5. The amplitude and the time period in a S.H.M. is 0.5 *cm* and 0.4 *sec* respectively. If the initial phase is $\pi/2$ radian, then the equation of S.H.M. will be

(a) $y = 0.5\sin 5\pi t$ (b) $y = 0.5\sin 4\pi t$

(c) $y = 0.5\sin 2.5\pi t$ (d) $y = 0.5\cos 5\pi t$

6. 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) $2\pi t$

7. A particle is oscillating according to the equation $X = 7\cos 0.5\pi t$, where *t* is in second. The point moves from the position of equilibrium to maximum displacement in time **[CPMT 1989]**

(a) 4.0 *sec* (b) 2.0 *sec*

(c) 1.0 *sec* (d) 0.5 *sec*

8. A simple harmonic oscillator has an amplitude *a* and time period *T*. The time required by it to travel from *x* = *a* to *x* = *a* / 2 is **[CBSE PMT 1992; SCRA 1996; BHU 1997]**

(a) *T* / 6 (b) *T* / 4

(c) *T* / 3 (d) *T* / 2

9. Which of the following expressions represent simple harmonic motion

(a) $x = A\sin(\omega t + \delta)$ (b) $x = B\cos(\omega t + \phi)$

(c) $x = A\tan(\omega t + \phi)$ (d) $x = A\sin\omega t\cos\omega t$

10. A $1.00 \times 10^{-20} kg$ particle is vibrating with simple harmonic motion with a period of $1.00 \times 10^{-5} sec$ and a maximum speed of $1.00 \times 10^{3} m/s$. The maximum displacement of the particle is

(a) 1.59 *mm* (b) 1.00 *m*

(c) 10 *m* (d) None of these

11. The phase (at a time *t*) of a particle in simple harmonic motion tells **[AMU (Engg.) 1999]**

(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*

12. 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

13. 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 **[EAMCET (Med.) 2000]**

(a) *T* (b) *T*/4

(c) *T*/8 (d) *T*/16

14. A simple harmonic motion is represented by $F(t) = 10\sin(20t + 0.5)$. The amplitude of the S.H.M. is **[DPMT 1998; CBSE PMT 2000; MH CET 2001]**

(a) *a* = 30 (b) *a* = 20

(c) *a* = 10 (d) *a* = 5

[Roorkee 1999]

15. 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) $y = a\tan\omega t$

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 $\pi\, rad/s$, then it's amplitude is **[AMU (Med.) 2002]**

[AMU (Med.) 1999]

(a) 1 *cm* (b) $\sqrt{2}$ *cm*

(c) 2 *cm* (d) 2.5 *cm*

17. 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 **[UPSEAT 2002]**

(a) *T* / 2 (b) *T* / 4

(c) *T* / 8 (d) *T* / 12

18. 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 **[Orissa JEE 2003]**

(a) A (b) B

(c) $A + B$ (d) $\sqrt{A+B}$

19. 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 **[BHU 1995]**

(a) 1 *sec* (b) 1/3 *sec*

(c) 2/3 *sec* (d) $\sqrt{3/2}$ *sec*

20. Which one of the following is a simple harmonic motion **[CBSE PMT 1994]**

(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

21. A particle is moving in a circle with uniform speed. Its motion is **[CPMT 1978; CBSE PMT 2005]**

(a) Periodic and simple harmonic

(b) Periodic but not simple harmonic

(c) A periodic

(d) None of the above

22. Two simple harmonic motions are represented by the equations $y_1 = 0.1\sin\left(100\pi t + \frac{\pi}{3}\right)$ and $y_2 = 0.1\cos\pi t$. The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is **[AIEEE 2005]**

(a) $\frac{-\pi}{3}$ (b) $\frac{\pi}{6}$

(c) $\frac{-\pi}{6}$ (d) $\frac{\pi}{3}$

23. Two particles are executing S.H.M. The equation of their motion are $y_1 = 10\sin\left(\omega t + \frac{\pi T}{4}\right)$, $y_2 = 25\sin\left(\omega t + \frac{\sqrt{3}\pi T}{4}\right)$. What is the ratio of their amplitude **[DCE 1996]**

(a) 1 : 1 (b) 2 : 5

(c) 1 : 2 (d) None of these

24. The periodic time of a body executing simple harmonic motion is 3 *sec*. After how much interval from time t = 0, its displacement will be half of its amplitude **[BHU 1998]**

(a) $\frac{1}{8}$ *sec* (b) $\frac{1}{6}$ *sec*

(c) $\frac{1}{4}$ *sec* (d) $\frac{1}{3}$ *sec*

25. A system exhibiting S.H.M. must possess **[KCET 1994]**

(a) Inertia only

(b) Elasticity as well as inertia

(c) Elasticity, inertia and an external force

(d) Elasticity only

26. If $x = a\sin\left(\omega t + \frac{\pi}{6}\right)$ and $x' = a\cos\omega t$, then what is the phase difference between the two waves **[RPET 1996]**

(a) $\pi/3$ (b) $\pi/6$

(c) $\pi/2$ (d) π

Velocity of Simple Harmonic Motion

1. A simple pendulum performs simple harmonic motion about X = 0 with an amplitude A and time period T. The speed of the pendulum at $X = \frac{A}{2}$ will be **[MP PMT 1987]**

(a) $\frac{\pi A\sqrt{3}}{T}$ (b) $\frac{\pi A}{T}$

(c) $\frac{\pi A\sqrt{3}}{2T}$ (d) $\frac{3\pi^2 A}{T}$

2. A body is executing simple harmonic motion with an angular frequency $2 rad/s$. The velocity of the body at 20 *mm* displacement, when the amplitude of motion is 60 *mm*, is **[Pb. CET 1996; Pb. PMT 1997; AFMC 1998; CPMT 1999]**

(a) 40 *mm* /*s* (b) $60 mm/s$

(c) $113 mm/s$ (d) $120 mm/s$

3. 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 **[CPMT 1976]**

(a) 5 (b) $5\sqrt{2}$

(c) $5\sqrt{3}$ (d) $10\sqrt{2}$

4. A simple harmonic oscillator has a period of 0.01 *sec* and an amplitude of 0.2 *m*. The magnitude of the velocity in $m\sec^{-1}$ at the centre of oscillation is **[JIPMER 1997]**

(a) 20π (b) 100

(c) 40π (d) 100π

5. A particle executes S.H.M. with a period of 6 second and amplitude of 3 *cm*. Its maximum speed in *cm/sec* is **[AIIMS 1982]**

(a) $\pi / 2$ (b) π

(c) 2π (d) 3π

6. A particle is executing S.H.M. If its amplitude is 2 *m* and periodic time 2 *seconds*, then the maximum velocity of the particle will be **[MP PMT 1985]**

(a) $\pi\, m/s$ (b) $\sqrt{2\pi}\, m/s$

(c) $2\pi\, m/s$ (d) $4\pi\, m/s$

7. A S.H.M. has amplitude '*a*' and time period *T*. The maximum velocity will be **[MP PMT 1985; CPMT 1997; UPSEAT 1999]**

(a) $\frac{4a}{T}$ (b) $\frac{2a}{T}$

(c) $2\pi\sqrt{\frac{a}{T}}$ (d) $\frac{2\pi a}{T}$

8. 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 **[CPMT 1991; MP PET 1995]**

(a) $2\pi\, sec$ (b) $\pi / 2\, sec$

(c) $\pi\, sec$ (d) $3\pi / 2\, sec$

9. A particle has simple harmonic motion. The equation of its motion is $x = 5\sin\left(4t - \frac{\pi}{6}\right)$, where *x* is its displacement. If the displacement of the particle is 3 units, then it velocity is **[MP PMT 1994]**

(a) $\frac{2\pi}{3}$ (b) $\frac{5\pi}{6}$

(c) 20 (d) 16

10. 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) 0.26 m/s

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 **[AFMC 1998]**

(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 **[Pb. PMT 1998; MH CET 1999, 2003]**

(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 $2 \times 10^{-3}\, m$. 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

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 **[EAMCET**

(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

[EAMCET (Med.) 2000]

(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

[EAMCET 2001]

(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 **[Kerala (Med.) 2002]**

(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

[MH CET (Med.) 2002; BCECE 2004]

(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

[BCECE 2003; RPMT 2003]

(a) $\omega\sqrt{a^2+y^2}$ (b) $\omega\sqrt{a^2-y^2}$

(c) ωy (d) $\omega^2\sqrt{a^2-y^2}$

21. A particle is executing the motion $x = A\cos(\omega t - \theta)$. The maximum velocity of the particle is

[BHU 2003; CPMT 2004]

(a) $A\omega\cos\theta$ (b) $A\omega$

(c) $A\omega\sin\theta$ (d) None of these

22. A particle executing simple harmonic motion with amplitude of 0.1 *m*. At a certain instant when its displacement is 0.02 *m*, its acceleration is 0.5 m/s^2. The maximum velocity of the particle is (in *m/s*) **[MP PET 2003]**

(a) 0.01 (b) 0.05

(c) 0.5 (d) 0.25

23. The amplitude of a particle executing SHM is 4 *cm*. At the mean position the speed of the particle is 16 *cm/sec*. The distance of the particle from the mean position at which the speed of the particle becomes $8\sqrt{3}\,cm/s$, will be

[Pb. PET 2003]

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

(c) 1 *cm* (d) 2 *cm*

24. The maximum velocity of a simple harmonic motion represented by $y = 3\sin\left(100t + \frac{\pi}{6}\right)$ is given by

[BCECE 2005]

(a) 300 (b) $\frac{3\pi}{6}$

(c) 100 (d) $\frac{\pi}{6}$

[BHU 2002]

25. The displacement equation of a particle is $x = 3\sin 2t + 4\cos 2t$. The amplitude and maximum velocity will be respectively

[RPMT 1998]

(a) 5, 10 (b) 3, 2

(c) 4, 2 (d) 3, 4

26. Velocity at mean position of a particle executing S.H.M. is *v*, they velocity of the particle at a distance equal to half of the amplitude **[RPMT 2001]**

(a) 4*v* (b) 2*v*

(c) $\frac{\sqrt{3}}{2}v$ (d) $\frac{\sqrt{3}}{4}v$

27. The instantaneous displacement of a simple pendulum oscillator is given by $x = A\cos\left(\omega t + \frac{\pi}{4}\right)$. Its speed will be maximum at time **[CPMT 2000]**

(a) $\frac{\pi}{4\omega}$ (b) $\frac{\pi}{2\omega}$

(c) $\frac{\pi}{\omega}$ (d) $\frac{2\pi}{\omega}$

Acceleration of Simple Harmonic Motion

1. Which of the following is a necessary and sufficient condition for S.H.M. **[NCERT 1974]**

(a) Constant period

(b) Constant acceleration

(c) Proportionality between acceleration and displacement from equilibrium position

(d) Proportionality between restoring force and displacement from equilibrium position

2. If a hole is bored along the diameter of the earth and a stone is dropped into hole **[CPMT 1984]**

(a) The stone reaches the centre of the earth and stops there

(b) The stone reaches the other side of the earth and stops there

(c) The stone executes simple harmonic motion about the centre of the earth

(d) The stone reaches the other side of the earth and escapes into space

3. The acceleration of a particle in S.H.M. is **[MP PMT 1993]**

(a) Always zero

(b) Always constant

(c) Maximum at the extreme position

(d) Maximum at the equilibrium position

4. The displacement of a particle moving in S.H.M. at any instant is given by $y = a\sin\omega t$. The acceleration after time $t = \frac{T}{4}$ is (where T is the time period) **[MP PET 1984]**

(a) $a\omega$ (b) $-a\omega$

(c) $a\omega^2$ (d) $-a\omega^2$

5. 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

[DPMT 1998; CBSE PMT 1999; AFMC 2001; Pb. PMT 2001; Pb. PET 2001, 02; CPMT 1993, 95, 04; RPMT 2005; MP PMT 2005]

(a) $144\pi^2 m/sec^2$ (b) $144 m/sec^2$

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

6. 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*

7. A body executing simple harmonic motion has a maximum acceleration equal to $24 \, metres/sec^2$ and maximum velocity equal to $16 \, metres/sec$. The amplitude of the simple harmonic motion is

[MP PMT 1995; DPMT 2002; RPET 2003; Pb. PET 2004]

(a) $\frac{32}{3}$ *metres* (b) $\frac{3}{32}$ *metres*

(c) $\frac{1024}{9}$ *metres* (d) $\frac{64}{9}$ *metres*

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

[MP PMT 1997; AIIMS 1999; Kerala PMT 2005]

(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

9. 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 **[MP PET 1999; MP PMT 2000]**

(a) 25 *N* (b) 5 *N*

(c) 2.5 *N* (d) 0.5 *N*

10. 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 [AMU 1995]

(a) $5.21 cm/s^2$ (b) $3.62 cm/s^2$
(c) $1.81 cm/s^2$ (d) $0.62 cm/s^2$

11. A particle moving along the *x*-axis executes simple harmonic motion, then the force acting on it is given by [CBSE PMT 1994]

(a) – *A Kx* (b) *A* cos (*Kx*)
(c) *A exp* (– *Kx*) (d) *A Kx*

Where *A* and *K* are positive constants

12. A body is vibrating in simple harmonic motion with an amplitude of 0.06 *m* and frequency of 15 *Hz*. The velocity and acceleration of body is [AFMC 1999]

(a) $5.65 m/s$ and $5.32\times10^2 m/s^2$
(b) $6.82 m/s$ and $7.62\times10^2 m/s^2$
(c) $8.91 m/s$ and $8.21\times10^2 m/s^2$
(d) $9.82 m/s$ and $9.03\times10^2 m/s^2$

13. A particle executes harmonic motion with an angular velocity and maximum acceleration of 3.5 *rad/sec* and 7.5 m/s^2 respectively. The amplitude of oscillation is [AIIMS 1999; Pb. PET 1999]

(a) 0.28 *m* (b) 0.36 *m*
(c) 0.53 *m* (d) 0.61 *m*

14. 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 [AMU (Engg.) 2000]

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

15. In S.H.M. maximum acceleration is at [RPET 2001; BVP 2003]

(a) Amplitude (b) Equilibrium
(c) Acceleration is constant (d) None of these

16. 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 [MP PET 2001]

(a) $100\ m/s^2$ (b) $100\pi^2\ m/s^2$
(c) $100\ m/s^2$ (d) $200\pi^2\ m/s^2$

17. Acceleration of a particle, executing SHM, at it's mean position is [MH CET (Med.) 2002]

(a) Infinity (b) Varies
(c) Maximum (d) Zero

18. Which one of the following statements is true for the speed *v* and the acceleration *a* of a particle executing simple harmonic motion [CBSE PMT 2004]

(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

19. What is the maximum acceleration of the particle doing the SHM $y=2\sin\left[\frac{\pi t}{2}+\phi\right]$ where 2 is in *cm* [DCE 2003]

(a) $\frac{\pi}{2} cm/s^2$ (b) $\frac{\pi^2}{2} cm/s^2$
(c) $\frac{\pi}{4} cm/s^2$ (d) $\frac{\pi}{4} cm/s^2$

20. 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 [Kerala PET 2005]

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

21. In simple harmonic motion, the ratio of acceleration of the particle to its displacement at any time is a measure of [UPSEAT 2001]

(a) Spring constant (b) Angular frequency
(c) (Angular frequency)^2 (d) Restoring force

Energy of Simple Harmonic Motion

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

[CPMT 1974, 78; EAMCET 1994; RPET 1999;

MP PMT 2001; Pb. PMT 2002; MH CET 2002]

(a) Displacement from equilibrium position
(b) Frequency of oscillation
(c) Velocity in equilibrium position
(d) Square of amplitude of motion

2. A particle executes simple harmonic motion along a straight line with an amplitude *A*. The potential energy is maximum when the displacement is **[CPMT 1982]**

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

3. 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 **[NCERT 1984; MNR 1995; RPMT 1995; DCE 2000; UPSEAT 2000]**

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

4. For a particle executing simple harmonic motion, the kinetic energy *K* is given by $K = K_o \cos^2 \omega t$. The maximum value of potential energy is **[CPMT 1981]**

(a) K_0 (b) Zero
(c) $\frac{K_0}{2}$ (d) Not obtainable

5. The potential energy of a particle with displacement *X* is *U(X)*. The motion is simple harmonic, when (*K* is a positive constant) **[CPMT 1982]**

(a) $U = -\frac{KX^2}{2}$ (b) $U = KX^2$
(c) $U = K$ (d) $U = KX$

6. The kinetic energy and potential energy of a particle executing simple harmonic motion will be equal, when displacement (amplitude = *a*) is **[MP PMT 1987; CPMT 1990; DPMT 1996; MH CET 1997, 99; AFMC 1999; CPMT 2000]**

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

7. The total energy of the body executing S.H.M. is *E*. Then the kinetic energy when the displacement is half of the amplitude, is **[RPMT 1994, 96; CBSE PMT 1995; JIPMER 2002]**

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

8. 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 **[DPMT 2001]**

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

9. The angular velocity and the amplitude of a simple pendulum is ω and *a* respectively. At a displacement *X* from the mean position if its kinetic energy is *T* and potential energy is *V*, then the ratio of *T* to *V* is **[CBSE PMT 1991]**

(a) $X^2\omega^2 / (a^2 - X^2\omega^2)$ (b) $X^2 / (a^2 - X^2)$
(c) $(a^2 - X^2\omega^2) / X^2\omega^2$ (d) $(a^2 - X^2) / X^2$

10. When the potential energy of a particle executing simple harmonic motion is one-fourth of its maximum value during the oscillation, the displacement of the particle from the equilibrium position in terms of its amplitude *a* is **[CBSE PMT 1993; EAMCET (Engg.) 1995; MP PMT 1994, 2000; MP PET 1995, 96, 2002]**

(a) $a/4$ (b) $a/3$
(c) $a/2$ (d) $2a/3$

11. 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 **[MP PMT 1996]**

(a) $37.5\pi^2 ergs$ (b) $3.75\pi^2 ergs$
(c) $375\pi^2 ergs$ (d) $0.375\pi^2 ergs$

12. 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) $\frac{1}{8}$

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

[Roorkee 1992; CPMT 1997; RPMT 1999]

(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

14. 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

[SCRA 1998]

(a) Velocity

(b) Potential energy

(c) Phase difference between acceleration and displacement

(d) Difference between kinetic energy and potential energy

15. 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 **[RPET 2000]**

(a) 3 *cm* (b) 4.2 *cm*

(c) 5.8 *cm* (d) 6 *cm*

16. 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

[EAMCET (Engg.) 2000]

(a) 6 *J* (b) 18 *J*

(c) 24 *J* (d) 36 *J*

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

[MP PET 2000]

(a) *f*/2 (b) *f*

(c) 2 *f* (d) 4 *f*

18. 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

[CBSE PMT 2001]

(a) *K, x* (b) *K, a*

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

19. 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

[Kerala (Engg.) 2001]

(a) 60 *J* (b) 10 *J*

(c) 40 *J* (d) 45 *J*

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

[AIEEE 2002]

(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

21. 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) $\pm\frac{a}{4}$

22. 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 **[BHU 2002]**

(a) $\frac{kl}{2}$ (b) $2kl$

(c) $\frac{1}{2}Mgl$ (d) *Mgl*

23. 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) $\frac{2}{3}E$

24. 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

25. 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 **[MP PMT 2004]**

(a) <*E*> = <*U*> (b) <*E*> = 2<*U*>

(c) <*E*> = – 2<*U*> (d) <*E*>= – <*U*>

26. The total energy of a particle, executing simple harmonic motion is **[AIEEE 2004]**

(a) $\propto x$ (b) $\propto x^2$

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

27. The kinetic energy of a particle executing S.H.M. is 16 *J* when it is at its mean position. If the mass of the particle is 0.32 *kg*, then what is the maximum velocity of the particle **[MH CET 2004]**

(a) $5 m/s$ (b) $15 m/s$

(c) $10 m/s$ (d) $20 m/s$

28. Consider the following statements. The total energy of a particle executing simple harmonic motion depends on its

(1) Amplitude (2) Period (3) Displacement

Of these statements **[RPMT 2001; BCECE 2005]**

(a) (1) and (2) are correct

(b) (2) and (3) are correct

(c) (1) and (3) are correct

(d) (1), (2) and (3) are correct

29. A particle starts simple harmonic motion from the mean position. Its amplitude is *a* and total energy *E*. At one instant its kinetic energy is $3E/4$. Its displacement at that instant is **[Kerala PET 2005]**

(a) $a/\sqrt{2}$ (b) $a/2$

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

30. A particle executes simple harmonic motion with a frequency f. The frequency with which its kinetic energy oscillates is **[AIEEE 2003]** **[IIT JEE 1973, 87; Manipal MEE 1995; MP PET 1997; DCE 1997; DCE 1999; UPSEAT 2000; RPET 2002; RPMT 2004; BHU 2005]**

(a) $f/2$ (b) f

(c) $2f$ (d) $4f$

31. The amplitude of a particle executing SHM is made three-fourth keeping its time period constant. Its total energy will be **[RPMT 2004]**

(a) $\frac{E}{2}$ (b) $\frac{3}{4}E$

(c) $\frac{9}{16}E$ (d) None of these

32. A particle of mass *m* is hanging vertically by an ideal spring of force constant *K*. If the mass is made to oscillate vertically, its total energy is **[CPMT 1978; RPET 1999]**

(a) Maximum at extreme position

(b) Maximum at mean position

(c) Minimum at mean position

(d) Same at all position

33. A body is moving in a room with a velocity of 20 *m* / s perpendicular to the two walls separated by 5 *meters*. There is no friction and the collisions with the walls are elastic. The motion of the body is **[MP PMT 1999]**

(a) Not periodic

(b) Periodic but not simple harmonic

(c) Periodic and simple harmonic

(d) Periodic with variable time period

34. 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 **[EAMCET 2001]**

(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) $E = E_1 + E_2$

Time Period and Frequency

1. A particle moves such that its acceleration *a* is given by $a = -bx$, where *x* is the displacement from equilibrium position and *b* is a constant. The period of oscillation is

[NCERT 1984; CPMT 1991; MP PMT 1994; MNR 1995; UPSEAT 2000]

(a) $2\pi\sqrt{b}$ (b) $\frac{2\pi}{\sqrt{b}}$

(c) $\frac{2\pi}{b}$ (d) $2\sqrt{\frac{\pi}{b}}$

2. The equation of motion of a particle is $\frac{d^2y}{dt^2} + Ky = 0$, where *K* is positive constant. The time period of the motion is given by

[AIEEE 2005]

(a) $\frac{2\pi}{K}$ (b) $2\pi K$

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

3. 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

4. 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 **[DPMT 2002]**

(a) $\frac{1}{1.57}$ *sec* (b) 1.57 *sec*

(c) 2 *sec* (d) 4 *sec*

5. The motion of a particle executing S.H.M. is given by $x = 0.01 \sin 100\pi(t + .05)$, where *x* is in *metres* and time is in seconds. The time period is **[CPMT 1990]**

(a) 0.01 *sec* (b) 0.02 *sec*

(c) 0.1 *sec* (b) 0.2 *sec*

6. 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

[Haryana CEE 1996; AFMC 1998]

(a) $\frac{\pi}{5}$ *sec* (b) 2π *sec*

(c) 20π *sec* (d) 5π *sec*

7. 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*

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

[CPMT 1999]

(a) Double the mass

(b) Half the mass

(c) Quadruple the mass

(d) Reduce the mass to one-fourth

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

(a) Restoring force (b) Kinetic energy

(c) Potential energy (d) Periodic time

10. 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

[CBSE PMT 1992; RPMT 1996]

(a) $10\, rad\, s^{-1}$ (b) $0.1\, rad\, s^{-1}$

(c) $100\, rad\, s^{-1}$ (d) $1\, rad\, s^{-1}$

11. 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) $3000/\pi$

12. 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

13. 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}

[DPMT 2004]

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

14. 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 **[Pb. PET 2000]**

(a) 2.047 *s* (b) 1.047 *s*
(c) 3.047 *s* (d) 0.047 *s*

15. 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 **[UPSEAT 2004]**

(a) 0.5 *Hz* (b) 1.0 *Hz*
(c) $\frac{\pi}{2}$ *Hz* (d) π *Hz*

16. A simple harmonic wave having an amplitude *a* and time period *T* is represented by the equation $y = 5\sin\pi(t+4)m$. Then the value of amplitude (*a*) in (*m*) and time period (*T*) in second are **[Pb. PET 2004]**

(a) $a = 10, T = 2$ (b) $a = 5, T = 1$
(c) $a = 10, T = 1$ (d) $a = 5, T = 2$

17. A particle executing simple harmonic motion of amplitude 5 *cm* has maximum speed of 31.4 *cm/s*. The frequency of its oscillation is **[CBSE PMT 2005]**

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

18. The displacement *x* (in *metres*) of a particle performing simple harmonic motion is related to time *t* (in *seconds*) as $x = 0.05\cos\left(4\pi t + \frac{\pi}{4}\right)$.

The frequency of the motion will be **[MP PMT/PET 1998]**

(a) 0.5 *Hz* (b) 1.0 *Hz*
(c) 1.5 *Hz* (d) 2.0 *Hz*

Simple Pendulum

1. The period of a simple pendulum is doubled, when **[CPMT 1974; MNR 1980; AFMC 1995; Pb. PET/PMT 2002]**

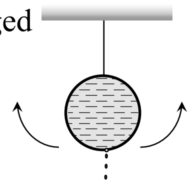
(a) Its length is doubled
(b) The mass of the bob is doubled
(c) Its length is made four times
(d) The mass of the bob and the length of the pendulum are doubled

2. 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

3. A simple pendulum is made of a body which is a hollow sphere containing mercury suspended by means of a wire. If a little mercury is drained off, the period of pendulum will **[NCERT 1972; BHU 1979]**

(a) Remains unchanged
(b) Increase
(c) Decrease
(d) Become erratic



4. A pendulum suspended from the ceiling of a train has a period *T*, when the train is at rest. When the train is accelerating with a uniform acceleration *a*, the period of oscillation will **[NCERT 1980; CPMT 1997]**

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

5. The mass and diameter of a planet are twice those of earth. The period of oscillation of pendulum on this planet will be (If it is a second's pendulum on earth) **[IIT 1973; DCE 2002]**

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

6. A simple pendulum is set up in a trolley which moves to the right with an acceleration a on a horizontal plane. Then the thread of the pendulum in the mean position makes an angle θ with the vertical **[CPMT 1983]**

(a) $\tan^{-1}\frac{a}{g}$ in the forward direction

(b) $\tan^{-1}\frac{a}{g}$ in the backward direction

(c) $\tan^{-1}\frac{g}{a}$ in the backward direction

(d) $\tan^{-1}\frac{g}{a}$ in the forward direction

7. Which of the following statements is not true ? In the case of a simple pendulum for small amplitudes the period of oscillation is **[NCERT 1982]**

(a) Directly proportional to square root of the length of the pendulum

(b) Inversely proportional to the square root of the acceleration due to gravity

(c) Dependent on the mass, size and material of the bob

(d) Independent of the amplitude

8. The time period of a second's pendulum is 2 *sec*. The spherical bob which is empty from inside has a mass of 50 *gm*. This is now replaced by another solid bob of same radius but having different mass of 100 *gm*. The new time period will be **[NCERT 1972]**

(a) 4 *sec* (b) 1 *sec*

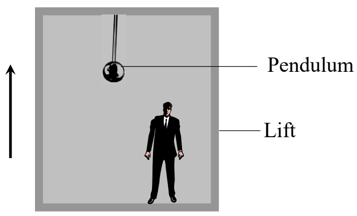
(c) 2 *sec* (d) 8 *sec*

9. A man measures the period of a simple pendulum inside a stationary lift and finds it to be T sec. If the lift accelerates upwards with an acceleration $g/4$, then the period of the pendulum will be **[NCERT 1990; BHU 2001]**

(a) T

(b) $\frac{T}{4}$

(c) $\frac{2T}{\sqrt{5}}$



(d) $2T\sqrt{5}$

10. A simple pendulum is suspended from the roof of a trolley which moves in a horizontal direction with an acceleration a, then the time period is given by $T=2\pi\sqrt{\frac{l}{g}}$, where g is equal to **[BHU 1997]**

(a) g (b) $g-a$

(c) $g+a$ (d) $\sqrt{g^2+a^2}$

11. A second's pendulum is placed in a space laboratory orbiting around the earth at a height $3R$, where R is the radius of the earth. The time period of the pendulum is **[CPMT 1989; RPMT 1995]**

(a) Zero (b) $2\sqrt{3}$ *sec*

(c) 4 *sec* (d) Infinite

12. The bob of a simple pendulum of mass m and total energy E will have maximum linear momentum equal to **[MP PMT 1986]**

(a) $\sqrt{\frac{2E}{m}}$ (b) $\sqrt{2mE}$

(c) $2mE$ (d) mE^2

13. 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 **[CPMT 1971]**

(a) 1 / 6 *m* (b) 6 *m*

(c) 1 / 36 *m* (d) 36 *m*

14. If the length of second's pendulum is decreased by 2%, how many seconds it will lose per day **[CPMT 1992]**

(a) 3927 *sec* (b) 3727 *sec*

(c) 3427 *sec* (d) 864 sec

15. 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 **[MNR 1979]**

(a) The same (b) Increased by 3/5

(c) Decreased by 2/3 times (d)None of the above

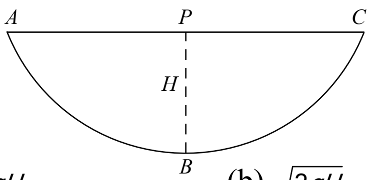
16. The length of a simple pendulum is increased by 1%. Its time period will **[MP PET 1994; RPET 2001]**

(a) Increase by 1% (b) Increase by 0.5%

(c) Decrease by 0.5% (d) Increase by 2%

17. 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

[CBSE PMT 1995; DPMT 1995; Pb. PMT 1996]



(a) mgH (b) $\sqrt{2gH}$

(c) $2gH$ (d) Zero

18. Identify correct statement among the following **[Manipal MEE 1995]**

(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

19. 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 **[Haryana CEE 1996]**

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

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

20. 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

21. A pendulum bob has a speed of 3 *m/s* at its lowest position. The pendulum is 0.5 *m* long. The speed of the bob, when the length makes an angle of 60^o to the vertical, will be (If $g = 10 m/s^2$) **[MP PET 1996]**

(a) $3 m/s$ (b) $\frac{1}{3} m/s$

(c) $\frac{1}{2} m/s$ (d) $2 m/s$

22. The time period of a simple pendulum is 2 *sec*. If its length is increased 4 times, then its period becomes

[CBSE PMT 1999; DPMT 1999]

(a) 16 *sec* (b) 12 *sec*

(c) 8 *sec* (d) 4 *sec*

23. If the metal bob of a simple pendulum is replaced by a wooden bob, then its time period will **[AIIMS 1998, 99]**

(a) Increase

(b) Decrease

(c) Remain the same

(d) First increase then decrease

24. In a simple pendulum, the period of oscillation *T* is related to length of the pendulum *l* as

[EAMCET (Med.) 1995]

(a) $\frac{l}{T}$ = constant (b) $\frac{l^2}{T}$ = constant

(c) $\frac{l}{T^2}$ = constant (d) $\frac{l^2}{T^2}$ = constant

25. A pendulum has time period *T*. If it is taken on to another planet having acceleration due to gravity half and mass 9 times that of the earth then its time period on the other planet will be

[CMEET Bihar 1995]

(a) $\sqrt{T}$ (b) *T*

(c) $T^{1/3}$ (d) $\sqrt{2}$ T

26. A simple pendulum is executing simple harmonic motion with a time period *T*. If the length of the pendulum is increased by 21%, the percentage increase in the time period of the pendulum of increased length is

[BHU 1994, 96; Pb. PMT 1995; AFMC 2001; AIIMS 2001; AIEEE 2003]

(a) 10% (b) 21%

(c) 30% (d) 50%

27. If the length of simple pendulum is increased by 300%, then the time period will be increased by **[RPMT 1999]**

(a) 100% (b) 200%

(c) 300% (d) 400%

28. The length of a seconds pendulum is **[RPET 2000]**

(a) 99.8 *cm* (b) 99 *cm*

(c) 100 *cm* (d) None of these

29. The time period of a simple pendulum in a lift descending with constant acceleration *g* is **[DCE 1998; MP PMT 2001]**

(a) $T = 2\pi\sqrt{\frac{l}{g}}$ (b) $T = 2\pi\sqrt{\frac{l}{2g}}$

(c) Zero (d) Infinite

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

[KCET (Engg./Med.) 2000; AIEEE 2002; DPMT 2004]

(a) Become infinite (b) Remain same

(c) Increase (d) Decrease

31. The acceleration due to gravity at a place is $\pi^2 m/sec^2$. Then the time period of a simple pendulum of length one *metre* is **[JIPMER 2002]**

(a) $\frac{2}{\pi} sec$ (b) $2\pi\ sec$

(c) $2\,sec$ (d) $\pi\ sec$

32. A plate oscillated with time period '*T*'. Suddenly, another plate put on the first plate, then time period **[AIEEE 2002]**

(a) Will decrease (b) Will increase

(c) Will be same (d) None of these

33. 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 2*T*, then new length is **[MP PMT 2002]**

(a) 2 *l* (b) 4 *l*

(c) 4 *l x* (d) $\frac{4l}{x}$

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

[Orissa PMT 2001]

(a) 1 *sec* (b) 2 *sec*

(c) 4 *sec* (d) 3 *sec*

35. The time period of a simple pendulum when it is made to oscillate on the surface of moon **[J & K CET 2004]**

(a) Increases (b) Decreases

(c) Remains unchanged (d) Becomes infinite

36. A simple pendulum is attached to the roof of a lift. If time period of oscillation, when the lift is stationary is *T*. Then frequency of oscillation, when the lift falls freely, will be

[DCE 2002]

(a) Zero (b) *T*

(c) 1/*T* (d) None of these

37. A simple pendulum, suspended from the ceiling of a stationary van, has time period *T*. If the van starts moving with a uniform velocity the period of the pendulum will be

[RPMT 2003]

(a) Less than *T* (b) Equal to 2*T*

(c) Greater than *T* (d) Unchanged

38. If the length of the simple pendulum is increased by 44%, then what is the change in time period of pendulum

[MH CET 2004; UPSEAT 2005]

(a) 22% (b) 20%

(c) 33% (d) 44%

39. To show that a simple pendulum executes simple harmonic motion, it is necessary to assume that **[CPMT 2001]**

(a) Length of the pendulum is small

(b) Mass of the pendulum is small

(c) Amplitude of oscillation is small

(d) Acceleration due to gravity is small

40. The height of a swing changes during its motion from 0.1 *m* to 2.5 *m*. The minimum velocity of a boy who swings in this swing is **[CPMT 1997]**

(a) 5.4 m/s (b) 4.95 m/s

(c) 3.14 m/s (d) Zero

41. The amplitude of an oscillating simple pendulum is 10*cm* and its period is 4 *sec*. Its speed after 1 *sec* after it passes its equilibrium position, is

(a) Zero (b) $0.57 m/s$

(c) $0.212 m/s$ (d) $0.32 m/s$

42. A simple pendulum consisting of a ball of mass *m* tied to a thread 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 **[NCERT 1977]**

(a) Zero (b) $m\theta\sqrt{\frac{g}{l}}$

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

43. A simple pendulum hangs from the ceiling of a car. If the car accelerates with a uniform acceleration, the frequency of the simple pendulum will **[Pb. PMT 2000]**

(a) Increase (b) Decrease

(c) Become infinite (d) Remain constant

44. The periodic time of a simple pendulum of length 1 *m* and amplitude 2 *cm* is 5 seconds. If the amplitude is made 4 *cm*, its periodic time in seconds will be **[MP PMT 1985]**

(a) 2.5 (b) 5

(c) 10 (d) $5\sqrt{2}$

45. The ratio of frequencies of two pendulums are 2 : 3, then their length are in ratio **[DCE 2005]**

(a) $\sqrt{2/3}$ (b) $\sqrt{3/2}$

(c) $4/9$ (d) $9/4$

46. 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 **[J & K CET 2005]**

(a) 7 : 8 (b) 8 : 7

(c) 49 : 64 (d) 64 : 49

47. 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 **[Orissa JEE 2005]**

(a) T_2 is infinity (b) $T_2 > T_1$

(c) $T_2 < T_1$ (d) $T_2 = T_1$

48. 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 **[BHU 2005]**

(a) 3*T* (b) 3/2*T*

(c) 4*T* (d) 2*T*

49. A simple pendulum is taken from the equator to the pole. Its period **[Kerala (PET/PMT) 2005]**

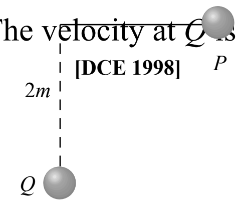
(a) Decreases

(b) Increases

(c) Remains the same

(d) Decreases and then increases

50. A pendulum of length 2*m* lift at *P*. When it reaches *Q*, it losses 10% of its total energy due to air resistance. The velocity at *Q* is **[DCE 1998]**



(a) 6 *m/sec*

(b) 1 *m/sec*

(c) 2 *m/sec*

(d) 8 *m/sec*

51. 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 **[DCE 2004]**

(a) 0.8 *T* (b) 0.25 *T*

(c) 2 *T* (d) 4 *T*

52. 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 **[RPMT 2000; DPMT 2000, 03]**

(a) $\frac{T}{\sqrt{3}}$ (b) $\frac{T}{3}$

(c) $\frac{\sqrt{3}}{2}T$ (d) $\sqrt{3}\,T$

53. Time period of a simple pendulum will be double, if we **[MH CET 2003]**

(a) Decrease the length 2 times

(b) Decrease the length 4 times

(c) Increase the length 2 times

(d) Increase the length 4 times

54. Length of a simple pendulum is l and its maximum angular displacement is θ, then its maximum K.E. is **[RPMT 1995; BHU 2003]**

(a) $mgl\sin\theta$ (b) $mgl(1+\sin\theta)$

(c) $mgl(1+\cos\theta)$ (d) $mgl(1-\cos\theta)$

55. The velocity of simple pendulum is maximum at **[RPMT 2004]**

(a) Extremes (b) Half displacement

(c) Mean position (d) Every where

56. A simple pendulum is vibrating in an evacuated chamber, it will oscillate with **[Pb. PMT 2004]**

(a) Increasing amplitude (b) Constant amplitude

(c) Decreasing amplitude (d) First (c) then (a)

57. The time period of a simple pendulum of length L as measured in an elevator descending with acceleration $\frac{g}{3}$ is **[CPMT 2000]**

(a) $2\pi\sqrt{\frac{3L}{g}}$ (b) $\pi\sqrt{\left(\frac{3L}{g}\right)}$

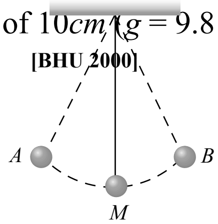
(c) $2\pi\sqrt{\left(\frac{3L}{2g}\right)}$ (d) $2\pi\sqrt{\frac{2L}{3g}}$

58. If a body is released into a tunnel dug across the diameter of earth, it executes simple harmonic motion with time period **[CPMT 1999]**

(a) $T=2\pi\sqrt{\frac{R_e}{g}}$ (b) $T=2\pi\sqrt{\frac{2R_e}{g}}$

(c) $T=2\pi\sqrt{\frac{R_e}{2g}}$ (d) $T=2$ seconds

59. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of $10cm$ ($g = 9.8\ m/s^2$) **[BHU 2000]**



(a) 2.2 m/s

(b) 1.8 m/s

(c) 1.4 m/s

(d) 0.6 m/s

60. 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 **[AFMC 2004]**

(a) Less than T (b) Greater than T

(c) Equal to T (d) Infinite

61. What effect occurs on the frequency of a pendulum if it is taken from the earth surface to deep into a mine **[AFMC 2005]**

(a) Increases

(b) Decreases

(c) First increases then decrease

(d) None of these

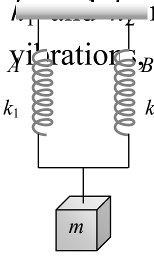
Spring Pendulum

1. Two bodies M and N of equal masses are suspended from two separate massless springs of force constants k_1 and k_2 respectively. If the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude M to that of N is **[IIT-JEE 1988; MP PET 1997, 2001; MP PMT 1997; BHU 1998; Pb. PMT 1998; MH CET 2000, 03; AIEEE 2003]**

(a) $\frac{k_1}{k_2}$ (b) $\sqrt{\frac{k_1}{k_2}}$

(c) $\frac{k_2}{k_1}$ (d) $\sqrt{\frac{k_2}{k_1}}$

2. 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 **[MP PMT 2001]**



(a) $2\pi\sqrt{\left(\frac{m}{k_1k_2}\right)}$ (b) $2\pi\sqrt{m\left(\frac{k_1}{k_2}\right)}$

(c) $2\pi\sqrt{\left(\frac{m}{k_1-k_2}\right)}$ (d) $2\pi\sqrt{\left(\frac{m}{k_1+k_2}\right)}$

3. A spring has a certain mass suspended from it and its period for vertical oscillation is T. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is now

[MP PET 1995]

(a) $\frac{T}{2}$ (b) $\frac{T}{\sqrt{2}}$

(c) $\sqrt{2}T$ (d) $2T$

4. Two masses m_1 and m_2 are suspended together by a massless spring of constant k. When the masses are in equilibrium, m_1 is removed without disturbing the system. Then the angular frequency of oscillation of m_2 is

(a) $\sqrt{\frac{k}{m_1}}$ (b) $\sqrt{\frac{k}{m_2}}$

(c) $\sqrt{\frac{k}{m_1+m_2}}$ (d) $\sqrt{\frac{k}{m_1m_2}}$

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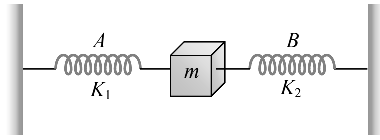
5. In arrangement given in figure, if the block of mass m is displaced, the frequency is given by

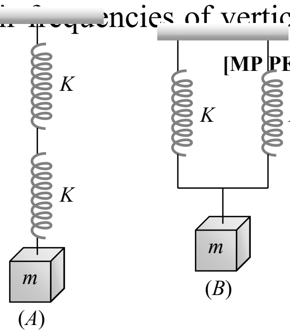
[BHU 1994; Pb. PET 2001]



(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) $n=\frac{1}{2\pi}\sqrt{\left(\frac{m}{k_1-k_2}\right)}$

6. Two identical spring of constant K are connected in series and parallel as shown in figure. A mass m is suspended from them. The ratio of their frequencies of vertical oscillations will be **[MP PET 1993; BHU 1997]**



(a) 2 : 1 (b) 1 : 1

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

7. A mass m is suspended from the two coupled springs connected in series. The force constant for springs are K_1 and K_2. The time period of the suspended mass will be

[CBSE PMT 1990; Pb. PET 2002]

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

(c) $T=2\pi\sqrt{\left(\frac{m(K_1+K_2)}{K_1K_2}\right)}$ (d) $T=2\pi\sqrt{\left(\frac{mK_1K_2}{K_1+K_2}\right)}$

8. A spring is stretched by 0.20 m, when a mass of 0.50 kg is suspended. When a mass of 0.25 kg is suspended, then its period of oscillation will be $(g=10 m/s^2)$

(a) 0.328 *sec* (b) 0.628 *sec*

(c) 0.137 *sec* (d) 1.00 *sec*

9. 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 $\frac{m}{M}$ is **[CPMT 1991]**

(a) 9/16 (b) 25/16

(c) 4/5 (d) 5/4

10. A spring having a spring constant 'K' is loaded with a mass 'm'. The spring is cut into two equal parts and one of these is loaded again with the same mass. The new spring constant is **[NCERT 1990; KCET 1999; Kerala PMT 2004; BCECE 2004]**

(a) $K/2$ (b) K

(c) $2K$ (d) K^2

11. 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 $2m$ is suspended from it. The frequency of oscillation will now become

[CPMT 1988]

(a) n (b) $2n$

(c) $n/\sqrt{2}$ (d) $n(2)^{1/2}$

12. 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 **[CPMT 1989, 1998 ; UPSEAT 2000]**

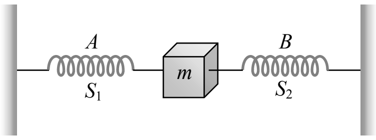
(a) $T = 2\pi\sqrt{(mg/x(M+m))}$

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

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

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

13. 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 **[CPMT 1971]**



(a) f (b) $f \times 2$

(c) $f \times \sqrt{2}$ (d) $f/\sqrt{2}$

14. 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

[CPMT 1981; MP PMT 2003]

(a) 20π sec (b) 2π sec

(c) $2\pi/10$ sec (d) 200π sec

15. 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 **[MP PET 1994]**

(a) 0.31 *sec* (b) 0.15 *sec*

(c) 0.05 *sec* (d) 0.02 *sec*

16. 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) $\frac{x}{4}$

17. 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 **[MP PMT 1994]**

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

18. 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

[Manipal MEE 1995]

(a) 1 : 3 (b) 1 : 2

(c) 2 : 3 (d) 2 : 1

19. 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

[MP PMT 1995]

(a) $x = 0.16\cos(\pi t)$ (b) $x = -0.16\cos(\pi t)$

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

20. 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 **[MP PET 1996]**

(a) $x = \sqrt{m/k}$ (b) $x = \frac{1}{v}\sqrt{m/k}$

(c) $x = v\sqrt{m/k}$ (d) $x = \sqrt{mv/k}$

21. 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

[MP PET 2002]

(a) $K_1 : K_2$ (b) $K_2 : K_1$

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

22. A mass *m* is vertically suspended from a spring of negligible mass; the system oscillates with a frequency *n*. What will be the frequency of the system if a mass 4 *m* is suspended from the same spring **[CBSE PMT 1998]**

(a) $n/4$ (b) $4n$

(c) $n/2$ (d) $2n$

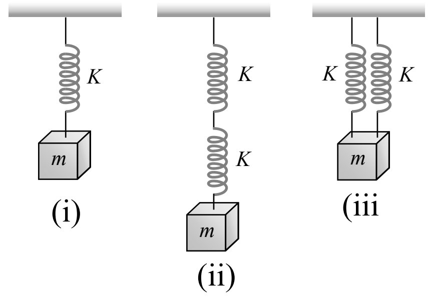
23. If the period of oscillation of mass *m* suspended from a spring is 2 *sec*, then the period of mass 4*m* will be

[AIIMS 1998]

(a) 1 *sec* (b) 2 *sec*

(c) 3 *sec* (d) 4 *sec*

24. 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 **[AMU 1995]**

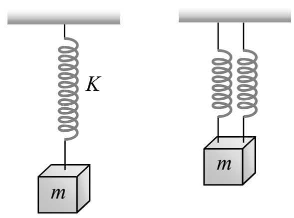


(a) $1 : \sqrt{2} : \frac{1}{\sqrt{2}}$ (b) $2 : \sqrt{2} : \frac{1}{\sqrt{2}}$

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

25. A mass *m* performs oscillations of period *T* when hanged by spring of force constant *K*. If spring is cut in two parts and arranged in parallel and same mass is oscillated by them, then the new time period will be

[CPMT 1995; RPET 1997; RPMT 2003]



(a) 2*T*

(b) *T*

(c) $\frac{T}{\sqrt{2}}$

(d) $\frac{T}{2}$

26. If a watch with a wound spring is taken on to the moon, it

[AFMC 1993]

(a) Runs faster (b) Runs slower

(c) Does not work (d) Shows no change

27. What will be the force constant of the spring system shown in the figure

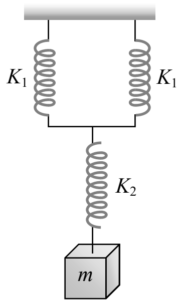
[RPET 1996; Kerala (Med./ Engg.) 2005]

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

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

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

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



28. 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

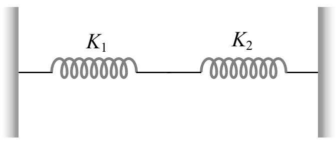
[RPMT 1999]

(a) More in spring *A* (b) More in spring *B*

(c) Equal in both (d) Noting can be said

29. The effective spring constant of two spring system as shown in figure will be

[RPMT 1999]



(a) $K_1 + K_2$ (b) $K_1 K_2 / K_1 + K_2$

(c) $K_1 - K_2$ (d) $K_1 K_2 / K_1 - K_2$

30. 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

AIIMS 2000; MP PET 2000; DPMT 2001; Pb. PMT 2003]

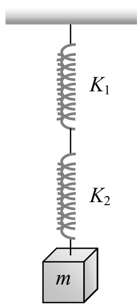
(a) 1.6 *kg* (b) 3.9 *kg*

(c) 9.6 *kg* (d) 12.6 *kg*

31. 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

[MP PMT 2000; RPET 2001]

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



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

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

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

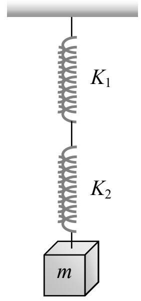
32. The frequency of oscillation of the springs shown in the figure will be **[AIIMS 2001; Pb. PET 200**

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

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

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

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



33. 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)

[Kerala (Engg.) 2001]

(a) 10 *kg* (b) 0.98 *kg*

(c) 5 *kg* (d) 20 *kg*

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

[AIEEE 2002]

(a) $T\sqrt{n}$ (b) $T/\sqrt{n}$

(c) *nT* (d) *T*

35. One-forth length of a spring of force constant *K* is cut away. The force constant of the remaining spring will be **[CBSE PMT 2000;**

[MP PET 2002]

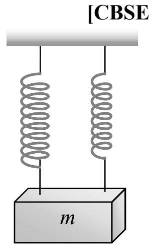
(a) $\frac{3}{4}K$ (b) $\frac{4}{3}K$

(c) *K* (d) 4 *K*

36. 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) $t = t_1 + t_2$

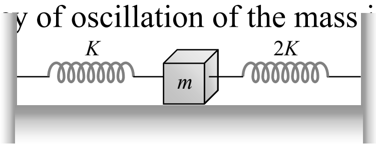


(b) $t = \frac{t_1 . t_2}{t_1 + t_2}$

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

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

37. Two springs of force constants K and $2K$ are connected to a mass as shown below. The frequency of oscillation of the mass is **[RPMT 1996; 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) $(1/2\pi)\sqrt{(m/K)}$

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

[CBSE PMT 2004]

(a) $\sqrt{k_1 k_2}$ (b) $(k_1 + k_2)/2$

(c) $k_1 + k_2$ (d) $k_1 k_2 /(k_1 + k_2)$

39. 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 **[AIEEE 2004]**

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

40. Infinite springs with force constant k, $2k$, $4k$ and $8k$.... respectively are connected in series. The effective force constant of the spring will be **[J & K CET 2004]**

(a) $2K$ (b) k

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

41. To make the frequency double of a spring oscillator, we have to **[CPMT 2004; MP PMT 2005]**

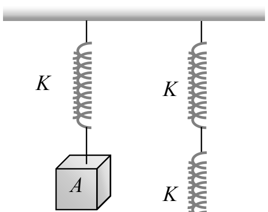
(a) Reduce the mass to one fourth

(b) Quardruple the mass

(c) Double of mass

(d) Half of the mass

42. The springs shown are identical. When $A = 4kg$, the elongation of spring is 1 cm. If $B = 6kg$, the



elongation produced by it is

[Pb. PET 2002]

(a) 4 cm (b) 3 cm

(c) 2 cm (d) 1 cm

43. When a body of mass 1.0 kg is suspended from a certain light spring hanging vertically, its length increases by 5 cm. By suspending 2.0 kg block to the spring and if the block is pulled through 10 cm and released the maximum velocity in it in m/s is : (Acceleration due to gravity $= 10 m/s^2$)

[EAMCET 2003]

(a) 0.5 (b) 1

(c) 2 (d) 4

44. 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 **[RPET 2001]**

(a) 2 : 1 (b) 1 : 2

(c) 4 : 1 (d) 1 : 4

45. If a spring extends by x on loading, then energy stored by the spring is (if T is the tension in the spring and K is the spring constant)

(a) $\frac{T^2}{2x}$ (b) $\frac{T^2}{2K}$

(c) $\frac{2K}{T^2}$ (d) $\frac{2T^2}{K}$

46. 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) $\frac{\pi}{\sqrt{200}}s$

47. 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 [MP PMT 2002; CBSE PMT 2003]

(a) *T* (b) $\frac{T}{2}$

(c) 2 *T* (d) $\frac{T}{4}$

48. 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 5*T*/3. Then the ratio of *m*/*M* is **[AIEEE 2003]**

(a) $\frac{5}{3}$ (b) $\frac{3}{5}$

(c) $\frac{25}{9}$ (d) $\frac{16}{9}$

49. 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 **[EAMCET 2003]**

(a) 3.0 (b) 2.0

(c) 1.5 (d) 1.0

50. 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 **[MH CET 2001]**

(a) $\frac{1}{7}$ *sec* (b) 1 *sec*

(c) $\frac{2\pi}{7}$ *sec* (d) $\frac{2}{3\pi}$ *sec*

51. If a body of mass 0.98 *kg* is made to oscillate on a spring of force constant 4.84 *N/m*, the angular frequency of the body is **[MP PET 2003]**

(a) 1.22 *rad/s* (b) 2.22 *rad/s*

(c) 3.22 *rad/s* (d) 4.22 *rad/s*

52. A mass *m* is suspended from a spring of length *l* and force constant *K*. The frequency of vibration of the mass is f_1. The spring is cut into two equal parts and the same mass is suspended from one of the parts. The new frequency of vibration of mass is f_2. Which of the following relations between the frequencies is correct **[NCERT 1983; CPMT 1986; MP PMT 1991; DCE 2002]**

(a) $f_1 = \sqrt{2} f_2$ (b) $f_1 = f_2$

(c) $f_1 = 2 f_2$ (d) $f_2 = \sqrt{2} f_1$

53. A mass *m* oscillates with simple harmonic motion with frequency $f = \frac{\omega}{2\pi}$ and amplitude *A* on a spring with constant *K*, therefore

(a) The total energy of the system is $\frac{1}{2}KA^2$

(b) The frequency is $\frac{1}{2\pi}\sqrt{\frac{K}{M}}$

(c) The maximum velocity occurs, when $x = 0$

(d) All the above are correct

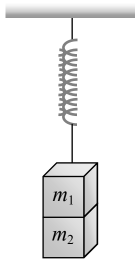
54. Two masses m_1 and m_2 are suspended together by a massless spring of constant *K*. When the masses are in equilibrium, m_1 is removed without disturbing the system. The amplitude of oscillations is **[J & K CET 2005]**

(a) $\frac{m_1 g}{K}$

(b) $\frac{m_2 g}{K}$

(c) $\frac{(m_1 + m_2)g}{K}$

(d) $\frac{(m_1 - m_2)g}{K}$



55. A spring executes SHM with mass of 10*kg* attached to it. The force constant of spring is 10*N/m*. If at any instant its velocity is 40*cm/sec*, the displacement will be (where amplitude is 0.5*m*) **[RPMT 2004]**

(a) 0.09 *m* (b) 0.3 *m*

(c) 0.03 *m* (d) 0.9 *m*

Superposition of S.H.M's and Resonance

[CBSE PMT 2001]

1. The S.H.M. of a particle is given by the equation $y = 3\sin\omega t + 4\cos\omega t$. The amplitude is **[MP PET 1993]**
(a) 7 (b) 1
(c) 5 (d) 12

2. If the displacement equation of a particle be represented by $y = A\sin PT + B\cos PT$, the particle executes **[MP PET 1986]**
(a) A uniform circular motion
(b) A uniform elliptical motion
(c) A S.H.M.
(d) A rectilinear motion

3. The motion of a particle varies with time according to the relation $y = a(\sin\omega t + \cos\omega t)$, then
(a) The motion is oscillatory but not S.H.M.
(b) The motion is S.H.M. with amplitude *a*
(c) The motion is S.H.M. with amplitude $a\sqrt{2}$
(d) The motion is S.H.M. with amplitude $2a$

4. The resultant of two rectangular simple harmonic motions of the same frequency and unequal amplitudes but differing in phase by $\frac{\pi}{2}$ is **[BHU 2003; CPMT 2004; MP PMT 1989, 2005; BCECE 2005]**
(a) Simple harmonic (b) Circular
(c) Elliptical (d) Parabolic

5. The composition of two simple harmonic motions of equal periods at right angle to each other and with a phase difference of π results in the displacement of the particle along **[CBSE PMT 1990]**
(a) Straight line (b) Circle
(c) Ellipse (d) Figure of eight

6. Two mutually perpendicular simple harmonic vibrations have same amplitude, frequency and phase. When they superimpose, the resultant form of vibration will be **[MP PMT 1992]**
(a) A circle (b) An ellipse
(c) A straight line (d) A parabola

7. The displacement of a particle varies according to the relation $x = 4(\cos\pi t + \sin\pi t)$. The amplitude of the particle is **[AIEEE 2003]**
(a) 8 (b) – 4
(c) 4 (d) $4\sqrt{2}$

8. 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 **[MH CET 2004]**
(a) 10 *cm* (b) 20 *cm*
(c) $5\sqrt{2}$ *cm* (d) 50 *cm*

9. Resonance is an example of **[CBSE PMT 1999; BHU 1999; 2005]**
(a) Tuning fork (b) Forced vibration
(c) Free vibration (d) Damped vibration

10. In case of a forced vibration, the resonance wave becomes very sharp when the **[CBSE PMT 2003]**
(a) Restoring force is small
(b) Applied periodic force is small
(c) Quality factor is small
(d) Damping force is small

11. Amplitude of a wave is represented by
$$A = \frac{c}{a + b - c}$$
Then resonance will occur when **[CPMT 1984]**
(a) $b = -c/2$ (b) $b = 0$ and $a = -c$
(c) $b = -a/2$ (d) None of these

12. A particle with restoring force proportional to displacement and resisting force proportional to velocity is subjected to a force $F\sin\omega t$. If the amplitude of the particle is maximum for $\omega = \omega_1$ and the energy of the particle is maximum for $\omega = \omega_2$, then (where ω_0 natural frequency of oscillation of particle) **[CBSE PMT 1998]**
(a) $\omega_1 = \omega_0$ and $\omega_2 \neq \omega_o$ (b) $\omega_1 = \omega_0$ and $\omega_2 = \omega_o$
(c) $\omega_1 \neq \omega_0$ and $\omega_2 = \omega_o$ (d) $\omega_1 \neq \omega_0$ and $\omega_2 \neq \omega_o$

13. A simple pendulum is set into vibrations. The bob of the pendulum comes to rest after some time due to

[AFMC 2003; JIPMER 1999]

(a) Air friction

(b) Moment of inertia

(c) Weight of the bob

(d) Combination of all the above

14. A simple pendulum oscillates in air with time period T and amplitude A. As the time passes

[CPMT 2005]

(a) T and A both decrease

(b) T increases and A is constant

(c) T increases and A decreases

(d) T decreases and A is constant