ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

path to success

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PRE-MEDICAL

PHYSICS

ENTHUSIAST | LEADER | ACHIEVER

EXERCISE

Oscillations (SHM)

ENGLISH MEDIUM

EXERCISE-I (Conceptual Questions) Build Up Your Understanding

PERIODIC MOTION AND ITS CHARACTERISTICS

1. A particle of mass m is executing S.H.M. If amplitude is a and frequency n, the value of its force constant will be :

(1) mn^2 (2) $4mn^2a^2$
(3) ma^2 (4) $4\pi^2mn^2$

SH0001

2. The equation of motion of a particle executing S.H.M. where letters have usual meaning is :

(1) $\frac{d^2x}{dt^2} = -\frac{k}{m}x$ (2) $\frac{d^2x}{dt^2} = +\omega^2x$
(3) $\frac{d^2x}{dt^2} = -\omega^2x^2$ (4) $\frac{d^2x}{dt^2} = -kmx$

SH0002

3. The equation of motion of a particle executing SHM is $\left(\frac{d^2x}{dt^2}\right) + kx = 0$. The time period of the particle will be :

(1) $2\pi/\sqrt{k}$ (2) $2\pi/k$
(3) $2\pi k$ (4) $2\pi\sqrt{k}$

SH0003

4. Which of the following equation does not represent a simple harmonic motion :

(1) $y = a\sin\omega t$
(2) $y = b\cos\omega t$
(3) $y = a\sin\omega t + b\cos\omega t$
(4) $y = a\tan\omega t$

SH0004

SIMPLE HARMONIC MOTION (SHM) AND ITS EQUATION

5. The displacement of a particle in S.H.M. is indicated by equation $y = 10\sin(20t + \pi/3)$ where y is in metres. The value of time period of vibration will be (in seconds) :

(1) $10/\pi$ (2) $\pi/10$
(3) $2\pi/10$ (4) $10/2\pi$

SH0005

6. The value of phase at maximum displacement from the mean position of a particle in S.H.M. is:

(1) $\pi/2$ (2) π (3) Zero (4) 2π

SH0006

7. The equation of a simple harmonic motion is $x = 0.34\cos(3000t + 0.74)$. Where x and t are in mm and sec. respectively. The frequency of the motion is :

(1) 3000 (2) $3000/2\pi$
(3) $0.74/2\pi$ (4) $3000/\pi$

SH0007

8. The acceleration of a particle executing S.H.M. is

(1) Always directed towards the equillibrium position
(2) Always towards the one end
(3) Continuously changing in direction
(4) Maximum at the mean position

SH0008

9. The distance covered by a particle executing SHM, in one time period is equal to :

(1) Four times the amplitude
(2) Two times the amplitude
(3) One times the amplitude
(4) Eight times the amplitude

SH0009

10. The phase of a particle in S.H.M. is $\pi/2$, then :

(1) Its velocity will be maximum.
(2) Its acceleration will be minimum.
(3) Restoring force on it will be minimum.
(4) Its displacement will be maximum.

SH0010

11. The displacement of a particle in S.H.M. is indicated by equation $y = 10\sin(20t + \pi/3)$ where y is in metres. The value of maximum velocity of the particle will be :

(1) 100 m/sec. (2) 150 m/sec.
(3) 200 m/sec. (4) 400 m/sec.

SH0011

12. In the above question, the value of phase constant will be :

(1) Zero (2) 45° (3) 60° (4) 30°

SH0012

13. The phase of a particle in SHM at time t is $\pi/6$. The following inference is drawn from this:
(1) The particle is at $x = a/2$ and moving in + X-direction
(2) The particle is at $x = a/2$ and moving in – X-direction
(3) The particle is at $x = -a/2$ and moving in + X-direction
(4) The particle is at $x = -a/2$ and moving in – X-direction

SH0013

14. Two particles execute S.H.M. along the same line at the same frequency. They move in opposite direction at the mean position. The phase difference will be :
(1) 2π (2) $2\pi/3$ (3) π (4) $\pi/2$

SH0014

15. The displacement from mean position of a particle in SHM at 3 seconds is $\sqrt{3}/2$ times of the amplitude. Its time period will be :
(1) 18 sec. (2) $6\sqrt{3}$ sec.
(3) 9 sec. (4) $3\sqrt{3}$ sec.

SH0015

16. A particle executes SHM of type $x = a\sin\omega t$. It takes time t_1 from $x = 0$ to $x = \frac{a}{2}$ and t_2 from $x = \frac{a}{2}$ to $x = a$. The ratio of $t_1 : t_2$ will be :
(1) 1 : 1 (2) 1 : 2
(3) 1 : 3 (4) 2 : 1

SH0016

17. The time taken by a particle in SHM for maximum displacement is :
(1) T/8 (2) T/6 (3) T/2 (4) T/4

SH0017

18. A particle executes SHM with periodic time of 6 seconds. The time taken for traversing a distance of half the amplitude from mean position is :
(1) 3 sec. (2) 2 sec.
(3) 1 sec. (4) 1/2 sec.

SH0018

19. The phase difference between the displacement and acceleration of particle executing S.H.M. in radian is :
(1) $\pi/4$ (2) $\pi/2$ (3) π (4) 2π

SH0019

20. The phase difference in radians between displacement and velocity in S.H.M. is :
(1) $\pi/4$ (2) $\pi/2$ (3) π (4) 2π

SH0020

21. If the maximum velocity of a particle in SHM is v_0. then its velocity at half the amplitude from position of rest will be :
(1) $v_0/2$ (2) v_0
(3) $v_0\sqrt{3/2}$ (4) $v_0\sqrt{3}/2$

SH0021

22. At a particular position the velocity of a particle in SHM with amplitude a is $\sqrt{3}/2$ times that at its mean position. In this position, its displacement is :
(1) a/2 (2) $\sqrt{3}a/2$ (3) $a\sqrt{2}$ (4) $\sqrt{2a}$

SH0022

23. The acceleration of a particle in SHM at 5 cm from its mean position is 20 cm/sec^2. The value of angular frequency in radians/sec will be :
(1) 2 (2) 4 (3) 10 (4) 14

SH0023

24. The amplitude of a particle in SHM is 5 cms and its time period is π. At a displacement of 3 cms from its mean position the velocity in cms/sec will be :
(1) 8 (2) 12 (3) 2 (4) 16

SH0024

25. The maximum velocity and acceleration of a particle in S.H.M. are 100 cms/sec and 157 cm/sec^2 respectively. The time period in seconds will be :
(1) 4 (2) 1.57 (3) 0.25 (4) 1

SH0025

26. If the displacement, velocity and acceleration of a particle in SHM are 1 cm, 1cm/sec, 1cm/sec^2 respectively its time period will be (in seconds) :
(1) π (2) 0.5π (3) 2π (4) 1.5π

SH0026

27. The particle is executing S.H.M. on a line 4 cms long. If its velocity at mean position is 12 cm/sec, its frequency in Hertz will be :

(1) $\frac{2\pi}{3}$ (2) $\frac{3}{2\pi}$ (3) $\frac{\pi}{3}$ (4) $\frac{3}{\pi}$

SH0027

28. Which of the following statement is incorrect for an object executing S.H.M. :

(1) The value of acceleration is maximum at the extreme points

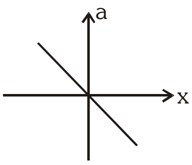
(2) The total work done for completing one oscillation is zero.

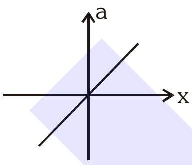
(3) The energy changes from one form to another

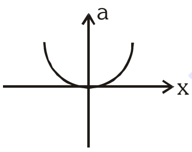
(4) The velocity at the mean position is zero

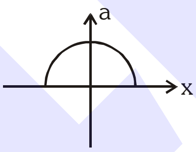
SH0028

29. The variation of acceleration (a) and displacement (x) of the particle executing SHM is indicated by the following curve :

(1) 

(2) 

(3) 

(4) 

SH0029

30. The time period of an oscillating body executing SHM is 0.05 sec and its amplitude is 40 cm. The maximum velocity of particle is :

(1) $16\pi \text{ ms}^{-1}$ (2) $2\pi \text{ ms}^{-1}$

(3) 3.1 ms^{-1} (4) 4π m/s

SH0030

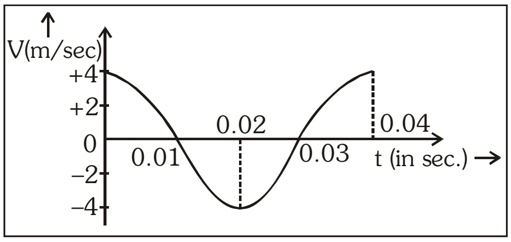
31. A body of mass 5 gm is executing S.H.M. about a point with amplitude 10 cm. Its maximum velocity is 100 cm/sec. Its velocity will be 50 cm/sec at a distance from mean position :

(1) 5 cm (2) $5\sqrt{2}$ cm

(3) $5\sqrt{3}$ cm (4) $10\sqrt{2}$ cm

SH0031

32. The velocity-time diagram of a harmonic oscillator is shown in the adjoining figure. The frequency of oscillation is :



(1) 25 Hz (2) 50 Hz

(3) 12.25 Hz (4) 33.3 Hz

SH0032

33. If amplitude of the particle which is executing S.H.M., is doubled, then which quantity will become double ?

(1) Frequency (2) Time period

(3) Energy (4) Maximum velocity

SH0034

34. Which one of the following statements is true for the speed 'v' and the acceleration 'a' of a particle executing simple harmonic motion

(1) Value of 'a' is zero, whatever may be the value of 'v'

(2) When 'v' is zero, 'a' is zero

(3) When 'v' is maximum, 'a' is zero

(4) When 'v' is maximum, 'a' is maximum

SH0035

35. For a particle executing simple harmonic motion which of the following statement is not correct:

(1) The total energy of particle always remains the same

(2) The restoring force is always directed towards a fix point.

(3) The restoring force is maximum at the extreme positions.

(4) The acceleration of particle is maximum at the equilibrium positions.

SH0036

36. In SHM velocity is maximum:

(1) At extreme position

(2) When displacement is half of amplitude

(3) At the central position

(4) When Displacement is $\frac{1}{\sqrt{2}}$ of amplitude

SH0037

37. A body oscillates with SHM according to the equation $x = 5.0 \cos(2\pi t + \pi)$. At time t = 1.5 s, its displacement, speed and acceleration respectively is :
(1) $0, -10\pi, +20\pi^2$ (2) $5, 0, -20\pi^2$
(3) $2.5, +20\pi, 0$ (4) $-5.0, +5\pi, -10\pi^2$
SH0038

38. The maximum velocity of simple harmonic motion represented by $y = 3\sin\left(100t + \frac{\pi}{6}\right)$ is given by
(1) 300 (2) $\frac{3\pi}{6}$ (3) 100 (4) $\frac{\pi}{6}$
SH0040

39. The maximum velocity of a particle, executing simple harmonic motion with an amplitude 7 mm is 4.4 m/s. The period of oscillation is :
(1) 100 s (2) 0.01 s (3) 10 s (4) 0.1 s
SH0041

40. Average velocity of a particle performing SHM in one time period is :-
(1) Zero (2) $\frac{A\omega}{2}$ (3) $\frac{A\omega}{2\pi}$ (4) $\frac{2A\omega}{\pi}$
SH0042

41. A particle is executing S.H.M. with amplitude A and Time period T. Time taken by the particle to reach from extreme position to $\frac{A}{2}$
(1) $\frac{T}{6}$ (2) $\frac{T}{12}$ (3) $\frac{T}{3}$ (4) $\frac{T}{4}$
SH0043

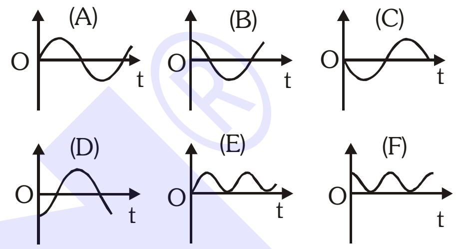
42. Total work done on a simple pendulum in one complete oscillation will be :-
(1) $\frac{1}{2}kx^2$ (2) $\frac{1}{2}kA^2$
(3) kA^2 (4) Zero
SH0044

43. In S.H.M. Which one of the following quantities has constant ratio with acceleration :-
(1) Time (2) Displacement
(3) Velocity (4) Mass
SH0045

44. The displacement y of a particle varies with time t, in seconds, as
$y = 2 \cos(\pi t + \pi/6)$.
The time period of the oscillations is
(1) 2 s (3) 4 s (3) 1 s (4) 0.5 s
SH0046

ENERGY IN SHM-KINETIC AND POTENTIAL ENERGIES

45. The displacement of a particle in S.H.M. is $x = a\sin\omega t$. Which of the following graph between displacement and time is correct :



(1) A (2) B (3) C (4) D
SH0047

46. In previous question which of the graph between velocity and time is correct ?
(1) A (2) B (3) C (4) D
SH0048

47. In Question 45 which of the graph between kinetic energy and time is correct ?
(1) A (2) B (3) E (4) F
SH0049

48. In Question 45 which of the graph between potential energy and time is correct ?
(1) A (2) B (3) E (4) F
SH0050

49. In Question 45 which of the graph between acceleration and time is correct ?
(1) A (2) B (3) C (4) D
SH0051

50. In Question 45 if the displacement of a particle executing SHM is $x = a\cos\omega t$, which of the graph between displacement and time is correct ?
(1) A (2) B (3) C (4) D
SH0052

51. In question 50 which of the graph between velocity and time is correct ?
(1) A (2) B (3) C (4) D
SH0053

52. In question 50 which of the graph between acceleration and time is correct ?

(1) A (2) B (3) C (4) D

SH0054

53. In question 50 which of the graph between K.E. and time is correct ?

(1) A (2) B (3) E (4) F

SH0055

54. In question 50 which of the graph between P.E. and time is correct ?

(1) A (2) B (3) E (4) F

SH0056

55. The total energy of a particle executing SHM is directly proportional to the square of the following quantity :

(1) Acceleration (2) Amplitude

(3) Time period (4) Mass

SH0058

56. The total energy of a vibrating particle in SHM is E. If its amplitude and time period are doubled, its total energy will be :

(1) 16E (2) 8E (3) 4E (4) E

SH0059

57. The total vibrational energy of a particle in S.H.M. is E. Its kinetic energy at half the amplitude from mean position will be :

(1) E/2 (2) E/3 (3) E/4 (4) 3E/4

SH0060

58. If total energy of a particle in SHM is E, then the potential energy of the particle at half the amplitude will be :

(1) E/2 (2) E/4 (3) 3E/4 (4) E/8

SH0061

59. A particle executes SHM on a line 8 cm long. Its K.E. and P.E. will be equal when its distance from the mean position is :

(1) 4 cm (2) 2 cm (3) $2\sqrt{2}$ cm (4) $\sqrt{2}$ cm

SH0062

60. The average P.E. of a body executing S.H.M. is :

(1) $\frac{1}{2}ka^2$ (2) $\frac{1}{4}ka^2$ (3) ka^2 (4) Zero

SH0063

61. The value of total mechanical energy of a particle in S.H.M. is :

(1) Always constant (2) Depend on time

(3) $\frac{1}{2}kA^2\cos^2(\omega t+\phi)$ (4) $\frac{1}{2}mA^2\cos^2(\omega t+\phi)$

SH0064

62. The maximum K.E. of a oscillating spring is 5 joules and its amplitude 10 cm. The force constant of the spring is :

(1) 100 Newton/m. (2) 1000 Newton–m

(3) 1000 Newton/m. (4) 1000 watts.

SH0065

63. The force acting on a 4gm mass in the energy region $U = 8x^2$ at $x = -2$cm is :

(1) 8 dyne (2) 4 dyne

(3) 16 dyne (4) 32 dyne

SH0066

64. Displacement between max. P.E. position and max. K.E. position for a particle executing simple harmonic motion is :

(1) $\pm \frac{a}{2}$ (2) + a

(3) ± a (4) – 1

SH0067

65. A particle is describing SHM with amplitude 'a'. When the potential energy of particle is one fourth of the maximum energy during oscillation, then its displacement from mean position will be:

(1) $\frac{a}{4}$ (2) $\frac{a}{3}$ (3) $\frac{a}{2}$ (4) $\frac{2a}{3}$

SH0068

66. The ratio of K.E. of the particle at mean position to the point when distance is half of amplitude will be:

(1) $\frac{1}{3}$ (2) $\frac{2}{3}$ (3) $\frac{4}{3}$ (4) $\frac{3}{2}$

SH0069

67. A particle is executing S.H.M., If its P.E. & K.E. is equal then the ratio of displacement & amplitude will be :

(1) $\frac{1}{\sqrt{2}}$ (2) $\sqrt{2}$ (3) $\frac{1}{2}$ (4) $\frac{3}{2}$

SH0070

68. Which of the following is constant during SHM:

(1) Velocity
(2) Acceleration
(3) Total energy
(4) Phase

SH0071

69. If <E> and <V> denotes the average kinetic and average potential energies respectively of mass describing a simple harmonic motion over one period then the correct relation is:

(1) <E> = <V> (2) <E> = 2<V>
(3) <E> = –2<V> (4) <E> = – <V>

SH0072

70. The elongation of spring is 1 cm and its potential energy is U. If the spring is elongated by 3cm then potential energy will be :-

(1) 3U (2) $\frac{U}{3}$ (3) 9U (4) $\frac{U}{9}$

SH0073

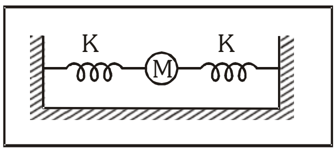
71. The potential energy of a spring when stretched by a distance x is E. The energy of the spring when stretched by x/2 is

(1) E (2) E/2 (3) E/4 (4) E/6

SH0074

OSCILLATIONS OF A SPRING

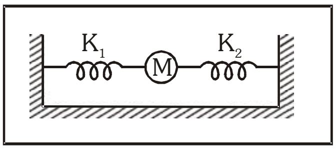
72. On suspending a mass M from a spring of force constant K, frequency of vibration f is obtained. If a second spring as shown in the figure, is arranged then the frequency will be :



(1) $f\sqrt{2}$ (2) $f/\sqrt{2}$ (3) 2f (4) f

SH0075

73. In the adjoining figure the frequency of oscillation for a mass M will be proportional to :



(1) K_1K_2 (2) $K_1 + K_2$
(3) $\sqrt{K_1+K_2}$ (4) $\sqrt{1/K_1+K_2}$

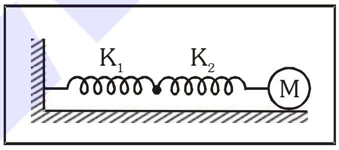
SH0076

74. An object of mass m is suspended from a spring and it executes S.H.M. with frequency υ. If the mass is increased 4 times, the new frequency will be :

(1) 2υ (2) υ/2
(3) υ (4) υ/4

SH0077

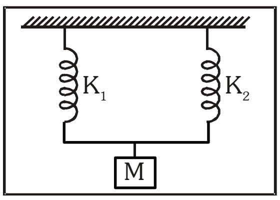
75. As shown in the figure, two light springs of force constant K_1 and K_2 oscillate a block of mass M. Its effective force constant will be :



(1) K_1K_2 (2) $K_1 + K_2$
(3) $\frac{1}{K_1}+\frac{1}{K_2}$ (4) $\frac{K_1K_2}{K_1+K_2}$

SH0078

76. The spring constants of two springs of same length are K_1 and K_2 as shown in figure. If an object of mass M is suspended and set vibration, the time period will be :



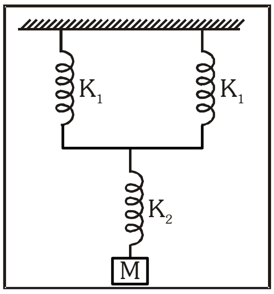
(1) $2\pi\sqrt{\frac{MK_1}{K_2}}$ (2) $2\pi\sqrt{\frac{M}{K_1K_2}}$

(3) $2\pi\sqrt{\frac{M}{K_1-K_2}}$ (4)$2\pi\sqrt{M/(K_1+K_2)}$

SH0079

ALLEN

77. The total spring constant of the system as shown in the figure will be :



(1) $\frac{K_1}{2}+K_2$

(2) $\left[\frac{1}{2K_1}+\frac{1}{K_2}\right]^{-1}$

(3) $\frac{1}{2K_1}+\frac{1}{K_2}$

(4) $\left[\frac{2}{K_1}+\frac{1}{K_2}\right]^{-1}$

SH0080

78. A spring is made to oscillate after suspending a mass m from one of its ends. The time period obtained is 2 seconds. On increasing the mass by 2 kg, the period of oscillation is increased by 1 second. The initial mass m will be :

(1) 2 kg (2) 1 kg
(3) 0.5 kg (4) 1.6 kg

SH0082

79. The time period of a spring pendulum on earth is T. If it is taken on the moon, and made to oscillate, the period of vibration will be :

(1) Less than T
(2) Equal to T
(3) More than T
(4) None of these

SH0083

80. On loading a spring with bob, its period of oscillation in a vertical plane is T. If this spring pendulum is tied with one end to the a friction less table and made to oscillate in a horizontal plane, its period of oscillation will be :

(1) T
(2) 2T
(3) T/2
(4) will not execute S.H.M.

SH0084

81. In a winding (spring) watch, the energy is stored in the form of :

(1) Kinetic energy (2) Potential energy
(3) Electrical energy (4) None of these

SH0085

82. In an artificial satellite, the object used is :

(1) Spring watch
(2) Pendulum watch
(3) Watches of both spring and pendulum
(4) None of these

SH0086

83. Mass 'm' is suspended from a spring of force constant K. Spring is cut into two equal parts and same mass is suspended from it, then new frequency will be:

(1) 2ν (2) $\sqrt{2}\,\nu$ (3) ν (4) $\frac{\nu}{2}$

SH0087

84. The spring constant of two springs are K_1 and K_2 respectively springs are stretch up to that limit when potential energy of both becomes equal. The ratio of applied force (F_1 and F_2) on them will be :

(1) $K_1 : K_2$ (2) $K_2 : K_1$
(3) $\sqrt{K_1} : \sqrt{K_2}$ (4) $\sqrt{K_2} : \sqrt{K_1}$

SH0088

85. Force constant of a spring is K. If one fourth part is detach then force constant of remaining spring will be :

(1) $\frac{3}{4}K$ (2) $\frac{4}{3}K$ (3) K (4) 4K

SH0089

86. The spring constant of a spring is K. When it is divided into n equal parts, then what is the spring constant of one part :

(1) nK (2) K/n
(3) $\frac{nK}{(n+1)}$ (4) $\frac{(n+1)K}{n}$

SH0090

87. A mass of 10g is connected to a massless spring then time period of small oscillation is 10 second. If 10 g mass is replaced by 40 g mass in same spring, then its time period will be:-

(1) 5s (2) 10s (3) 20s (4) 40s

SH0094

SIMPLE PENDULUM

88. The mass of a bob, suspended in a simple pendulum, is halved from the initial mass, its time period will :

(1) Be less (2) Be more
(3) Remain unchanged (4) None of these

SH0095

89. If the amplitude of a simple pendulum is doubled, how many times will the value of its maximum velocity be that of the maximum velocity in initial case :

(1) $\frac{1}{2}$ (2) 2 (3) 4 (4) $\frac{1}{4}$

SH0096

90. The length of a simple pendulum is $39.2/\pi^2$ m. If g = 9.8 m/sec^2, the value of time period is:

(1) 4 s (2) 8 s (3) 2 s (4) 3 s

SH0097

91. The length of a simple pendulum is increased four times of its initial value, its time period with respect to its previous value will :

(1) Become twice (2) Not be different
(3) Be halved (4) Be $\sqrt{2}$ times

SH0098

92. The time taken for a second pendulum from one extreme point to another is :

(1) 1 s (2) 2 s
(3) 1/2 s (4) 4 s

SH0099

93. The length of a seconds pendulum is (approximately) :

(1) 1 m (2) 1 cm
(3) 2 m (4) 2 cm

SH0100

94. The acceleration due to gravity at height R above the surface of the earth is g/4. The periodic time of a simple pendulum in an artificial satellite at this height will be :

(1) $T = 2\pi\sqrt{2l/g}$

(2) $T = 2\pi\sqrt{l/2g}$

(3) Zero

(4) Infinity

SH0101

95. An oscillating pendulum stops, because its energy

(1) Changes into kinetic energy

(2) Change into potential energy

(3) Change into heat energy

(4) Is destroyed

SH0103

96. Simple pendulum of large length is made equal to the radius of the earth. Its period of oscillation will be :

(1) 84.6 min. (2) 59.8 min.
(3) 42.3 min. (4) 21.15 min.

SH0104

97. The maximum time period of oscillation of a simple pendulum of large length is:

(1) Infinity (2) 24 hours
(3) 12 hours (4) 1½hours

SH0105

98. In a simple oscillating pendulum, the work done by the string in one oscillation will be:

(1) Equal to the total energy of the pendulum

(2) Equal to the K.E. of the pendulum

(3) Equal to the P.E. of the pendulum

(4) Zero

SH0106

99. A lift is ascending with acceleration g/3. What will be the time period of a simple pendulum suspended from its ceiling if its time period in stationary lift is T ?

(1) $\frac{T}{2}$ (2) $\frac{\sqrt{3}T}{2}$ (3) $\frac{\sqrt{3}T}{4}$ (4) $\frac{T}{4}$

SH0107

100. A child swinging on a swing in sitting position, stands up, then the period of the swing will be:

(1) Increase

(2) Decrease

(3) Remain same

(4) Increase if child is long and decrease if child is short

SH0108

101. A simple pendulum is suspended from the ceiling of a vehicle, its time period is T. Vehicle is moving with constant velocity, then time period of simple pendulum will be :

(1) Less than T (2) Equal to T
(3) More than T (4) Cannot predict

SH0109

SUPERPOSITION OF SHMs, FREE, FORCED AND DAMPED OSCILATIONS, RESONANCE

102. The vibrations taking place in the diaphragm of a microphone will be :-
(1) free vibrations
(2) damped vibrations
(3) forced vibrations
(4) electrically maintained vibrations
SH0110

103. In the case of sustained forced oscillations the amplitude of oscillations :-
(1) decreases linearly
(2) decreases sinusoidally
(3) decreases exponentially
(4) always remains constant
SH0111

104. Two sources of sound are in resonance when :-
(1) they look alike
(2) they are situated at a particular distance from each other
(3) they produce the sound of same intensity
(4) they are excited by the same exciting device
SH0112

105. When a tuning fork is vibrated, another in the neighbourhood begins to vibrate. This is due to the phenomenon of :-
(1) gravitation
(2) Newton's III law
(3) Resonance
(4) None
SH0113

106. The amplitude of a SHM reduces to 1/3 in first 20 second then in first 40 second its amplitude becomes:
(1) $\frac{1}{3}$ (2) $\frac{1}{9}$ (3) $\frac{1}{27}$ (4) $\frac{1}{\sqrt{3}}$
SH0114

107. Amplitude of vibrations remains constant in case of
(i) free vibrations
(ii) damped vibrations
(iii) maintained vibrations
(iv) forced vibrations
(1) i, iii, iv (2) ii, iii
(3) i, ii, iii (4) ii, iv
SH0115

EXERCISE-I (Conceptual Questions) ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**4**	**1**	**1**	**4**	**2**	**1**	**2**	**1**	**1**	**4**	**3**	**3**	**1**	**3**	**1**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**2**	**4**	**4**	**3**	**2**	**4**	**1**	**1**	**1**	**1**	**3**	**4**	**4**	**1**	**1**
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	**3**	**1**	**4**	**3**	**4**	**3**	**2**	**1**	**2**	**1**	**1**	**4**	**2**	**1**	**1**
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	**2**	**4**	**3**	**3**	**2**	**3**	**4**	**3**	**4**	**2**	**4**	**4**	**2**	**3**	**2**
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans.	**1**	**3**	**4**	**3**	**3**	**3**	**1**	**3**	**1**	**3**	**3**	**1**	**3**	**2**	**4**
Que.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans.	**4**	**2**	**4**	**2**	**1**	**2**	**1**	**2**	**3**	**2**	**1**	**3**	**3**	**2**	**1**
Que.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
Ans.	**1**	**1**	**1**	**4**	**3**	**2**	**4**	**4**	**2**	**2**	**2**	**3**	**4**	**4**	**3**
Que.	106	107													
Ans.	**2**	**1**													

EXERCISE-II (Previous Year Questions) AIPMT/NEET

AIPMT 2006

1. The potential energy of a long spring when stretched by 2cm is U. If the spring is stretched by 8 cm the potential energy stored in it is :-

(1) 4 U (2) 8 U

(3) 16 U (4) $\frac{U}{4}$

SH0116

AIPMT 2007

2. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is :-

(1) Zero (2) 0.5 π

(3) π (4) 0.707π

SH0117

3. The particle executing simple harmonic motion has a kinetic energy $K_o \cos^2 \omega t$. The maximum values of the potential energy and the total energy are respectively :-

(1) K_o and K_o

(2) 0 and $2K_o$

(3) $\frac{K_o}{2}$ and K_o

(4) K_o and $2K_o$

SH0118

4. A particle executes simple harmonic oscillation with an amplitude a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is :-

(1) T/2 (2) T/4

(3) T/8 (4) T/12

SH0119

AIPMT 2008

5. Two simple Harmonic Motions of angular frequency 100 and 1000 rad s^{-1} have the same displacement amplitude. The ratio of their maximum accelerations is:-

(1) 1 : 10^3

(2) 1 : 10^4

(3) 1 : 10

(4) 1: 10^2

SH0120

6. A point performs simple harmonic oscillation of period T and the equation of motion is given by $x = a \sin(\omega t + \pi/6)$. After the elapse of what fraction of the time period the velocity of the point will be equal to half of its maximum velocity ?

(1) T/3

(2) T/12

(3) T/8

(4) T/6

SH0121

AIPMT 2009

7. A simple pendulum performs simple harmonic motion about x = 0 with an amplitude a and time period T. The speed of the pendulum at x = a/2 will be :-

(1) $\frac{\pi a\sqrt{3}}{T}$ (2) $\frac{\pi a\sqrt{3}}{2T}$

(3) $\frac{\pi a}{T}$ (4) $\frac{3\pi^2 a}{T}$

SH0122

8. Which one of the following equations of motion represents simple harmonic motion :-

(1) Acceleration = kx

(2) Acceleration = $-k_0x+k_1x^2$

(3) Acceleration = $-k(x + a)$

(4) Acceleration = $k(x + a)$

Where k, k_0, k_1 and a are all positive

SH0123

AIPMT (Pre) 2010

9. The period of oscillation of a mass M suspended from a spring of negligible mass is T. If along with it another mass M is also suspended, the period of oscillation will now be :-

(1) $\sqrt{2}T$ (2) T

(3) $\frac{T}{\sqrt{2}}$ (4) 2T

SH0124

AIPMT (Pre) 2011

10. Out of the following functions representing motion of a particle which represents SHM :

(A) $y = \sin\omega t - \cos\omega t$

(B) $y = \sin^3\omega t$

(C) $y = 5\cos\left(\frac{3\pi}{4} - 3\omega t\right)$

(D) $y = 1 + \omega t + \omega^2 t^2$

(1) Only (A)

(2) Only (D) does not represent SHM

(3) Only (A) and (C)

(4) Only (A) and (B)

SH0125

AIPMT (Mains) 2011

11. Two particles are oscillating along two close parallel straight lines side by side, with the same frequency and amplitudes. They pass each other, moving in opposite directions when their displacement is half of the amplitude. The phase difference is:-

(1) $\frac{\pi}{6}$ (2) 0 (3) $\frac{2\pi}{3}$ (4) π

SH0126

AIPMT 2014

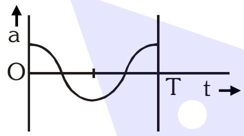
12. The oscillation of a body on a smooth horizontal surface is represented by the equation,

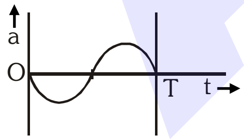
$X = A\cos(\omega t)$

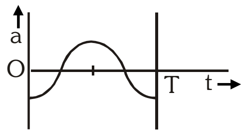
where X = displacement at time t

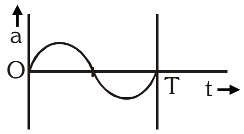
ω = frequency of oscillation

Which one of the following graphs shows correctly the variation 'a' with 't' ?

(1) 

(2) 

(3) 

(4) 

SH0127

AIPMT 2015

13. When two dispalcements represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed the motion is :

(1) simple harmonic with amplitude $\frac{a}{b}$

(2) simple harmonic with amplitude $\sqrt{a^2 + b^2}$

(3) simple harmonic with amplitude $\frac{(a+b)}{2}$

(4) not a simple harmonic

SH0128

14. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are V_1 and V_2, respectively. Its time period is :-

(1) $2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$ (2) $2\pi\sqrt{\frac{V_1^2 + V_2^2}{x_1^2 + x_2^2}}$

(3) $2\pi\sqrt{\frac{V_1^2 - V_2^2}{x_1^2 - x_2^2}}$ (4) $2\pi\sqrt{\frac{x_1^2 + x_2^2}{V_1^2 + V_2^2}}$

SH0129

15. Two similar springs P and Q have spring constants K_P and K_Q, such that $K_P > K_Q$. The are stretched, first by the same amount (case a,) then by the same force (case b). The work done by the springs W_P and W_Q are related as, in case (a) and case (b), respectively :

(1) $W_P = W_Q$; $W_P = W_Q$

(2) $W_P > W_Q$; $W_Q > W_P$

(3) $W_P < W_Q$; $W_Q < W_P$

(4) $W_P = W_Q$; $W_P > W_Q$

SH0130

RE-AIPMT 2015

16. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then its time period of vibration will be :-

(1) $\frac{2\pi\beta}{\alpha}$ (2) $\frac{\beta^2}{\alpha^2}$

(3) $\frac{\alpha}{\beta}$ (4) $\frac{\beta^2}{\alpha}$

SH0131

NEET-II 2016

17. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3s. When the mass m is increased by 1 kg, the time period of oscillations becomes 5 s. The value of m in kg is :-

(1) $\frac{16}{9}$ (2) $\frac{9}{16}$ (3) $\frac{3}{4}$ (4) $\frac{4}{3}$

SH0133

NEET(UG) 2017

18. A spring of force constant k is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constant is k'. Then they are connected in parallel and force constant is k''. Then $k' : k''$ is:-

(1) 1 : 9 (2) 1 : 11

(3) 1 : 14 (4) 1 : 16

SH0137

19. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is :-

(1) $\frac{\sqrt{5}}{2\pi}$ (2) $\frac{4\pi}{\sqrt{5}}$

(3) $\frac{2\pi}{\sqrt{3}}$ (4) $\frac{\sqrt{5}}{\pi}$

SH0138

NEET(UG) 2018

20. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is 20 m/s^2 at a distance of 5 m from the mean position. The time period of oscillation is :-

(1) 2π s (2) π s

(3) 2 s (4) 1 s

SH0140

NEET(UG) 2019

21. The displacement of a particle executing simple harmonic motion is given by

$y = A_0 + A\sin\omega t + B\cos\omega t$.

Then the amplitude of its oscillation is given by :

(1) $A_0 + \sqrt{A^2 + B^2}$ (2) $\sqrt{A^2 + B^2}$

(3) $\sqrt{A_0^2 + (A+B)^2}$ (4) A + B

SH0171

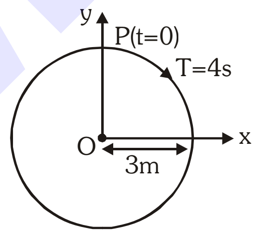
22. Average velocity of a particle executing SHM in one complete vibration is :

(1) $\frac{A\omega}{2}$ (2) $A\omega$

(3) $\frac{A\omega^2}{2}$ (4) Zero

SH0172

23. The radius of circle the period of revolution initial position and sense of revolution are indicated in the fig.



y-projection of the radius vector of rotating particle P is :

(1) $y(t) = -3\cos 2\pi t$, where y in m

(2) $y(t) = 4\sin\left(\frac{\pi t}{2}\right)$, where y in m

(3) $y(t) = 3\cos\left(\frac{3\pi t}{2}\right)$, where y in m

(4) $y(t) = 3\cos\left(\frac{\pi t}{2}\right)$, where y in m

SH0173

NEET(UG) 2019 (Odisha)

24. The distance covered by a particle undergoing SHM in one time period is (amplitude = A) :-

(1) zero (2) A

(3) 2A (4) 4A

SH0174

25. A mass falls from a height 'h' and its time of fall 't' is recorded in terms of time period T of a simple pendulum. On the surface of earth it is found that t = 2T. The entire set up is taken on the surface of another planet whose mass is half of that of earth and radius the same. Same experiment is repeated and corresponding times noted as t' and T', then

(1) $t' = \sqrt{2}T'$ (2) $t' > 2T'$

(3) $t' < 2T'$ (4) $t' = 2T'$

SH0175

NEET(UG) 2020

26. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is :

(1) Zero (2) π rad

(3) $\frac{3\pi}{2}$ rad (4) $\frac{\pi}{2}$ rad

SH0176

NEET(UG) 2020 (Covid-19)

27. Identify the function which represents a periodic motion

(1) $e^{\omega t}$ (2) $\log_e(\omega t)$

(3) $\sin \omega t + \cos \omega t$ (4) $e^{-\omega t}$

SH0177

NEET(UG) 2021

28. A body is executing simple harmonic motion with frequency 'n', the frequency of its potential energy is :-

(1) n (2) 2n

(3) 3n (4) 4n

SH0178

29. A spring is stretched by 5 cm by a force 10 N. The time period of the oscillations when a mass of 2 kg is suspended by it is :

(1) 0.0628 s (2) 6.28 s

(3) 3.14 s (4) 0.628 s

SH0179

NEET (UG) 2021(Paper-2)

30. A mass m is vertically suspended from a spring of negligible mass, the system oscillates with a frequency f. Now spring is cut into two equal parts, these parts are connected in parallel and a mass 4m is suspended, the new frequency of oscillation will be

(1) f

(2) 2f

(3) 3f

(4) 4f

SH0180

NEET (UG) 2022

31. Two pendulums of length 121 cm and 100 cm start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is :

(1) 9

(2) 10

(3) 8

(4) 11

SH0181

NEET (UG) 2022 (Overseas)

32. During simple harmonic motion of a body, the energy at the extreme positions is:

(1) is always zero

(2) purely kinetic

(3) purely potential

(4) both kinetic and potential

SH0182

Re-NEET (UG) 2022

33. Identify the function which represents a non-periodic motion.

(1) $e^{-\omega t}$

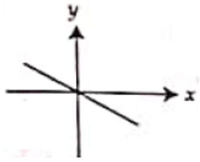
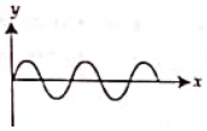
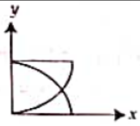
(2) $\sin\omega t$

(3) $\sin\omega t + \cos\omega t$

(4) $\sin(\omega t + \pi/4)$

SH0183

34. Match List – I with List – II :

	List –I (x-y graphs)		**List-II (Situations)**
(a)		(i)	Total mechanical energy is conserved
(b)		(ii)	Bob of a pendulum is oscillating under negligible air friction
(c)		(iii)	Restoring force of a spring
(d)		(iv)	Bob of a pendulum is oscillating along with air friction

Choose the **correct** answer from the options given below :

(1) (a) - (iv), (b) - (ii), (c) - (iii), (d) - (i)

(2) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

(3) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)

(4) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

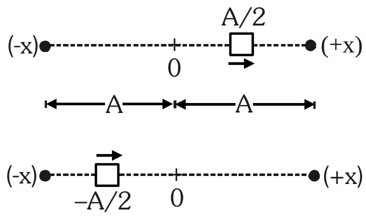
SH0184

EXERCISE-II (Previous Year Questions) ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**3**	**2**	**1**	**4**	**4**	**2**	**1**	**3**	**1**	**3**	**3**	**3**	**2**	**1**	**2**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**1**	**2**	**2**	**2**	**2**	**2**	**4**	**4**	**4**	**4**	**2**	**3**	**2**	**4**	**1**
Que.	31	32	33	34											
Ans.	**4**	**3**	**1**	**2**											

EXERCISE-III (Analytical Questions)   Master Your Understanding

1. Two bodies performing S.H.M. have same amplitude and frequency. Their phases at a certain instant are as shown in the figure. The phase difference between them is



(1) $\frac{11}{6}\pi$ (2) π (3) $\frac{\pi}{3}$ (4) $\frac{3}{5}\pi$

SH0142

2. The period of a particle is 8s. At t = 0 it is at the mean position. The ratio of distance covered by the particle in first second and second will be-

(1) $\frac{\sqrt{2}-1}{\sqrt{2}}$ (2) $\frac{1}{\sqrt{2}}$ (3) $\frac{1}{\sqrt{2}-1}$ (4) $\sqrt{2}-1$

SH0144

3. A man of mass 60 kg standing on a plateform executing S.H.M. in the vertical plane. The displacement from the mean position varies as $y = 0.5 \sin (2\pi ft)$. The minimum value of f, for which the man will feel weightlessness at the highest point is : (y is in metres)

(1) $\frac{g}{4\pi}$ (2) $4\pi g$

(3) $\frac{\sqrt{2g}}{2\pi}$ (4) $2\pi\sqrt{2g}$

SH0145

4. Two simple harmonic motions are represented by the equations $y_1 = 0.1 \sin\left(100\pi t + \frac{\pi}{3}\right)$ and $y_2 = 0.1 \cos 100\pi t$. The phase difference of the velocity of particle 1, with respect to the velocity of particle 2 is-

(1) $\frac{-\pi}{6}$ (2) $\frac{\pi}{3}$ (3) $\frac{-\pi}{3}$ (4) $\frac{\pi}{6}$

SH0146

5. A point mass oscillates along the x-axis according to the law $x = x_0 \cos(\omega t - \pi/4)$. If the acceleration of the particle is written as- $a = A \cos (\omega t + \delta)$, then-

(1) $A = x_0, \delta = -\pi/4$
(2) $A = x_0\omega^2, \delta = \pi/4$
(3) $A = x_0\omega^2, \delta = -\pi/4$
(4) $A = x_0\omega^2, \delta = 3\pi/4$

SH0147

6. The potential energy of a simple harmonic oscillator at mean position is 3 joules. If its mean K.E. is 4 joules, its total energy will be :

(1) 7J (2) 8J (3) 10J (4) 11J

SH0148

7. The total energy of a harmonic oscillator of mass 2kg is 9 joules. If its potential energy at mean position is 5 joules, its K.E. at the mean position will be :

(1) 9J (2) 14J (3) 4J (4) 11J

SH0149

8. A horizontal spring is connected to a mass M. It executes simple harmonic motion. When the mass M passes through its mean position, an object of mass m is put on it and the two move together. The ratio of frequencies before and after will be-

(1) $\left(1+\frac{m}{M}\right)^{1/2}$ (2) $\left(1+\frac{m}{M}\right)$

(3) $\left(\frac{M}{M+m}\right)^{1/2}$ (4) $\left(\frac{M}{M+m}\right)$

SH0150

9. Two particles A and B of equal masses are suspended from two massless springs of spring constants k_1 and k_2, respectively. If the maximum velocities during oscillations are equal, the ratio of amplitudes of A and B is-

(1) $\sqrt{k_1/k_2}$ (2) k_1/k_2

(3) $\sqrt{k_2/k_1}$ (4) k_2/k_1

SH0151

10. A simple pendulum has time period T_1. The point of suspension is now moved upward according to the relation $y = Kt^2$, $(K = 1\ m/s^2)$ where y is the vertical displacement. The time period now becomes T_2. The ratio of $\frac{T_1^2}{T_2^2}$ is : $(g = 10\ m/s^2)$

(1) $\frac{6}{5}$ (2) $\frac{5}{6}$ (3) 1 (4) $\frac{4}{5}$

SH0153

11. A particle describes SHM in a straight line about O.

If the time period of the motion is T then its kinetic energy at P be half of its peak value at O, if the time taken by the particle to travel from O to P is

(1) $\frac{1}{2}T$ (2) $\frac{1}{4}T$ (3) $\frac{1}{2\sqrt{2}}T$ (4) $\frac{1}{8}T$

SH0154

12. An oscillator consists of a block attached to 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 = 0.100m, v = – 15.0 m/s, and a = – 90 m/s^2. The amplitude of the motion and the mass of the block are :-

(1) 0.2 m, 0.84 kg (2) 0.3 m, 0.76 kg

(3) 0.4 m, 0.54 kg (4) 0.5 m, 0.44 kg

SH0155

EXERCISE-III (Analytical Questions) **ANSWER KEY**

Que.	1	2	3	4	5	6	7	8	9	10	11	12
Ans.	**3**	**3**	**3**	**1**	**4**	**4**	**3**	**1**	**3**	**1**	**4**	**4**