EXERCISE-I

Displacement of S.H.M. and Phase

1. The phase (at a time *t*) of a particle in simple harmonic motion tells

(A) Only the position of the particle at time *t*

(B) Only the direction of motion of the particle at time *t*

(C) Both the position and direction of motion of the particle at time *t*

(D) Neither the position of the particle nor its direction of motion at time *t*

2. A particle is moving with constant angular velocity along the circumference of a circle. Which of the following statements is true

(A) The particle so moving executes S.H.M.

(B) The projection of the particle on any one of the diameters executes S.H.M.

(C) The projection of the particle on any of the diameters executes S.H.M.

(D) None of the above

3. A particle is executing simple harmonic motion with a period of *T seconds* and amplitude *a metre*. The shortest time it takes to reach a point $\frac{a}{\sqrt{2}}$ m from its mean position in *seconds* is

(A) *T* (B) *T*/4

(C) *T*/8 (D) *T*/16

4. A simple harmonic motion is represented by $F(t) = 10\sin(20t + 0.5)$. The amplitude of the S.H.M. is

(A) $a = 30$ (B) $a = 20$

(C) $a = 10$ (D) $a = 5$

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

(A) $y = a\sin\omega t$

(B) $y = a\cos\omega t$

(C) $y = a\sin\omega t + b\cos\omega t$

(D) $y = a\tan\omega t$

6. A particle in S.H.M. is described by the displacement function $x(t) = a\cos(\omega t + \theta)$. If the initial $(t = 0)$ position of the particle is 1 *cm* and its initial velocity is π cm/s. The angular frequency of the particle is π rad / s, then it's amplitude is

(A) 1 *cm* (B) $\sqrt{2}$ cm

(C) 2 *cm* (D) 2.5 *cm*

7. A particle executes a simple harmonic motion of time period *T*. Find the time taken by the particle to go directly from its mean position to half the amplitude

(A) *T* / 2 (B) *T* / 4

(C) *T* / 8 (D) *T* / 12

8. A particle executing simple harmonic motion along *y*-axis has its motion described by the equation $y = A\sin(\omega t) + B$. The amplitude of the simple harmonic motion is

(A) *A* (B) *B*

(C) *A* + *B* (D) $\sqrt{A + B}$

9. A particle executing S.H.M. of amplitude 4 *cm* and *T* = 4 *sec*. The time taken by it to move from positive extreme position to half the amplitude is

(A) 1 *sec* (B) 1/3 *sec*

(C) 2/3 *sec* (D) $\sqrt{3/2}$ *sec*

10. Which one of the following is a simple harmonic motion

(A) Wave moving through a string fixed at both ends

(B) Earth spinning about its own axis

(C) Ball bouncing between two rigid vertical walls

(D) Particle moving in a circle with uniform speed

Velocity of Simple Harmonic Motion

11. If the displacement of a particle executing SHM is given by $y = 0.30\sin(220t + 0.64)$ in *metre*, then the frequency and maximum velocity of the particle is

(A) 35 *Hz*, 66 *m/s* (B) 45 *Hz*, 66 *m/s*
(C) 58 *Hz*, 113 *m/s* (D) 35 *Hz*, 132 *m/s*

12. The maximum velocity and the maximum acceleration of a body moving in a simple harmonic oscillator are $2\,m/s$ and $4\,m/s^2$. Then angular velocity will be

(A) 3 *rad/sec* (B) 0.5 *rad/sec*
(C) 1 *rad/sec* (D) 2 *rad/sec*

13. If a particle under S.H.M. has time period 0.1 *sec* and amplitude $\tan^{-1}\frac{a}{g}$. It has maximum velocity

(A) $\frac{\pi}{25}$ m/s (B) $\frac{\pi}{26}$ m/s
(C) $\tan^{-1}\frac{a}{g}$ (D) None of these

14. A particle executing simple harmonic motion has an amplitude of 6 *cm*. Its acceleration at a distance of 2 *cm* from the mean position is $8\,cm/s^2$. The maximum speed of the particle is

(A) 8 *cm/s* (B) 12 *cm/s*
(C) 16 *cm/s* (D) 24 *cm/s*

15. A particle executes simple harmonic motion with an amplitude of 4 *cm*. At the mean position the velocity of the particle is 10 *cm/s*. The distance of the particle from the mean position when its speed becomes 5 *cm/s* is

(A) $\sqrt{3}$ cm (B) $\sqrt{5}$ cm
(C) $2(\sqrt{3})$ cm (D) $2(\sqrt{5})$ cm

16. Two particles *P* and *Q* start from origin and execute Simple Harmonic Motion along *X*-axis with same amplitude but with periods 3 *seconds* and 6 *seconds* respectively. The ratio of the velocities of *P* and *Q* when they meet is

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

17. A particle is performing simple harmonic motion with amplitude *A* and angular velocity *ω*. The ratio of maximum velocity to maximum acceleration is

(A) ω (B) $1/\omega$
(C) ω^2 (D) $A\omega$

18. The angular velocities of three bodies in simple harmonic motion are $\omega_1, \omega_2, \omega_3$ with their respective amplitudes as A_1, A_2, A_3. If all the three bodies have same mass and velocity, then

(A) $A_1\omega_1 = A_2\omega_2 = A_3\omega_3$
(B) $A_1\omega_1^2 = A_2\omega_2^2 = A_3\omega_3^2$
(C) $A_1^2\omega_1 = A_2^2\omega_2 = A_3^2\omega_3$
(D) $A_1^2\omega_1^2 = A_2^2\omega_2^2 = A^2$

19. The velocity of a particle performing simple harmonic motion, when it passes through its mean position is

(A) Infinity (B) Zero
(C) Minimum (D) Maximum

20. The velocity of a particle in simple harmonic motion at displacement *y* from mean position is

(A) $\omega\sqrt{a^2 + y^2}$ (B) $\omega\sqrt{a^2 - y^2}$
(C) ωy (D) $\omega^2\sqrt{a^2 - y^2}$

Acceleration of Simple Harmonic Motion

21. A small body of mass 0.10 *kg* is executing S.H.M. of amplitude 1.0 *m* and period 0.20 *sec*. The maximum force acting on it is

(A) 98.596 *N* (B) 985.96 *N*
(C) 100.2 *N* (D) 76.23 *N*

22. A body executing simple harmonic motion has a maximum acceleration equal to 24meters/sec^2 and maximum velocity equal to 16meters/sec. The amplitude of the simple harmonic motion is

(A) $\frac{32}{3}$metres (B) $\frac{3}{32}$metres

(C) $\frac{1024}{9}$metres (D) $\frac{64}{9}$metres

23. For a particle executing simple harmonic motion, which of the following statements is not correct

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

(B) The restoring force of always directed towards a fixed point

(C) The restoring force is maximum at the extreme positions

(D) The acceleration of the particle is maximum at the equilibrium position

24. A particle of mass 10 *grams* is executing simple harmonic motion with an amplitude of 0.5*m* and periodic time of $(\pi/5)$ *seconds*. The maximum value of the force acting on the particle is

(A) 25 *N* (B) 5 *N*

(C) 2.5 *N* (D) 0.5 *N*

25. The displacement of an oscillating particle varies with time (in *seconds*) according to the equation *y (cm)* = $\sin\frac{\pi}{2}\left(\frac{t}{2}+\frac{1}{3}\right)$. The maximum acceleration of the particle is approximately

(A) $5.21\text{cm}/\text{s}^2$ (B) $3.62\text{cm}/\text{s}^2$

(C) $1.81\text{cm}/\text{s}$ (D) $0.62\text{cm}/\text{s}^2$

26. A particle is executing simple harmonic motion with an amplitude of 0.02 *metre* and frequency 50 *Hz*. The maximum acceleration of the particle is

(A) 100 m/s^2 (B) $100\pi^2$ m/s^2

(C) 100 m/s^2 (D) $200\pi^2$ m/s^2

27. Acceleration of a particle, executing SHM, at it's mean position is

(A) Infinity (B) Varies

(C) Maximum (D) Zero

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

(A) When *v* is maximum, *a* is maximum

(B) Value of *a* is zero, whatever may be the value of *v*

(C) When *v* is zero, *a* is zero

(D) When *v* is maximum, *a* is zero

29. What is the maximum acceleration of the particle doing the SHM $y = 2\sin\left[\frac{\pi t}{2}+\varphi\right]$ where 2 is in *cm*

(A) $\frac{\pi}{2}\text{cm}/\text{s}^2$ (B) $\frac{\pi^2}{2}\text{cm}/\text{s}^2$

(C) $\frac{\pi}{4}\text{cm}/\text{s}^2$ (D) $\frac{\pi}{4}\text{cm}/\text{s}^2$

30. A particle executes linear simple harmonic motion with an amplitude of 2 *cm*. When the particle is at 1 *cm* from the mean position the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is

(A) $\frac{1}{2\pi\sqrt{3}}$ (B) $2\pi\sqrt{3}$

(C) $\frac{2\pi}{\sqrt{3}}$ (D) $\frac{\sqrt{3}}{2\pi}$

Energy of Simple Harmonic Motion

31. A particle of mass 10 *gm* is describing S.H.M. along a straight line with period of 2 *sec* and amplitude of 10 *cm*. Its kinetic energy when it is at 5 *cm* from its equilibrium position is

(A) $37.5\pi^2$ergs (B) $3.75\pi^2$ergs

(C) $375\pi^2$ergs (D) $0.375\pi^2$ergs

32. When the displacement is half the amplitude, the ratio of potential energy to the total energy is

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$

(C) 1 (D) $\frac{1}{8}$

33. The P.E. of a particle executing SHM at a distance *x* from its equilibrium position is

(A) $\frac{1}{2}m\omega^2x^2$ (B) $\frac{1}{2}m\omega^2a^2$

(C) $\frac{1}{2}m\omega^2(a^2-x^2)$ (D) Zero

34. A vertical mass-spring system executes simple harmonic oscillations with a period of 2*s*. A quantity of this system which exhibits simple harmonic variation with a period of 1 *s* is

(A) Velocity

(B) Potential energy

(C) Phase difference between acceleration and displacement

(D) Difference between kinetic energy and potential energy

35. For any S.H.M., amplitude is 6 *cm*. If instantaneous potential energy is half the total energy then distance of particle from its mean position is

(A) *3 cm* (B) 4.2 *cm*

(C) 5.8 *cm* (D) 6 *cm*

36. A body of mass 1kg is executing simple harmonic motion. Its displacement y(cm) at *t* seconds is given by $y=6\sin(100t+\pi/4)$. Its maximum kinetic energy is

(A) 6 *J* (B) 18 *J*

(C) 24 *J* (D) 36 *J*

37. A particle is executing simple harmonic motion with frequency *f*. The frequency at which its kinetic energy change into potential energy is

(A) *f*/2 (B) *f*

(C) 2 *f* (D) 4 *f*

38. There is a body having mass *m* and performing S.H.M. with amplitude *a*. There is a restoring force $F=-Kx$, where *x* is the displacement. The total energy of body depends upon

(A) *K, x* (B) *K, a*

(C) *K, a, x* (D) *K, a, v*

39. The total energy of a particle executing S.H.M. is 80 *J*. What is the potential energy when the particle is at a distance of 3/4 of amplitude from the mean position

(A) 60 *J* (B) 10 *J*

(C) 40 *J* (D) 45 *J*

40. In a simple harmonic oscillator, at the mean position

(A) Kinetic energy is minimum, potential energy is maximum

(B) Both kinetic and potential energies are maximum

(C) Kinetic energy is maximum, potential energy is minimum

(D) Both kinetic and potential energies are minimum

41. Displacement between maximum potential energy position and maximum kinetic energy position for a particle executing S.H.M. is

(A) – *a* (B) + *a*

(C) $\pm a$ (D) $\pm\frac{a}{4}$

42. When a mass *M* is attached to the spring of force constant *k*, then the spring stretches by *l*. If the mass oscillates with amplitude *l*, what will be maximum potential energy stored in the spring

(A) $\frac{kl}{2}$ (B) 2kl

(C) $\frac{1}{2}Mgl$ (D) *Mgl*

43. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is (where E is the total energy)

(A) $\frac{1}{8}E$ (B) $\frac{1}{4}E$

(C) $\frac{1}{2}E$ (D) $\frac{2}{3}E$

44. A body executes simple harmonic motion. The potential energy (P.E.), the kinetic energy (K.E.) and total energy (T.E.) are measured as a function of displacement x. Which of the following statements is true

(A) P.E. is maximum when $x = 0$

(B) K.E. is maximum when $x = 0$

(C) T.E. is zero when $x = 0$

(D) K.E. is maximum when x is maximum

45. If $<E>$ and $<U>$ denote the average kinetic and the average potential energies respectively of mass describing a simple harmonic motion, over one period, then the correct relation is

(A) $<E> = <U>$ (B) $<E> = 2<U>$

(C) $<E> = -2<U>$ (D) $<E> = -<U>$

Time Period and Frequency

46. The kinetic energy of a particle executing S.H.M. is 16 J when it is in its mean position. If the amplitude of oscillations is 25 cm and the mass of the particle is 5.12 kg, the time period of its oscillation is

(A) $\frac{\pi}{5}$ *sec* (B) 2π *sec*

(C) 20π *sec* (D) 5π *sec*

47. The acceleration of a particle performing S.H.M. is $12 cm/sec^2$ at a distance of 3 cm from the mean position. Its time period

(A) 0.5 *sec* (B) 1.0 *sec*

(C) 2.0 *sec* (D) 3.14 *sec*

48. To make the frequency double of an oscillator, we have to

(A) Double the mass

(B) Half the mass

(C) Quadruple the mass

(D) Reduce the mass to one-fourth

49. What is constant in S.H.M.

(A) Restoring force (B) Kinetic energy

(C) Potential energy (D) Periodic time

50. If a simple harmonic oscillator has got a displacement of 0.02 m and acceleration equal to $2.0 ms^{-2}$ at any time, the angular frequency of the oscillator is equal to

(A) $10 rad s^{-1}$ (B) $0.1 rad s^{-1}$

(C) $100 rad s^{-1}$ (D) $1 rad s^{-1}$

51. The equation of a simple harmonic motion is $X = 0.34\cos(3000t + 0.74)$ where X and t are in *mm* and *sec*. The frequency of motion is

(A) 3000 (B) $3000/2\pi$

(C) $0.74/2\pi$ (D) $3000/\pi$

52. Mark the wrong statement

(A) All S.H.M.'s have fixed time period

(B) All motion having same time period are S.H.M.

(C) In S.H.M. total energy is proportional to square of amplitude

(D) Phase constant of S.H.M. depends upon initial conditions

53. A particle in SHM is described by the displacement equation $x(t) = A\cos(\omega t + \theta)$. If the initial ($t = 0$) position of the particle is 1 cm and its initial velocity is π *cm/s*, what is its amplitude? The angular frequency of the particle is πs^{-1}

(A) 1 cm (B) $\sqrt{2}$ cm

(C) 2 cm (D) 2.5 cm

54. A particle executes SHM in a line 4 cm long. Its velocity when passing through the centre of line is 12 *cm/s*. The period will be

(A) 2.047 s (B) 1.047 s

(C) 3.047 s (D) 0.047 s

55. The displacement x (in *metre*) of a particle in, simple harmonic motion is related to time t (in seconds) as

$$x = 0.01\cos\left(\pi t + \frac{\pi}{4}\right)$$

The frequency of the motion will be

(A) 0.5 *Hz* (B) 1.0 *Hz*

(C) $\frac{\pi}{2}$Hz (D) π Hz

Simple Pendulum

56. A second's pendulum is placed in a space laboratory orbiting around the earth at a height 3*R*, where *R* is the radius of the earth. The time period of the pendulum is

(A) Zero (B) $2\sqrt{3}$ sec

(C) 4 *sec* (D) Infinite

57. The bob of a simple pendulum of mass *m* and total energy *E* will have maximum linear momentum equal to

(A) $\sqrt{\frac{2E}{m}}$ (B) $\sqrt{2mE}$

(C) 2mE (D) mE^2

58. The length of the second pendulum on the surface of earth is 1 *m*. The length of seconds pendulum on the surface of moon, where *g* is 1/6th value of *g* on the surface of earth, is

(A) 1 / 6 *m* (B) 6 *m*

(C) 1 / 36 *m* (D) 36 *m*

59. If the length of second's pendulum is decreased by 2%, how many seconds it will lose per day

(A) 3927 *sec* (B) 3727 *sec*

(C) 3427 *sec* (D) 864 sec

60. The period of simple pendulum is measured as *T* in a stationary lift. If the lift moves upwards with an acceleration of 5 *g*, the period will be

(A) The same

(B) Increased by 3/5

(C) Decreased by 2/3 times

(D) None of the above

61. The length of a simple pendulum is increased by 1%. Its time period will

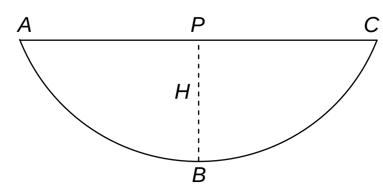
(A) Increase by 1%

(B) Increase by 0.5%

(C) Decrease by 0.5%

(D) Increase by 2%

62. A simple pendulum with a bob of mass *'m'* oscillates from *A* to *C* and back to *A* such that *PB* is *H*. If the acceleration due to gravity is *'g'*, then the velocity of the bob as it passes through *B* is



(A) mgH (B) $\sqrt{2gH}$

(C) 2gH (D) Zero

63. Identify correct statement among the following

(A) The greater the mass of a pendulum bob, the shorter is its frequency of oscillation

(B) A simple pendulum with a bob of mass *M* swings with an angular amplitude of 40^o. When its angular amplitude is 20^o the tension in the string is less than $Mg\cos 20^o$.

(C) As the length of a simple pendulum is increased, the maximum velocity of its bob during its oscillation will also decreases

(D) The fractional change in the time period of a pendulum on changing the temperature is independent of the length of the pendulum

64. The bob of a pendulum of length l is pulled aside from its equilibrium position through an angle θ and then released. The bob will then pass through its equilibrium position with a speed v, where v equals

(A) $\sqrt{2gl(1-\sin\theta)}$ (B) $\sqrt{2gl(1+\cos\theta)}$

(C) $\sqrt{2gl(1-\cos\theta)}$ (D) $\sqrt{2gl(1+\sin\theta)}$

65. A simple pendulum executing S.H.M. is falling freely along with the support. Then

(A) Its periodic time decreases

(B) Its periodic time increases

(C) It does not oscillate at all

(D) None of these

66. The acceleration due to gravity at a place is π^2 m/sec^2. Then the time period of a simple pendulum of length one *metre* is

(A) $\frac{2}{\pi}$sec (B) 2π sec

(C) 2 sec (D) π sec

67. A plate oscillated with time period 'T'. Suddenly, another plate put on the first plate, then time period

(A) Will decrease (B) Will increase

(C) Will be same (D) None of these

68. A simple pendulum of length l has a brass bob attached at its lower end. Its period is T. If a steel bob of same size, having density x times that of brass, replaces the brass bob and its length is changed so that period becomes $2T$, then new length is

(A) $2\,l$ (B) $4\,l$

(C) $4\,l\,x$ (D) $\frac{4l}{x}$

69. In a seconds pendulum, mass of bob is 30 *gm*. If it is replaced by 90 *gm* mass. Then its time period will

(A) 1 *sec* (B) 2 *sec*

(C) 4 *sec* (D) 3 *sec*

70. The time period of a simple pendulum when it is made to oscillate on the surface of moon

(A) Increases

(B) Decreases

(C) Remains unchanged

(D) Becomes infinite

71. Two pendulums begin to swing simultaneously. If the ratio of the frequency of oscillations of the two is 7 : 8, then the ratio of lengths of the two pendulums will be

(A) 7 : 8 (B) 8 : 7

(C) 49 : 64 (D) 64 : 49

72. A simple pendulum hanging from the ceiling of a stationary lift has a time period T_1. When the lift moves downward with constant velocity, the time period is T_2, then

(A) T_2 is infinity (B) $T_2 > T_1$

(C) $T_2 < T_1$ (D) $T_2 = T_1$

73. If the length of a pendulum is made 9 times and mass of the bob is made 4 times then the value of time period becomes

(A) $3T$ (B) $3/2T$

(C) $4T$ (D) $2T$

74. A simple pendulum is taken from the equator to the pole. Its period

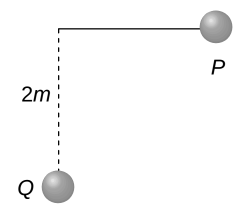
(A) Decreases

(B) Increases

(C) Remains the same

(D) Decreases and then increases

75. A pendulum of length $2m$ lift at P. When it reaches Q, it losses 10% of its total energy due to air resistance. The velocity at Q is



(A) 6 *m/sec* (B) 1 *m/sec*

(C) 2 *m/sec* (D) 8 *m/sec*

76. There is a simple pendulum hanging from the ceiling of a lift. When the lift is stand still, the time period of the pendulum is *T*. If the resultant acceleration becomes $g/4$, then the new time period of the pendulum is

(A) 0.8 *T* (B) 0.25 *T*

(C) 2 *T* (D) 4 *T*

77. The period of a simple pendulum measured inside a stationary lift is found to be *T*. If the lift starts accelerating upwards with acceleration of $g/3$, then the time period of the pendulum is

(A) $\frac{T}{\sqrt{3}}$ (B) $\frac{T}{3}$

(C) $\frac{\sqrt{3}}{2}T$ (D) $\sqrt{3}\,T$

78. Time period of a simple pendulum will be double, if we

(A) Decrease the length 2 times

(B) Decrease the length 4 times

(C) Increase the length 2 times

(D) Increase the length 4 times

79. Length of a simple pendulum is l and its maximum angular displacement is θ, then its maximum K.E. is

(A) $mgl\sin\theta$ (B) $mgl(1+\sin\theta)$

(C) $mgl(1+\cos\theta)$ (D) $mgl(1-\cos\theta)$

80. The velocity of simple pendulum is maximum at

(A) Extremes

(B) Half displacement

(C) Mean position

(D) Every where

Spring Pendulum

81. A weightless spring which has a force constant oscillates with frequency *n* when a mass *m* is suspended from it. The spring is cut into two equal halves and a mass 2*m* is suspended from it. The frequency of oscillation will now become

(A) n (B) 2n

(C) $n/\sqrt{2}$ (D) $n(2)^{1/2}$

82. A mass *M* is suspended from a light spring. An additional mass *m* added displaces the spring further by a distance *x*. Now the combined mass will oscillate on the spring with period

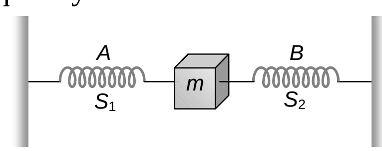
(A) $T = 2\pi\sqrt{(mg/x(M+m))}$

(B) $T = 2\pi\sqrt{((M+m)x/mg)}$

(C) $T = (\pi/2)\sqrt{(mg/x(M+m))}$

(D) $T = 2\pi\sqrt{((M+m)/mgx)}$

83. In the figure, S_1 and S_2 are identical springs. The oscillation frequency of the mass *m* is f. If one spring is removed, the frequency will become



(A) f (B) $f \times 2$

(C) $f \times \sqrt{2}$ (D) $f/\sqrt{2}$

84. The vertical extension in a light spring by a weight of 1 *kg* suspended from the wire is 9.8 *cm*. The period of oscillation

(A) 20π sec (B) 2π sec

(C) $2\pi/10$ sec (D) 200π sec

85. A particle of mass 200 *gm* executes S.H.M. The restoring force is provided by a spring of force constant 80 *N / m*. The time period of oscillations is

(A) 0.31 *sec* (B) 0.15 *sec*

(C) 0.05 *sec* (D) 0.02 *sec*

86. The length of a spring is *l* and its force constant is *k*. When a weight *W* is suspended from it, its length increases by *x*. If the spring is cut into two equal parts and put in parallel and the same weight *W* is suspended from them, then the extension will be

(A) 2x (B) x

(C) $\frac{x}{2}$ (D) $\frac{x}{4}$

87. A block is placed on a frictionless horizontal table. The mass of the block is *m* and springs are attached on either side with force constants K_1 and K_2. If the block is displaced a little and left to oscillate, then the angular frequency of oscillation will be

(A) $\left(\frac{K_1+K_2}{m}\right)^{1/2}$

(B) $\left[\frac{K_1K_2}{m(K_1+K_2)}\right]^{1/2}$

(C) $\left[\frac{K_1K_2}{(K_1-K_2)m}\right]^{1/2}$

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

88. A uniform spring of force constant *k* is cut into two pieces, the lengths of which are in the ratio 1:2. The ratio of the force constants of the shorter and the longer pieces is

(A) 1 : 3 (B) 1 : 2

(C) 2 : 3 (D) 2 : 1

89. A mass *m* =100 *gms* is attached at the end of a light spring which oscillates on a frictionless horizontal table with an amplitude equal to 0.16 *metre* and time period equal to 2 *sec*. Initially the mass is released from rest at *t* = 0 and displacement $x = -0.16$ *metre*. The expression for the displacement of the mass at any time *t* is

(A) $x = 0.16\cos(\pi t)$

(B) $x = -0.16\cos(\pi t)$

(C) $x = 0.16\sin(\pi t + \pi)$

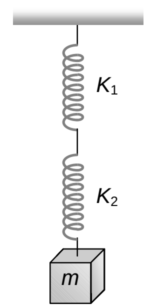
(D) $x = -0.16\sin(\pi t + \pi)$

90. A block of mass *m*, attached to a spring of spring constant *k*, oscillates on a smooth horizontal table. The other end of the spring is fixed to a wall. The block has a speed *v* when the spring is at its natural length. Before coming to an instantaneous rest, if the block moves a distance *x* from the mean position, then

(A) $x = \sqrt{m/k}$ (B) $x = \frac{1}{v}\sqrt{m/k}$

(C) $x = v\sqrt{m/k}$ (D) $x = \sqrt{mv/k}$

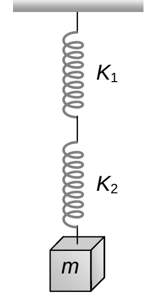
91. A mass *M* is suspended by two springs of force constants K_1 and K_2 respectively as shown in the diagram. The total elongation (stretch) of the two springs is



(A) $\frac{Mg}{K_1+K_2}$ (B) $\frac{Mg(K_1+K_2)}{K_1K_2}$

(C) $\frac{Mg\,K_1K_2}{K_1+K_2}$ (D) $\frac{K_1+K_2}{K_1K_2Mg}$

92. The frequency of oscillation of the springs shown in the figure will be



(A) $\frac{1}{2\pi}\sqrt{\frac{K}{m}}$

(B) $\frac{1}{2\pi}\sqrt{\frac{(K_1+K_2)m}{K_1K_2}}$

(C) $2\pi\sqrt{\frac{K}{m}}$

(D) $\frac{1}{2\pi}\sqrt{\frac{K_1K_2}{m(K_1+K_2)}}$

93. The scale of a spring balance reading from 0 to 10 *kg* is 0.25 *m* long. A body suspended from the balance oscillates vertically with a period of $\pi/10$ second. The mass suspended is (neglect the mass of the spring)

(A) 10 *kg* (B) 0.98 *kg*
(C) 5 *kg* (D) 20 *kg*

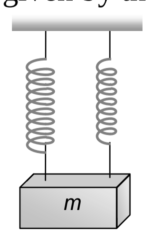
94. If a spring has time period *T*, and is cut into *n* equal parts, then the time period of each part will be

(A) $T\sqrt{n}$ (B) $T/\sqrt{n}$
(C) *nT* (D) *T*

95. One-forth length of a spring of force constant *K* is cut away. The force constant of the remaining spring will be

(A) $\frac{3}{4}K$ (B) $\frac{4}{3}K$
(C) *K* (D) 4 *K*

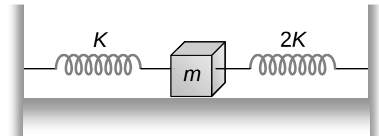
96. A mass *m* is suspended separately by two different springs of spring constant K_1 and K_2 gives the time-period t_1 and t_2 respectively. If same mass *m* is connected by both springs as shown in figure then time-period *t* is given by the relation



(A) $t = t_1 + t_2$ (B) $t = \frac{t_1.t_2}{t_1+t_2}$

(C) $t^2 = t_1^{\ 2} + t_2^{\ 2}$ (D) $t^{-2} = t_1^{-2} + t_2^{-2}$

97. Two springs of force constants *K* and 2*K* are connected to a mass as shown below. The frequency of oscillation of the mass is



(A) $(1/2\pi)\sqrt{(K/m)}$

(B) $(1/2\pi)\sqrt{(2K/m)}$

(C) $(1/2\pi)\sqrt{(3K/m)}$

(D) $(1/2\pi)\sqrt{(m/K)}$

98. Two springs of constant k_1 and k_2 are joined in series. The effective spring constant of the combination is given by

(A) $\sqrt{k_1k_2}$ (B) $(k_1+k_2)/2$

(C) k_1+k_2 (D) $k_1k_2/(k_1+k_2)$

99. A particle at the end of a spring executes simple harmonic motion with a period t_1, while the corresponding period for another spring is t_2. If the period of oscillation with the two springs in series is *T*, then

(A) $T = t_1 + t_2$ (B) $T^2 = t_1^2 + t_2^2$

(C) $T^{-1} = t_1^{-1} + t_2^{-1}$ (D) $T^{-2} = t_1^{-2} + t_2^{-2}$

100. Infinite springs with force constant *k*, 2*k*, 4*k* and 8*k*.... respectively are connected in series. The effective force constant of the spring will be

(A) 2*K* (B) *k*
(C) *k*/2 (D) 2048

101. A weightless spring of length 60 *cm* and force constant 200 *N/m* is kept straight and unstretched on a smooth horizontal table and its ends are rigidly fixed. A mass of 0.25 *kg* is attached at the middle of the spring and is slightly displaced along the length. The time period of the oscillation of the mass is

(A) $\frac{\pi}{20}$ s (B) $\frac{\pi}{10}$ s

(C) $\frac{\pi}{5}$ s (D) $\frac{\pi}{\sqrt{200}}$ s

102. The time period of a mass suspended from a spring is *T*. If the spring is cut into four equal parts and the same mass is suspended from one of the parts, then the new time period will be

(A) *T* (B) $\frac{T}{2}$

(C) 2 *T* (D) $\frac{T}{4}$

103. A mass *M* is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes S.H.M. of time period *T*. If the mass is increased by m, the time period becomes $5T/3$. Then the ratio of m/M is

(A) $\frac{5}{3}$ (B) $\frac{3}{5}$

(C) $\frac{25}{9}$ (D) $\frac{16}{9}$

104. An object is attached to the bottom of a light vertical spring and set vibrating. The maximum speed of the object is 15 *cm/sec* and the period is 628 *milli-seconds*. The amplitude of the motion in centimeters is

(A) 3.0 (B) 2.0

(C) 1.5 (D) 1.0

105. When a mass *m* is attached to a spring, it normally extends by 0.2 *m*. The mass *m* is given a slight addition extension and released, then its time period will be

(A) $\frac{1}{7}$ *sec* (B) 1 *sec*

(C) $\frac{2\pi}{7}$ *sec* (D) $\frac{2}{3\pi}$ *sec*

Superposition of S.H.M's and Resonance

106. Two mutually perpendicular simple harmonic vibrations have same amplitude, frequency and phase. When they superimpose, the resultant form of vibration will be

(A) A circle (B) An ellipse

(C) A straight line (D) A parabola

107. The displacement of a particle varies according to the relation $x = 4(\cos\pi t + \sin\pi t)$. The amplitude of the particle is

(A) 8 (B) – 4

(C) 4 (D) $4\sqrt{2}$

108. A S.H.M. is represented by $x = 5\sqrt{2}(\sin 2\pi t + \cos 2\pi t)$. The amplitude of the S.H.M. is

(A) 10 *cm* (B) 20 *cm*

(C) $5\sqrt{2}$ *cm* (D) 50 *cm*

109. Resonance is an example of

(A) Tuning fork

(B) Forced vibration

(C) Free vibration

(D) Damped vibration

110. In case of a forced vibration, the resonance wave becomes very sharp when the

(A) Restoring force is small

(B) Applied periodic force is small

(C) Quality factor is small

(D) Damping force is small