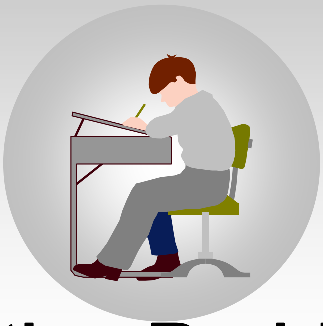


Practice Problems

Problems based on Displacement

1. A particle starts S.H.M. from the mean position. Its amplitude is *A* and time period is *T*. At the time when its speed is half of the maximum speed, its displacement *y* is

(a) $\frac{A}{2}$ (b) $\frac{A}{\sqrt{2}}$ (c) $\frac{A\sqrt{3}}{2}$ (d) $\frac{2A}{\sqrt{3}}$

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

[Kerala (Engg.) 2002]

(a) 3000 (b) $3000/2\pi$ (c) $0.74/2\pi$ (d) $3000/\pi$

3. A particle executes simple harmonic motion between $x = -A$ and $x = +A$. The time taken for it to go from 0 to $A/2$ is T_1 and to go from $A/2$ to A is T_2. Then

(a) $T_1 < T_2$ (b) $T_1 > T_2$ (c) $T_1 = T_2$ (d) $T_1 = 2T_2$

4. The equation of S.H.M. is $y = a\sin(2\pi nt + \alpha)$, then its phase at time *t* is **[DPMT 2001]**

(a) $2\pi nt$ (b) α (c) $2\pi nt + \alpha$ (d) $2\pi t$

5. 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

6. Two particles executes S.H.M. of same amplitude and frequency along the same straight line. They pass one another when going in opposite directions, each time their displacement is half of their amplitude. The phase difference between them is **[MP PMT 1999]**

(a) 30° (b) 60° (c) 90° (d) 120°

7. 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*

8. A particle is performing simple harmonic motion along *x*-axis with amplitude 4 *cm* and the period 1.2 *sec*. The minimum time taken by the particle to move from *x* = 2 *cm* to *x* = +4 *cm* and back again is given by

(a) 0.6 *s* (b) 0.4 *s* (c) 0.3 *s* (d) 0.2 *s*

9. The S.H.M. of a particle is given by the equation $y = 3\sin\omega t + 4\cos\omega t$. The amplitude is

(a) 7 (b) 1 (c) 5 (d) 12

10. The displacement y of a particle executing periodic motion is given by $y = 4\cos^2(t/2)\sin(1000\,t)$. This expression may be considered to be a result of the superposition of .... independent harmonic motions

(a) Two (b) Three (c) Four (d) Five

11. A S.H.M. is represented by the equation y = 10 sin 20πt. Its frequency is

(a) 10 Hz (b) 20 π Hz (c) 0.1 Hz (d) 20 Hz

12. Equations $y_1 = A\sin\omega t$ and $y_2 = \frac{A}{2}\sin\omega t + \frac{A}{2}\cos\omega t$ represent S.H.M. The ratio of the amplitudes of the two motions is

(a) 1 (b) 2 (c) 0.5 (d) $\sqrt{2}$

13. The general equation of S.H.M. is

(a) $y = a\sin(2\pi t + \alpha)$ (b) $y = a\sin\left(\frac{2\pi t}{T} + \alpha\right)$ (c) $y = a\sin(\omega T + \alpha)$ (d) $y = a\sin\omega t$

Problems based on Velocity

14. 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) $\omega^2\sqrt{a^2 - y^2}$

15. 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

16. 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 $\pi\, cm/s$. The angular frequency of the particle is $\pi\, s^{-1}$, then it's amplitude is **[AMU (Med.) 2002]**

(a) 1 *cm* (b) $\sqrt{2}\, cm$ (c) 2 *cm* (d) 2.5 *cm*

17. If a simple pendulum oscillates with an amplitude of 50 *mm* and time period of 2 *sec*, then its maximum velocity is

[AIIMS 1998; MH CET 2000; DPMT 2000]

(a) 0.10 *m/s* (b) 0.15 *m/s* (c) 0.8 *m/s* (d) 0.16 *m/s*

18. If a particle under S.H.M. has time period 0.1 *sec* and amplitude $2 \times 10^{-3}\, m$. It has maximum velocity **[RPET 2000]**

(a) $\frac{\pi}{25}\, m/s$ (b) $\frac{\pi}{26}\, m/s$ (c) $\frac{\pi}{30}\, m/s$ (d) None of these

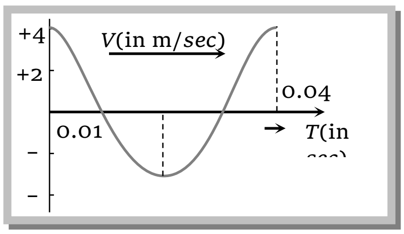
19. A particle executes simple harmonic motion with an amplitude of 4 *cm*. At the mean position the velocity of the particle is 10 *cm/s*. The distance of the particle from the mean position when its speed becomes 5 *cm/s* is

(a) $\sqrt{3}\, cm$ (b) $\sqrt{5}\, cm$ (c) $2(\sqrt{3})\, cm$ (d) $2(\sqrt{5})\, cm$

20. A body is executing S.H.M. When its displacement from the mean position is 4 *cm* and 5 *cm*, the corresponding velocity of the body is 10 *cm/sec* and 8 *cm/sec*. Then the time period of the body is

(a) 2π *sec* (b) π/2 *sec* (c) π *sec* (d) 3π/2 *sec*

21. The velocity-time diagram of a harmonic oscillator is shown in the adjoining figure. The frequency of oscillation is **[CPMT 1989]**



(a) 25 *Hz*

(b) 50 *Hz*

(c) 12.25 *Hz*

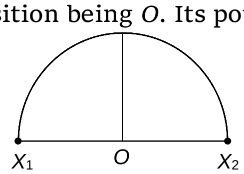
(d) 33.3 *Hz*

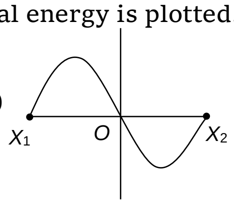
Problems based on Energy

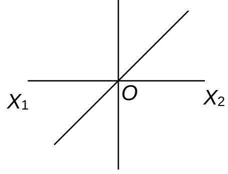
22. The total energy of a particle, executing simple harmonic motion is Where x is the displacement from the mean position **[AIEEE 2004]**

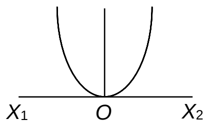
(a) $\propto x$ (b) $\propto x^2$ (c) Independent of x (d) $\propto x^{1/2}$

23. A particle of mass m oscillates with simple harmonic motion between points x_1 and x_2, the equilibrium position being O. Its potential energy is plotted. It will be as given below in the graph

(a) 

(b) 

(c) 

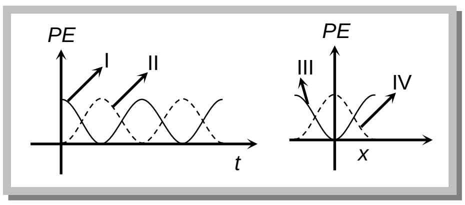
(d) 

24. 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)

[CBSE PMT 2003]

(a) $\frac{1}{8}E$ (b) $\frac{1}{4}E$ (c) $\frac{1}{2}E$ (d) $\frac{2}{3}E$

25. For a particle executing S.H.M. the displacement x is given by $x = A\cos\omega t$. Identify the graph which represents the variation of potential energy (P.E.) as a function of time t and displacement x



(a) I, III

(b) II, IV

(c) II, III

(d) I, IV

26. The total energy of a particle executing S.H.M. is proportional to

[CPMT 1974; EAMCET 1994; RPET 1999; MP PMT 2001; Pb. PMT 2002]

(a) Displacement from equilibrium position (b) Frequency of oscillation

(c) Velocity in equilibrium position (d) Square of amplitude of motion

27. When the displacement is half of the amplitude, then what fraction of total energy of a simple harmonic oscillator is kinetic

[RPMT 1994; CBSE 1995; JIPMER 2002]

(a) $3/4^{th}$ (b) $2/7^{th}$ (c) $5/7^{th}$ (d) $2/9^{th}$

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

[CPMT 1999; JIPMER 2000; Kerala PET 2002]

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) 1 (d) $\frac{1}{8}$

29. The potential energy of a particle executing S.H.M. is 2.5 *J*, when its displacement is half of amplitude. The total energy of the particle be

(a) 18 *J* (b) 10 *J* (c) 12 *J* (d) 2.5 *J*

30. There is a body having mass m and performing S.H.M. with amplitude a. There is a restoring force $F = -Kx$. The total energy of body depends upon

(a) K, x (b) K, a (c) K, a, x (d) K, a, v

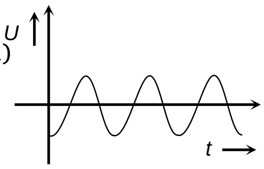
31. Two springs with spring constants $K_1 = 1500\ N/m$ and $K_2 = 3000\ N/m$ are stretched by the same force. The ratio of potential energy stored in spring will be

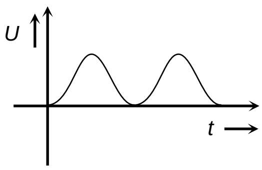
(a) 2 : 1 (b) 1 : 2 (c) 4 : 1 (d) 1 : 4

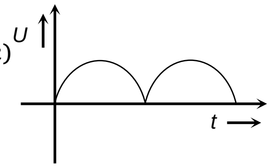
32. A body is executing Simple Harmonic Motion. At a displacement x its potential energy is E_1 and at a displacement y its potential energy is E_2. The potential energy E at displacement $(x+y)$ is

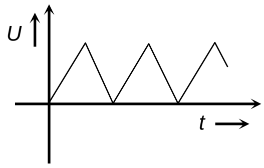
(a) $\sqrt{E} = \sqrt{E_1} - \sqrt{E_2}$ (b) $\sqrt{E} = \sqrt{E_1} + \sqrt{E_2}$ (c) $E = E_1 + E_2$ (d) $E = E_1 - E_2$

33. As a body performs S.H.M., its potential energy U. varies with time as indicated in

(a)


(b)


(c)


(d)


34. A particle is vibrating in a simple harmonic motion with an amplitude of 4 cm. At what displacement from the equilibrium position, is its energy half potential and half kinetic energy

(a) 1 cm (b) $\sqrt{2}\ cm$ (c) 3 cm (d) $2\sqrt{2}\ cm$

35. A particle executes simple harmonic motion with a frequency f. The frequency with which its kinetic energy oscillates is

[IIT-JEE 1973; Manipal MEE 1995; MP PET 1997; UPSEAT 2000]

(a) $f/2$ (b) f (c) $2f$ (d) $4f$

36. A body of mass $1\,kg$ 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. The kinetic energy of a particle executing S.H.M. is 16 J when it is in its mean position. If the amplitude of oscillation 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

Problems based on Differential equation of S.H.M.

38. 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 $rad\ s^{-1}$

39. Two equal negative charges $-q$ are fixed at points (0, a) and (0, $-a$) on the Y-axis. A positive charge Q is released from rest at point (2a, 0) on the X-axis. The charge Q will

(a) Execute simple harmonic motion about origin (b) Move to the origin and remained at rest

(c) Move to infinity (d) Execute oscillation but not simple harmonic motion

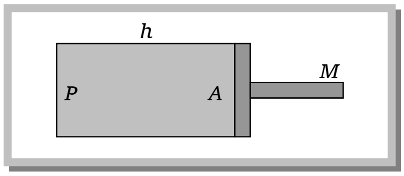
40. A cylindrical piston of mass M slides smoothly inside a long cylinder closed at one end, enclosing a certain mass of gas. The cylinder is kept with its axis horizontal. If the piston is disturbed from its equilibrium position, it oscillates simple harmonically. The period of oscillation will be

(a) $T = 2\pi\sqrt{\left(\frac{Mh}{PA}\right)}$

(b) $T = 2\pi\sqrt{\left(\frac{MA}{Ph}\right)}$

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

(d) $T = 2\pi\sqrt{MPhA}$



41. A sphere of radius r is kept on a concave mirror of radius of curvature R. The arrangement is kept on a horizontal table (the surface of concave mirror is frictionless and sliding not rolling). If the sphere is displaced from its equilibrium position and left, then it executes S.H.M. The period of oscillation will be

(a) $2\pi\sqrt{\left(\frac{(R-r)1.4}{g}\right)}$ (b) $2\pi\sqrt{\left(\frac{R-r}{g}\right)}$ (c) $2\pi\sqrt{\left(\frac{rR}{g}\right)}$ (d) $2\pi\sqrt{\left(\frac{R}{gr}\right)}$

42. A tunnel has been dug through the centre of the earth and a ball is released in it. It will reach the other end of the tunnel after

(a) 84.6 minutes (b) 42.3 minutes (c) 1 day (d) Will not reach the other end

43. A '*U*' tube of uniform bore of cross-sectional area '*a*' has been set up vertically with open ends facing up. Now *m gm* of a liquid of density *d* is poured into it. The column of liquid in this tube will oscillate with a period *T* such that

(a) $T = 2\pi\sqrt{\frac{m}{g}}$ (b) $T = 2\pi\sqrt{\frac{ma}{gd}}$ (c) $T = 2\pi\sqrt{\frac{m}{gda}}$ (d) $T = 2\pi\sqrt{\frac{m}{2adg}}$

44. A block of wood has dimensions *a*, *b* and *c*. Its relative density is *d*. It is floating in water such that the side *a* is vertical. It is now pushed down gently and released. The time period of its S.H.M. is

(a) $T = 2\pi\sqrt{\frac{abc}{g}}$ (b) $T = 2\pi\sqrt{\frac{bc}{dg}}$ (c) $T = 2\pi\sqrt{\frac{g}{da}}$ (d) $T = 2\pi\sqrt{\frac{da}{g}}$

Problems based on Simple pendulum

45. A simple pendulum has time period *T*. The bob is given negative charge and surface below it is given positive charge. The new time period will be

(a) Less than *T* (b) Greater than *T* (c) Equal to *T* (d) Infinite

46. In a seconds pendulum, mass of the bob is 30 *gm*. If it is replaced by 90 *gm* mass. Then its time period will be**[Orissa P**

(a) 1 *sec* (b) 2 *sec* (c) 4 *sec* (d) 3 *sec*

47. The bob of a simple pendulum executes simple harmonic motion 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 $(4/3)\times 1000\ kg/m^3$. Which relationship between *t* and t_0 is true

(a) $t = t_0$ (b) $t = t_0/2$ (c) $t = 2t_0$ (d) $t = 4t_0$

48. Two simple pendulum of length 5 *m* and 20 *m* respectively are given small linear displacement in one direction at the same time. They will again be in the phase when the pendulum of shorter length has completed... Oscillations **[CBSE PMT 1998; JIPMER 2001, 2002]**

(a) 5 (b) 1 (c) 2 (d) 3

49. A chimpanzee swinging on a swing in a sitting position, stands up suddenly, the time period will

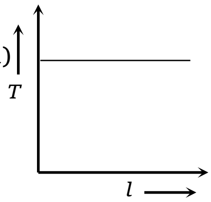
[Karnataka CET (Engg./Med.) 2000; AIEEE 2002]

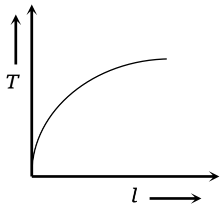
(a) Become infinite (b) Remain same (c) Increase (d) Decrease

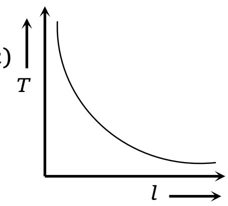
50. A simple pendulum of length l has a brass bob attached at its lower end. Its period is T. If a steel bob of same size, having density x times that of brass, replaces the brass bob and its length is changed so that period becomes $2T$, then new length is **[MP PMT 2002]**

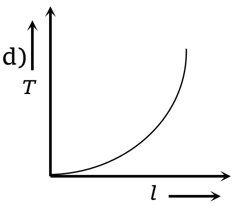
(a) $2\,l$ (b) $4\,l$ (c) $4\,l\,x$ (d) $\frac{4l}{x}$

51. In case of a simple pendulum, time period versus length is depicted by

(a) 

(b) 

(c) 

(d) 

52. A hollow sphere is filled with water through a small hole in it. It is then hung by a long thread and made to oscillate. As the water slowly flows out of the hole at the bottom, the period of oscillation will

[MP PMT 1994; KCET 1994; RPET 1996; AFMC 2000; CBSE PMT 2000; CPMT 2001]

(a) Continuously decrease (b) Continuously increase

(c) First decrease and then increase (d) First increase and then decrease

53. The period of oscillation of a simple pendulum of constant length at earth surface is T. Its period inside a mine is

[CPMT 1973; DPMT 2001]

(a) Greater than T (b) Less than T (c) Equal to T (d) Cannot be compared

54. The period of oscillation of a simple pendulum of length L suspended from the roof of a vehicle which moves without friction down an inclined plane of inclination α, is given by

(a) $2\pi\sqrt{\frac{L}{g\cos\alpha}}$ (b) $2\pi\sqrt{\frac{L}{g\sin\alpha}}$ (c) $2\pi\sqrt{\frac{L}{g}}$ (d) $2\pi\sqrt{\frac{L}{g\tan\alpha}}$

55. If the length of simple pendulum is increased by 300%, then the time period will be increased by

(a) 100% (b) 200% (c) 300% (d) 400%

56. 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*

57. A simple pendulum consisting of a ball of mass m is tied to a spring of length l is made to swing on a circular arc of angle θ in a vertical plane. At the end of this arc, another ball of mass m is placed at rest. The momentum transferred to this ball at rest by the swinging ball is

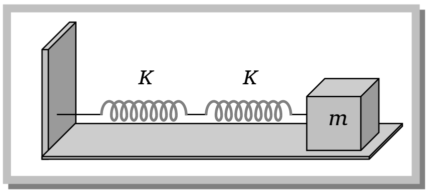
(a) Zero (b) $m\theta\sqrt{\frac{g}{l}}$ (c) $\frac{m\theta}{l}\sqrt{\frac{l}{g}}$ (d) $\frac{m}{l}2\pi\sqrt{\frac{l}{g}}$

58. A simple pendulum is suspended from the roof of a train. The train is moving with acceleration $49\ cm/\sec^2$. By what angle to the vertical, its string will be inclined

(a) 20° (b) 30° (c) Zero (d) 3° (approx.)

Problems based on Spring pendulum

59. Two springs are connected to a block of mass M placed on a frictionless surface as shown below. If both the springs have a spring constant K, the frequency of oscillation of the block is



(a) $(1/2\pi)\sqrt{(k/M)}$

(b) $(1/2\pi)\sqrt{\left(\frac{K}{2M}\right)}$

(c) $(1/2\pi)\sqrt{(2k/M)}$

(d) $(1/2\pi)\sqrt{(M/k)}$

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

(a) $2k$ (b) k (c) $k/2$ (d) 2048

61. A spring has length l and spring constant k. if spring is divided in two equal parts then spring constant is**[Bihar CEE 20**

(a) k (b) $k/2$ (c) $2k$ (d) $4k$

62. 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

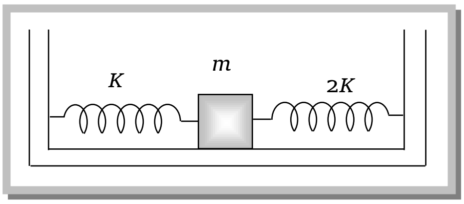
(a) $T = t_1 + t_2$ (b) $T^2 = t_1^2 + t_2^2$ (c) $T^{-1} = t_1^{-1} + t_2^{-1}$ (d) $T^{-2} = t_1^{-2} + t_2^{-2}$

63. 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 **[AIEEE 2003]**

(a) $\frac{5}{3}$ (b) $\frac{3}{5}$ (c) $\frac{25}{9}$ (d) $\frac{16}{9}$

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

[DCE 2000; AIIMS 2003]



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

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

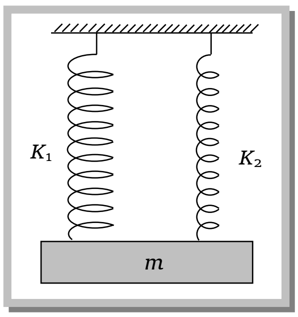
(c) $(1/2\pi)\sqrt{(3K/m)}$

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

65. One-fourth length of a spring of force constant K is cut away. The force constant of the remaining spring will be **[MP PET 20**

(a) $\frac{3}{4}K$ (b) $\frac{4}{3}K$ (c) K (d) $4\,K$

66. 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 **[CBSE PMT 2002]**



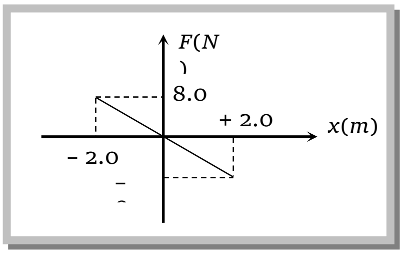
(a) $t = t_1 + t_2$

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

(c) $t^2 = {t_1}^2 + {t_2}^2$

(d) $t^{-2} = t_1^{-2} + t_2^{-2}$

67. A body of mass 0.01 *kg* executes simple harmonic motion (S.H.M.) about $x = 0$ under the influence of a force shown below : The period of the S.H.M. is



(a) 1.05 *s*

(b) 0.52 *s*

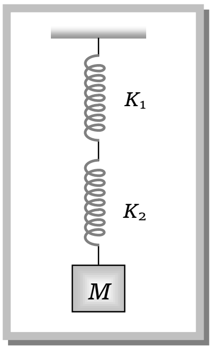
(c) 0.25 *s*

(d) 0.30 *s*

68. The force constants of two springs are K_1 and K_2. Both are stretched till their elastic energies are equal. If the stretching forces are F_1 and F_2, then $F_1 : F_2$ is

(a) $K_1 : K_2$ (b) $K_2 : K_1$ (c) $\sqrt{K_1} : \sqrt{K_2}$ (d) $K_1^2 : K_2^2$

69. 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



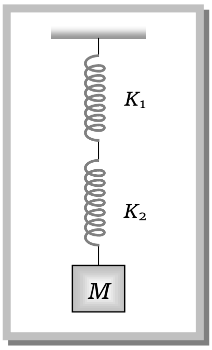
(a) $\dfrac{Mg}{K_1 + K_2}$

(b) $\dfrac{Mg(K_1 + K_2)}{K_1 K_2}$

(c) $\dfrac{Mg\, K_1 K_2}{K_1 + K_2}$

(d) $\dfrac{K_1 + K_2}{K_1 K_2 Mg}$

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



(a) $\dfrac{1}{2\pi}\sqrt{\dfrac{K}{m}}$

(b) $\dfrac{1}{2\pi}\sqrt{\dfrac{(K_1 + K_2)m}{K_1 K_2}}$

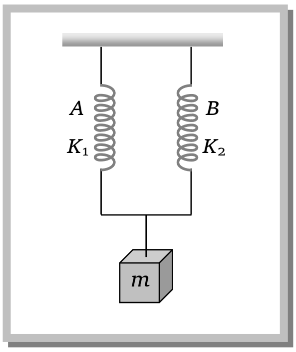
(c) $2\pi\sqrt{\dfrac{K}{m}}$

(d) $\dfrac{1}{2\pi}\sqrt{\dfrac{K_1 K_2}{m(K_1 + K_2)}}$

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

(a) $\dfrac{1}{7}$ *sec* (b) 1 *sec* (c) $\dfrac{2\pi}{7}$ *sec* (d) $\dfrac{2}{3\pi}$ *sec*

72. A mass m is suspended by means of two coiled spring which have the same length in unstretched condition as in figure. Their force constant are K_1 and K_2 respectively. When set into vertical vibrations, the period will be



(a) $2\pi\sqrt{\dfrac{m}{K_1 K_2}}$

(b) $2\pi\sqrt{m\left(\dfrac{K_1}{K_2}\right)}$

(c) $2\pi\sqrt{\left(\frac{m}{K_1 - K_2}\right)}$

(d) $2\pi\sqrt{\left(\frac{m}{K_1 + K_2}\right)}$

73. A mass m attached to a spring oscillates every 2 *sec*. If the mass is increased by 2 *kg*, then time-period increases by 1 *sec*. The initial mass is

(a) 1.6 *kg* (b) 3.9 *kg* (c) 9.6 *kg* (d) 12.6 *kg*

74. 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) $T = 2\pi\sqrt{[(M+m)x / mg]}$

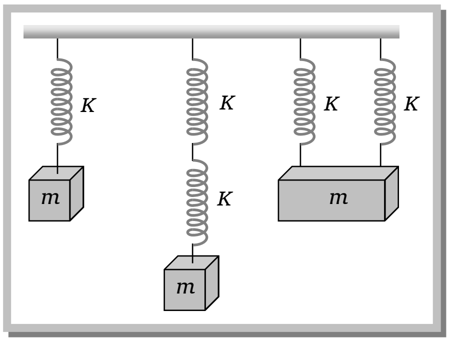
(c) $T = (\pi/2)\sqrt{[mg / x(M+m)]}$ (d) $T = 2\pi\sqrt{[(M+m)/mgx]}$

75. Two springs have spring constants K_A and K_B and $K_A > K_B$. The work required to stretch them by same extension will be

[RPMT 1999]

(a) More in spring A (b) More in spring B (c) Equal in both (d) Nothing can be said

76. Five identical springs are used in the following three configurations. The time periods of vertical oscillations in configurations (i), (ii) and (iii) are in the ratio



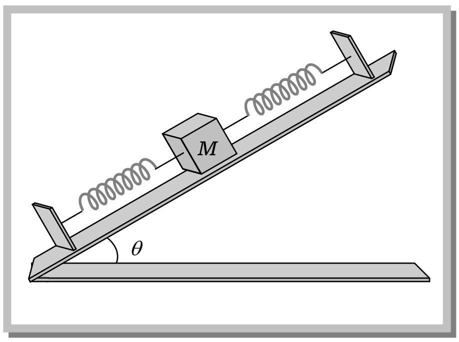
(a) $1 : \sqrt{2} : \frac{1}{\sqrt{2}}$

(b) $2 : \sqrt{2} : \frac{1}{\sqrt{2}}$

(c) $\frac{1}{\sqrt{2}} : 2 : 1$

(d) $2 : \frac{1}{\sqrt{2}} : 1$

77. On a smooth inclined plane, a body of mass M is attached between two springs. The other ends of the springs are fixed to firm supports. If each spring has force constant K, the period of oscillation of the body (assuming the spring as massless) is **[NSEP 1994]**



(a) $2\pi\left(\frac{M}{2K}\right)^{1/2}$

(b) $2\pi\left(\frac{2M}{K}\right)^{1/2}$

(c) $2\pi\frac{Mg\sin\theta}{2k}$

(d) $2\pi\left(\frac{2Mg}{K}\right)^{1/2}$

78. 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 **[MP PMT 1994]**

(a) $2x$ (b) x (c) $\frac{x}{2}$ (d) $\frac{x}{4}$

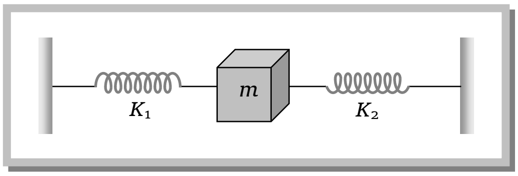
79. In arrangement given in figure, if the block of mass m is displaced, the frequency is given by

(a) $n = \frac{1}{2\pi}\sqrt{\left(\frac{K_1 - K_2}{m}\right)}$

(b) $n = \frac{1}{2\pi}\sqrt{\left(\frac{K_1 + K_2}{m}\right)}$

(c) $n = \frac{1}{2\pi}\sqrt{\left(\frac{m}{K_1 + K_2}\right)}$

(d) $n = \frac{1}{2\pi}\sqrt{\left(\frac{m}{K_1 - K_2}\right)}$



80. 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 simple harmonic oscillations with a time period T. If the mass is increased by m, then the time period becomes $\left(\frac{5}{4}T\right)$. The ratio of m/M is

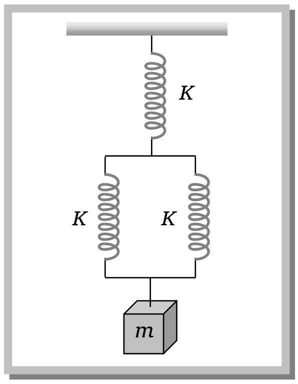
[CPMT 1991]

(a) 9/16 (b) 25/16 (c) 4/5 (d) 5/4

81. A mass on the end of a spring undergoes simple harmonic motion with a frequency of 0.5 Hz. If the attached mass is reduced to one quarter of its value, then the new frequency in Hz is

(a) 0.25 (b) 1.0 (c) 2.0 (d) 4.5

82. A body of mass m hangs from three springs, each of spring constant K as shown in the figure. If the mass is slightly displaced and let go, the system will oscillate with time period



(a) $2\pi\sqrt{\frac{m}{3K}}$

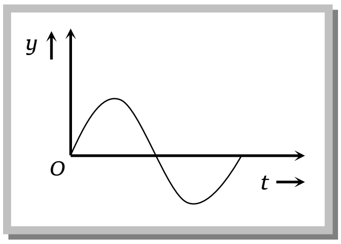
(b) $2\pi\sqrt{\frac{3m}{2K}}$

(c) $2\pi\sqrt{\frac{2m}{3K}}$

(d) $2\pi\sqrt{\frac{3K}{m}}$

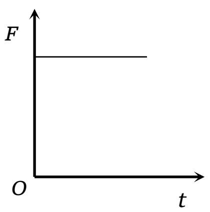
Miscellaneous Problems

83. The displacement time graph of a particle executing S.H.M. is as shown in the figure

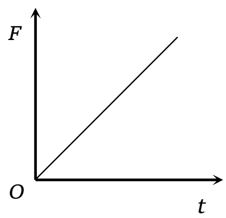


The corresponding force-time graph of the particle is **[Karnataka CET 2003]**

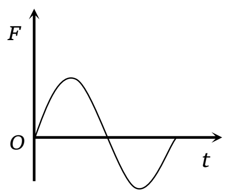
(a)



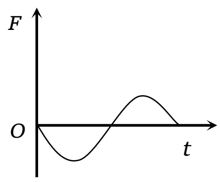
(b)



(c)



(d)



84. The amplitude of a damped oscillator becomes half on one minute. The amplitude after 3 minute will be $\frac{1}{X}$ times the original, where X is

(a) 2×3 (b) 2^3 (c) 3^2 (d) 3×2^2

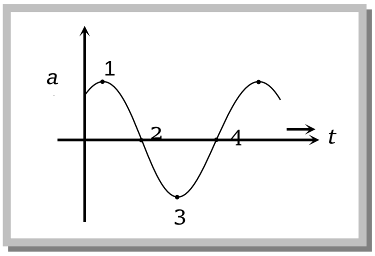
85. The maximum speed of a particle executing S.H.M. is 1 m/s and its maximum acceleration is 1.57 m/sec^2. The time period of the particle will be

(a) $\frac{1}{1.57}$ *sec* (b) 1.57 *sec* (c) 2 *sec* (d) 4 *sec*

86. The amplitude of a particle executing S.H.M. with frequency of 60 Hz is 0.01 m. The maximum value of the acceleration of the particle is

(a) $144\pi^2\ m/\sec^2$ (b) $144\ m/\sec^2$ (c) $\frac{144}{\pi^2}\ m/\sec^2$ (d) $288\pi^2\ m/\sec^2$

87. The acceleration a of a particle undergoing S.H.M. is shown in the figure. Which of the labelled points corresponds to the particle being at $-x_{max}$



(a) 4

(b) 3

(c) 2

(d) 1

88. A 0.10 kg block oscillates back and forth along a horizontal surface. Its displacement from the origin is given by: $x = (10\ cm)\cos[(10\ rad/s)t + \pi/2\ rad]$. What is the maximum acceleration experienced by the block

(a) $10\ m/s^2$ (b) $10\pi\ m/s^2$ (c) $\frac{10\pi}{2}\ m/s^2$ (d) $\frac{10\pi}{3}\ m/s^2$

89. A simple pendulum is set into vibrations. The bob of the pendulum comes to rest after sometime due to **[AFMC 2003; J**

(a) Air friction (b) Moment of inertia (c) Weight of the bob (d) Combination of all the above

90. A particle of mass 10 *grams* is executing simple harmonic motion with 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

91. 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 is

[MP PET 1996; MP PMT 1997]

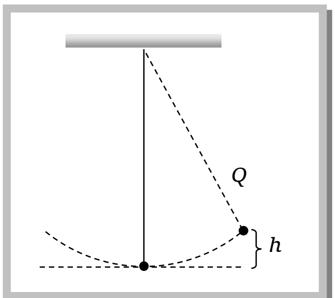
(a) 0.5 *sec* (b) 1.0 *sec* (c) 2.0 *sec* (d) 3.14 *sec*

92. A large horizontal surface moves up and down in S.H.M. with an amplitude of 1 cm. If a mass of 10 kg (which is placed on the surface) is to remain continually in contact with it, the maximum frequency of S.H.M. will be

(a) 0.5 Hz (b) 1.5 Hz (c) 5 Hz (d) 10 Hz

93. The bob of a simple pendulum is displaced from its equilibrium position O to a position Q which is at height h above O and the bob is then released. Assuming the mass of the bob to be m and time period of oscillations to be 2.0 *sec*, the tension in the string when the bob passes through O is

(a) $m(g + \pi\sqrt{2gh})$



(b) $m(g+\sqrt{\pi^2 gh})$

(c) $m\left(g+\sqrt{\frac{\pi^2}{2}gh}\right)$

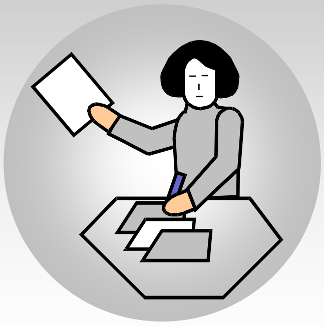
(d) $m\left(g+\sqrt{\frac{\pi^2}{3}gh}\right)$

94. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to massless spring of spring constant K. a mass m hangs freely from the free end of the spring. The area of cross-section and Young's modulus of the wire are A and Y respectively. If the mass is slightly pulled down and released, it will oscillate with a time period T equal to **[IIT-JEE 1993]**

(a) $2\pi\left(\frac{m}{K}\right)$ (b) $2\pi\left\{\frac{(YA+KL)m}{YAK}\right\}^{1/2}$ (c) $2\pi\frac{mYA}{KL}$ (d) $2\pi\frac{mL}{YA}$

95. The amplitude of vibration of a particle is given by $a_m=(a_0)/(a\omega^2-b\omega+c)$; where a_0, a, b and c are positive. The condition for a single resonant frequency is **[CPMT 1982]**

(a) $b^2<4ac$ (b) $b^2>4ac$ (c) $b^2=5ac$ (d) $b^2=7ac$



Answer Sheet (Practice problems)

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