **[1]**

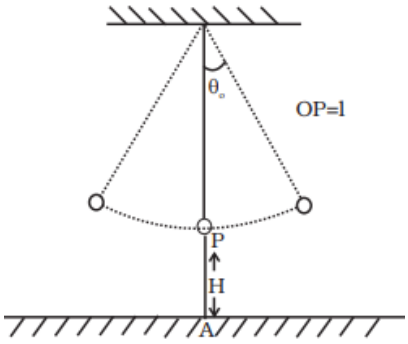
(c) A simple harmonic motion of acceleration a and displacement x is represented by a + $4\pi^2$x = 0. the time period of SHM is _____s. **[1]**

(d) The smallest interval of time after which the motion is repeated, in a periodic motion is called its _____. **[1]**

(e) The time period of a second's pendulum is _____ s and its length is _____ cm. **[1]**

62. Explain the time period of a simple pendulum. **[5]**

63. A simple pendulum of time period 1s and length l is hung from fixed support at O, such that the bob is at a distance H vertically above A on the ground (Figure). The amplitude is θ_o. The string snaps at $\theta\frac{\theta_0}{2}$. Find the time taken by the bob to hit the ground. Also, find the distance from A where bob hits the ground. Assume θ_o to be small so that sin θ_o and cosθ_o 1. **[5]**



64. A cylindrical piece of cork of density of base area *A* and height *h* floats in a liquid of density ρ_l. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period $T = 2\pi\sqrt{\frac{h\rho}{\rho_l g}}$ Where ρ is the density of cork. (Ignore damping due to viscosity of the liquid). **[5]**

65. One end of a V-tube containing mercury is connected to a suction pump and the other end to atmosphere. The two arms of the tube are inclined to horizontal at an angle of 45° each. A small pressure difference is created between two columns when the suction pump is removed. Will the column of mercury in V-tube execute simple harmonic motion? Neglect capillary and viscous forces. Find the time period of oscillation. **[5]**

Section E

66. **State True or False:** **[6]**

(a) Gravity does not play any role in determining time period of oscillations in spring mass system. **[1]**

(b) We can use a pendulum watch in an artificial satellite. **[1]**

(c) The bob of a simple pendulum is a ball full of water. If a fine hole is made in the bottom of the ball, then its time period will not remain constant. **[1]**

(d) The bob of a simple pendulum moves faster at the lowest point for larger amplitude. **[1]**

(e) One of the two clocks on the earth is controlled by a pendulum and the other by a spring. If these clocks be taken to the moon, then both will show the correct time. **[1]**

(f) The experiment of simple pendulum cannot be performed in the weightlessness state. **[1]**