PHYSICS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

OSCILLATIONS

Example

1. Two simple harmonic motions are represented by $y_1 = 5\left[\sin 2\pi t + \sqrt{3}\cos 2\pi t\right]$ and $y_2 = 5\sin\left(2\pi t + \frac{\pi}{4}\right)$

The ratio of their amplitudes is

A. $1:1$

B. $2:1$

C. $1:3$

D. $\sqrt{3}:1$

Answer: B

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2. A particle executes SHM with a time period of 2 s and amplitude 5 cm. What will be the displacement and velocity of that particle at t = 1/3 ?

A. 3.5 cm and 4.32 cms^{-1}

B. 4.33 cm and 7.85 cms^{-1}

C. 5.12 cm and 6.22 cms^{-1}

D. 7.85 cm and 4.33 cms^{-1}

Answer: B

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3. A simple harmonic motion is represented by

$x = 12\sin(10t + 0.6)$

Find out the maximum acceleration, if displacement is measured in metres and time in seconds.

A. $-1200m$

B. $-2000m$

C. $-2400m$

D. $7200m$

Answer: A

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4. Find time period of the function, $y = \sin\omega t + \sin 2\omega t + \sin 3\omega t$

A. $\frac{2\pi}{\omega}$

B. $\frac{\pi}{\omega}$

C. $\frac{\pi}{2\omega}$

D. None of the above

Answer: A

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5. A particle is SHM is described by the displacement function.

$x = A\cos(\omega t + \phi)$, where,$\omega = 2\pi / T$

If the initial (t = 0) position of the particle is 1 cm and its initial velocity is $\pi cm s^{-1}$, what is the initial phase angle ? The angular frequency of the particle is πs^{-1}.

A. $3\pi / 4$

B. $2\pi / 4$

C. $5\pi / 4$

D. $7\pi / 4$

Answer: A

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6. A particle executes SHM of amplitude A. At what distance from the mean position is its KE equal to its PE ?

A. 0.71 A

B. 0.61 A

C. 0.65 A

D. 0.8 A

Answer: A

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7. A body executes SHM of time period 8 s. if its mass be 0.1 kg, its velocity 1 sec after it passes through its mean position be $4ms^{-1}$, find its (i) kinetic energy (ii) potential energy and (iii) total energy.

A. 0.8 J, 1.6 J and 0.8 J

B. 0.8 J, 0.85 J an 1.6 J

C. 0.4 J, 0.4 J and 0.8 J

D. 0.2 J, 0.2 J and 0.4 J

Answer: B

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8. The acceleration due to gravity on the surface of the moon is $1.7ms^{-2}$. What is the time period of a simple pendulum on the surface of the moon, if its time period on the surface of earth is $3.5s$? Take $g = 9.8ms^{-2}$ on the surface of the earth.

A. 8.4 s

B. 8.2 s

C. 7.4 s

D. 6.4 s

Answer: A

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9. Consider a bob of mass 0.2 kg is performing linear SHM experiences a restoring force of 2 N when its displacement is 10 cm. Find the period of SHM.

A. 1.34 s

B. 0.314 s

C. 0.942 s

D. 0.628 s

Answer: D

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10. In the case of resonance, in forced oscillations

A. amplitude is infinity

B. driving frequency is equal to natural frequency

C. amplitude is zero

D. None of the above

Answer: B

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Exercise 1

1. Two bodies (M) and (N) of equal masses are suspended from two separate massless springs of spring 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 of vibration of (M) to the of (N) is.

A. $\frac{k_1}{k_2}$

B. $\sqrt{\frac{k_1}{k_2}}$

C. $\frac{k_2}{k_1}$

D. $\sqrt{\frac{k_2}{k_1}}$

Answer: D

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2. A body is executing SHM with an amplitude of 0.1 m. Its velocity while passing through the mean position is $3ms^{-1}$. Its frequency in Hz is

A. 15π

B. $\frac{15}{\pi}$

C. 30π

D. 25π

Answer: B

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3. Two particle are executing SHMs .The equations of their motions are

$$y_1 = 10\sin\left(\omega t + \frac{\pi}{4}\right) \text{ and } y_2 = 5\sin\left(\omega t + \frac{\sqrt{3}\pi}{4}\right)$$

What is the ratio of their amplitudes.

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:3$

Answer: C

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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

A. 0.25 s^{-1}

B. 2 s^{-1}

C. 1.57 s^{-1}

D. 2.57 s^{-1}

Answer: A

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5. A particle of mass 1 kg is moving in SHM with an amplitude 0.02 m and a frequency of 60 Hz. The maximum force (in N) acting on the particle is

A. 188 π^2

B. 144 π^2

C. 288 π^2

D. None of the above

Answer: C

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6. A horizontal plank has a rectangular block placed on it. The plank starts oscillating vertically and simple harmonically with an amplitude of 40 cm. The block just loses contact with the plank when the latter is at momentary rest Then.

A. the period of oscillation is $2\pi / 5$ s

B. the block wighs double its weight when the plank is at one of the positions of momentary at rest

C. the block weighs 1.5 times its weight on the plank half way down

D. the block weighs its true weight on the plank, when the later moves fastest

Answer: B

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7. A body has a time period T_1 under the action of one force and T_2 under the action of another force, the square of the time period when both the forces are acting in the same direction is

A. $T_1^2 T_2^2$

B. T_1^2 / T_2^2

C. $T_1^2 + T_2^2$

D. $T_1^2 T_2^2 / \left(T_1^2 + T_2^2\right)$

Answer: D

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8. 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

A. 5

B. $5\sqrt{2}$

C. $5\sqrt{3}$

D. $10\sqrt{2}$

Answer: C

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9. This time period of a particle undergoing SHM is 16 s. It starts motion from the mean position. After 2 s, its velocity is 0.4 ms^{-1}. The amplitude is

A. 1.44 m

B. 0.72 m

C. 2.88 m

D. 0.36 m

Answer: A

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10. The maximum acceleration of a body moving is SHM is a_0 and maximum velocity is v_0. The amplitude is given by

A. $\frac{v_0^2}{a_0}$

B. $a_0 v_0$

C. $\frac{a_0^2}{v_0}$

D. $\frac{1}{a_0 v_0}$

Answer: A

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11. The time period of a simple pendulum inside a stationary lift is $\sqrt{5}$ s. What will be the time period when the lift moves upward with an acceleration $\frac{g}{4}$?

A. $\sqrt{5}$ s

B. $2\sqrt{5}s$

C. $(2+\sqrt{5})$ s

D. 2 s

Answer: D

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12. 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

Answer: C

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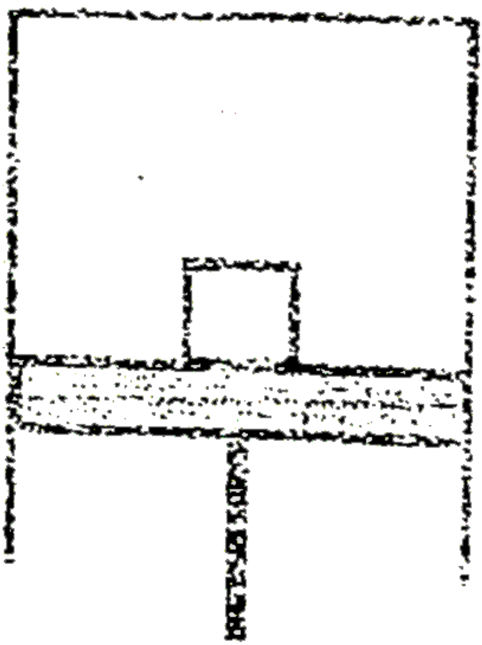
13. A block of mass m is resting on a piston as shown in figure which is moving vertically with a SHM of period $1s$. The minimum amplitude of motion at which the block and piston separate is :



A. 0.2 m

B. 0.25 m

C. 0.3 m

D. 0.35 m

Answer: B

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14. A particle executes SHM, its time period is 16 s. If it passes through the centre of oscillation, then its velocity is 2 ms^{-1} at times 2 s. The amplitude will be

A. 7.2 m

B. 4 cm

C. 6 cm

D. 0.72 m

Answer: A

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15. The equation of SHM of a particle is given as $2\frac{d^2x}{dt^2} + 32x = 0$ where x is the displacement from the mean position. The period of its oscillation (in seconds) is -

A. zero

B. $\frac{\pi}{2}$

C. π

D. 2π

Answer: B

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16. An iron ball of mass M is hanged from the ceilling by a spring with a spring constant k. It executes a SHM with a period P. If the mass of the ball is increased by four times, the new period will be

A. 4P

B. $\frac{P}{4}$

C. 2P

D. P

Answer: C

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

A. $2\sqrt{3}$ cm

B. $\sqrt{3}$ cm

C. 1 cm

D. 2 cm

Answer: D

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18. A particle executing simple harmonic motion of amplitude 5 cm has maximum speed of 31.4 cm / s . The frequency of its oscillation is

A. 3 Hz

B. 2 Hz

C. 4 Hz

D. 1 Hz

Answer: D

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19. The maximum velocity a particle, executing simple harmonic motion with an amplitude 7 mm, 4.4 m//s. The period of oscillation is.

A. 0.01 s

B. 10 s

C. 0.1 s

D. 100 s

Answer: B

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20. The motion of a particle is given by $x = A\sin\omega t + B\cos\omega t$. The motion of the particle is

A. not simple harmonic

B. simple harmonic with amplitude A + B

C. simple harmonic with amplitude $\frac{(A+B)}{2}$

D. simple harmonic with amplitude $\sqrt{A^2 + B^2}$

Answer: D

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21. The amplitude and maximum velocity will be respectively $X = 3 \sin 2t + 4 \cos 2t$The amplitude and maximum velocity will be respectively

A. 5, 10

B. 3, 2

C. 4, 2

D. 3, 4

Answer: A

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

I. $y = \sin \omega t - \cos \omega t$

II. $y = \sin^3 \omega t$

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

IV. $y = 1 + \omega t + \omega^2 t^2$

A. Only IV does not represent SHM

B. I and III

C. I and II

D. Only I

Answer: B

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23. The displacement of a particle from its mean position (in mean is given by $y = 0.2\sin(10\pi t + 1.5\pi)\cos(10\pi t + 1.5\pi)$. The motion but not $S.H.M.$

A. periodic but not SHM

B. non periodic

C. simple harmonic motion with period 0.1 s

D. simple harmonic motion with period 0.2 s

Answer: B

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24. Which of the following functionss represents a simple harmonic oscillation ?

A. $\sin \omega t - \cos \omega t$

B. $\sin^2 \omega t$

C. $\sin \omega t + \sin 2\omega t$

D. $\sin \omega t - \sin 2\omega t$

Answer: A

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25. The displacement of two particles executing SHM are represented by equations, $y_1 = 2\sin(10t + \theta)$, $y_2 = 3\cos 10t$. The phase difference between the velocity of these particles is

A. θ

B. $-\theta$

C. $\theta + \pi/2$

D. $\theta - \pi/2$

Answer: D

26. Two pendulums of length 1.21 m and 1.0 m starts vibrationg. At some instant, the two are in the mean position in same phase. After how many vibrations of the longer pendulum, the two will be in phase ?

A. 10

B. 11

C. 20

D. 21

Answer: B

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27. Two SHMs are respectively represented by $y_1 = a\sin(\omega t - kx)$ and $y_2 = b\cos(\omega t - kx)$. The phase difference between the two is

A. 45°

B. 90°

C. 60°

D. 30°

Answer: B

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28. The displacement-time graph of a particle executing SHM is shown in the figure. Which of the following statements is false ?

A. The acceleration is maximum at $t = T/14$

B. The force is zero at $t = \frac{3T}{4}$

C. The potential energy equals the total oscillation energy at $t = \frac{T}{2}$

D. None of the above

Answer: A

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29. The displacement-time graph of a particle executing SHM is as shown in the figure.

The corresponding force-time graph of the particle is

A.

B.

C.

D.

Answer: C

30. The period of SHM of a particle is 12 s. The phase difference between the positions at t = 3 s and t = 4 s will be

A. $\pi / 4$

B. $3\pi / 5$

C. $\pi / 6$

D. $\pi / 2$

Answer: C

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31. Two simple harmonic motions given by, $x = a\sin(\omega t + \delta)$ and $y = a\sin\left(\omega t + \delta + \frac{\pi}{2}\right)$ act on a particle will be

A. circular anti-clockwise

B. elliptical anti-clockwise

C. elliptical clockwise

D. circular clockwise

Answer: D

32. The resultant of two rectangular simple harmonic motion of the same frequency and unequal amplitude but differing in phase by $\pi / 2$ is

A. simple harmonic

B. circular

C. elliptical

D. parabolic

Answer: C

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33. A particle is executing two different simple harmonic motions, mutually perpendicular, of different amplitudes and having phase difference of $\pi / 2$. The path of the particle will be

A. circular

B. straight line

C. parabolic

D. elliptical

Answer: C

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34. 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. $\frac{U_{\max}}{2}$

B. $\frac{U_{\max}}{3}$

C. $\frac{U_{\max}}{4}$

D. $2U_{\max}$

Answer: C

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35. For a linear harmonic oscillator, its potential energy, kinetic energy and total energy given by E_P, K_K and E_T respectively. Its maximum acceleration is given by

A. $\sqrt{\frac{2E_P}{m}}$

B. $\sqrt{\frac{2E_K}{m}}$

C. $\sqrt{\frac{2E_T}{mA}}$

D. $\frac{2E_T}{mA}$

Answer: D

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36. A point particle if mass $0.1kg$ is executing SHM of amplitude $0.1m$. When the particle passes through the mean position, its kinetic energy is $8 \times 10^{-3} J$. Write down the equation of motion of this particle when the initial phase of oscillation is 45°.

A. $y = 0.1 \sin\left(\frac{r}{4} + \frac{\pi}{4}\right)$

B. $y = 0.1 \sin\left(\frac{t}{2} + \frac{\pi}{4}\right)$

C. $y = 0.1 \sin\left(4t - \frac{\pi}{4}\right)$

D. $y = 0.1 \sin\left(4t + \frac{\pi}{4}\right)$

Answer: D

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37. 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

A. $a/4$

B. $a/3$

C. $a/2$

D. $2a/3$

Answer: C

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38. For a particle executing SHM the displacement x is given by $x = A\cos\omega t$. Identify the graph which represents the variation of potential energy (PE) as a function of time and displacement x.

A. I, III

B. II, III

C. I, IV

D. II, IV

Answer: A

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39. The force constant of a weightless spring is $16Nm^{-1}$. A body of mass $1.0kg$ suspended from it is pulled down through $5cm$ and then released. The maximum energy of the system (spring + body) will be

A. 2×10^{-2}J

B. 4×10^{-2}J

C. 8×10^{-2}J

D. 16×10^{-2}J

Answer: A

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40. The total energy of the body executing SHM is E. the, the kinetic energy when the displacement is half of the amplitude is

A. $\frac{E}{2}$

B. $\frac{E}{4}$

C. $\frac{3E}{4}$

D. $\frac{\sqrt{3}E}{4}$

Answer: C

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41. If the KE of a particle performing a SHM of amplitude A is $\frac{3}{4}$ of its total energy, then the value of its displacement is

A. $x = \pm \frac{A}{2}$

B. $x = \pm \frac{A}{4}$

C. $x = \pm \frac{\sqrt{3}}{2}A$

D. $x = \pm \frac{A}{\sqrt{2}}$

Answer: A

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42. 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

A. I and II are correct

B. II and III are correct

C. I and III are correct

D. I, II and III are correct

Answer: A

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43. The amplitude of a particle executing SHM is made three-fourth keeping its time period constant. Its total energy will be

A. $\frac{E}{2}$

B. $\frac{3}{4}E$

C. $\frac{9}{16}E$

D. None of the above

Answer: C

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44. 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 in plotted it will be as given bellow in the graph

A.

B.

C.

D.

Answer: A

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45. A simple pendulum has a length l. The inertial and gravitational masses of the bob are m_i and m_g, respectively. Then, the time period T is given by

A. $T = 2\pi\sqrt{\frac{m_g I}{m_i g}}$

B. $T = 2\pi\sqrt{\frac{m_i I}{m_g g}}$

C. $T = 2\pi\sqrt{\frac{m_i \times m_g \times l}{g}}$

D. $T = 2\pi\sqrt{\frac{I}{m_i \times m_g \times g}}$

Answer: B

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46. The acceleration due to gravity on the moon is $\frac{1}{6}$ th the acceleration due to gravity on the surface of the earth. If the length of a second's pendulum is 1 m on the surface of the earth, then its length on the surface of the moon will be

A. $\frac{1}{2}m$

B. 6m

C. $\frac{1}{6}m$

D. $\frac{1}{4}m$

Answer: C

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47. A simple pendulum of length L and mass (bob) M is oscillating in a plane about a vertical line between angular limit $-\phi$ and $+\phi$. For an angular displacement $\theta(|\theta| < \phi)$, the tension in the string and the velocity of the bob are T and V respectively. The following relations hold good under the above conditions:

A. $T \cos \theta = Mg$

B. $T - Mg \cos \theta = Mv^2 / L$

C. $T + Mg \cos \theta = Mv^2 / L$

D. $T = Mg \cos \theta$

Answer: B

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

A. 3927 s

B. 3427 s

C. 3737 s

D. 864 s

Answer: D

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49. Two simple pendulum of length $5m$ and $20m$ respectively are given small displacement in one direction at the same time. They will again be in the same phase when the pendulum of shorter length has completed oscillation.

A. 5

B. 1

C. 2

D. 3

Answer: A

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50. A and B are fixed points and the mass M is tied by strings at A and B. If the mass M is displaced slightly out of this plane and released, it will execute oscillations with period.

(Given, AM = BM = L, AB = 2d)

A. $2\pi\sqrt{\frac{L}{g}}$

B. $2\pi\sqrt{\frac{\left(L^2-d^2\right)^{1/2}}{g}}$

C. $2\pi\sqrt{\frac{\left(L^2+d^2\right)^{1/2}}{g}}$

D. $2\pi\sqrt{\frac{\left(2d^2\right)^{3/2}}{g}}$

Answer: B

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51. Two simple pendulum first of bob mass M_1 and length L_1 second of bob mass M_2 and length $L_2 M_1 = M_2$ and L_1 = 2L_(2)`. if the vibrational energy of both is same which is correct?

A. Amplitude of B greater than A

B. Amplitude of B smaller than A

C. Amplitude will be same

D. None of the above

Answer: B

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52. The mass and diameter of a planet are twice those of earth. What will be the period of oscillation of a pendulum on this plenet. If it is a 2 second's pendulum on earth?

A. $1/\sqrt{2}s$

B. $2\sqrt{2}s$

C. 2s

D. $1/2s$

Answer: B

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53. A clock pendulum made of invar has a period of $0.5 \sec$ at $20^{\circ} C$. If the clock is used in a climate where the temperature average to $30^{\circ} C$, how much time does the clock loose in each oscilliation. For innar $\alpha = 9 \times 10^{-7} \hat{} (\circ) C^{-1}$

A. $2.25 \times 10^{-6} s$

B. $2.5 \times 10^{-7} s$

C. $5 \times 10^{-7} s$

D. $1.125 \times 10^{-6} s$

Answer: A

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54. The time period of a simple pendulum in a stationary train is T. The time period of a mass attached to a spring is also T. The train accelerates at the rate 5 ms^{-2}. If the new time periods of the pendulum and spring be T_p and T_s, respectively. Then,

A. $T_p = T_s$

B. $T_p > T_s$

C. $T_p < T_s$

D. Cannot be predicted

Answer: C

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

A.

B.

C.

D.

Answer: B

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56. A simple spring has length l and force constant K. It is cut into two springs of lengths $l_1 \text{and} l_2$ such that $l_1 = nl_2$ (n = an integer). The force constant of spring of length l_1 is

A. k(1 + n)

B. $\frac{(n+1)k}{n}$

C. k

D. $k/(n+1)$

Answer: A

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57. A particle of mass 200 g executes a simpel harmonit motion. The resrtoring force is provided by a spring of spring constant $80Nm^{-1}$. Find the time period.

A. 0.315 s

B. 0.15 s

C. 0.05 s

D. 0.02 s

Answer: A

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58. A massless spring, having force constant k, 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 one half. The frequency of oscillation will now be

A. n

B. 2n

C. $\frac{n}{\sqrt{2}}$

D. $n(2)^{1/2}$

Answer: A

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59. An object suspended from a spring exhibits oscillations of period T. Now, the spring is cut in two halves and the same object is suspended with two halves as shown in the figure. The new time period of oscillation will become

A. $\frac{T}{2\sqrt{2}}$

B. $\frac{T}{2}$

C. $\frac{T}{\sqrt{2}}$

D. 2T

Answer: B

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60. If k_s and k_p, respectively are effective spring constants in series and parallel combination of springs as shown in the figure, find $\frac{k_s}{k_p}$

A. $\frac{9}{2}$

B. $\frac{3}{7}$

C. $\frac{2}{9}$

D. $\frac{7}{3}$

Answer: C

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61. If f is the frequency when mass m is attached to a spring of spring constant k, then new frequency for this arrangement, is

A. $f/2$

B. $\sqrt{2}f$

C. $f/\sqrt{2}$

D. $2\sqrt{2}f$

Answer: B

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62. Frequency of oscillation is proportional to

A. $\sqrt{\frac{3k}{m}}$

B. $\sqrt{\frac{k}{m}}$

C. $\sqrt{\frac{2k}{m}}$

D. $\sqrt{\frac{m}{3k}}$

Answer: A

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

A. f

B. 2f

C. $\sqrt{2}f$

D. $\frac{1}{\sqrt{2}}f$

Answer: D

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64. A clock S is based on oscillations of a spring and clock P is based on pendulum motion, both clocks run at the same rate on Earth. On a planet having the same mass, but twice the radius that of the earth

A. S will run faster than P

B. P will run faster than S

C. both will run at the same rate as on the earth

D. both will run at the same rate which will be different from that on the earth

Answer: B

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

A. applied periodic force is smaal

B. quality factor is small

C. damping force is small

D. restoring force is small

Answer: C

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66. The amplitude of damped oscillator becomes $\frac{1}{3}$ in $2s$. Its amplitude after $6s$ is $1/n$ times the original. The value of n is

A. 3^2

B. $3\sqrt{2}$

C. $3\sqrt{3}$

D. 3^3

Answer: D

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67. If the differential equation given by $\frac{d^2y}{dt^2}+2k\frac{dy}{dt}+\omega^2y=F_0\sin\pi t$ describes the oscillatory motion of body in a dissipative medium under the influence of a periodic force, then the state of maximum amplitude of the oscillation is a measure of

A. free vibration

B. damped vibration

C. forced vibration

D. resonance

Answer: D

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Exercise 2

1. A body of mass 0.01 kg executes simple harmonic motion about x = 0 under the influence of a force shown in the figure. The period of the SHM is

A. 1.05 s

B. 0.52 s

C. 0.25 s

D. 0.31 s

Answer: D

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2. Period if small oscillations in the two cases shown in the figure is T_1 and T_2, respectively then

A. $T_1 = T_2$

B. $T_1 < T_2$

C. $T_1 > T_2$

D. Cannot say anything

Answer: B

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3. The variation of PE of harmonic oscillator is as shown in the figure. The spring constant is

A. $1 \times 10^2 Nm^{-1}$

B. $1.5 \times 10^2 Nm^{-1}$

C. $2 \times 10^2 Nm^{-1}$

D. $3 \times 10^2 Nm^{-1}$

Answer: B

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4. A particle is in linear SHM of amplitude A and time period T. If v refers to its average speed during any interval of T/3 , then the maximum possible value of v is

A. $\dfrac{3\sqrt{3}}{T}A$

B. $\dfrac{\sqrt{3}A}{T}$

C. $\dfrac{2\sqrt{3}}{T}A$

D. $\dfrac{3A}{T}$

Answer: A

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5. Maximum kinetic energy of a particle of mass 1 kg in SHM is 8 J. Time period of SHM is 4 s. Maximum potential energy during the motion is 10 J. Then

A. amplitude of oscillations is approximately 3.53 m

B. minimum potential energy of the particle is 4 J

C. maximum acceleration of the particle is approximately 6.3 ms^{-2}

D. minimum kinetic energy of the particle is 2 J

Answer: C

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6. Two particles execute simple harmonic motion of same amplitude and frequency along the same straight line. They pass on another, when going in opposite directions, each time their displacement is half of their amplitude. What is the phase difference between them?

A. 30°

B. 60°

C. 90°

D. 120°

Answer: D

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7. A particle under the action of a force has a period of $3s$ and under the action of another force it has a period $4\sec$ in SHM. What will be its period under the combined action of both forces in the same direction?

A. 7 s

B. 5 s

C. 2.4 s

D. 0.4 s

Answer: C

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8. 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. $E = E_1 + E_2$

C. $E = E_1 = E_2$

D. $\sqrt{E} = \sqrt{E_1} - \sqrt{E_2}$

Answer: A

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9. A horizontal platform with an object placed on it is executing SHM in the vertical direction . The amplitude of oscillation is 4×10^{-3} m. What must be least period of these oscillations , so that the object is not detached from the platform ? (take , $g = 10ms^{-2}$)

A. $\frac{\pi}{25}$s

B. $\frac{\pi}{5}$s

C. $\frac{\pi}{10}$s

D. $\frac{\pi}{50}$s

Answer: A

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10. A 10 kg metal block is attached to a spring constant $1000Nm^{-1}$. A block is displaced from equilibrium position by 10 cm and released. The maximum acceleration of the block is

A. $10ms^{-2}$

B. $100ms^{-2}$

C. $200ms^{-2}$

D. $0.1ms^{-2}$

Answer: A

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11. The potential energy of a particle of mass 2 kg in SHM is $(9x^2)$J. Here x is the displacement from mean position . If total mechanical energy of the particle is 36 J. The maximum speed of the particle is

A. $4ms^{-1}$

B. $2ms^{-1}$

C. $6ms^{-1}$

D. $10ms^{-1}$

Answer: C

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12. When a particle executes SHM oscillates with a frequency v, then the kinetic energy of the particle

A. changes periodically with a frequency of v

B. changes periodically with a frequency of 2 v

C. changes periodically with a frequency of v/2

D. remains constant

Answer: B

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13. Two identical springs S_1 and S_2 are joined as shown in the figure. The oscillation frequency of the m is v. What will be the frequency of mass m, if one spring is removed ?

A. $\sqrt{2}v$

B. v

C. $\frac{v}{\sqrt{2}}$

D. 2v

Answer: C

14. A particle moves with simple harmonic motion in a straight line. In first τs, after starting form rest it travels a destance a, and in next τs it travels 2a, in same direction, then:

A. amplitude of motion is 3a

B. time period of oscillations is 8π

C. amplitude of motion is 4a

D. time period of oscillations is 6τ

Answer: D

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15. A solid cube floats in water half immersed and h small vertical oscillations of time period $\frac{\pi}{5}$s. Find the mass (in kg) (Take g=10m/s^2.

A. 4

B. 2

C. 1

D. 0.5

Answer: A

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16. when two displacements represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed the motion is

A. not a simple harmonic

B. simple harmonic with amplitude $\frac{a}{b}$

C. simple harmonic with amplitude $\sqrt{a^2 + b^2}$

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

Answer: C

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

A. $4 / 5$

B. $6 / 5$

C. $5 / 6$

D. 1

Answer: B

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18. A simple harmonic oscillator consists of a particle of mass m and an ideal spring with spring constant k. The particle oscillates with a time period T. The spring is cut into two equal parts. If one part oscillates with the same particle, the time period will be

A. 2T

B. $\sqrt{2}T$

C. $\frac{T}{\sqrt{2}}$

D. $\frac{T}{2}$

Answer: C

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19. The displacement-time graph of a particle executing SHM is shown.

Which of the following statement(s) is/are true ?

I. The force is zero at t = 3T/4

II. The acceleration is maximum at t = T

III. The velocity is maximum at t = T/4

IV. The potential energy is equal to kinetic energy at t = T/2

A. I and II

B. I, II and III

C. I and IV

D. All of these

Answer: D

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20. 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 (prop), 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. $2\pi\sqrt{\frac{L}{(g\tan\alpha)}}$

Answer: A

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21. A spring balance has a scale that reads 0 to $20kg$. The length of the scale is $10cm$. A body suspended from this balance, when displaced and released, oscillates with period of $\frac{\pi}{10}s$. The mass of the body is

A. 350.67 N

B. 540.11 N

C. 311.24 N

D. 300.5 N

Answer: C

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22. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are v_1 and v_2, respectively. Its time period is

A. $2\pi\sqrt{\frac{x_1^2 + x_2^2}{v_1^2 + v_2^2}}$

B. $2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2 - v_2^2}}$

C. $2\pi\sqrt{\frac{v_1^2 + v_2^2}{x_1^2 + x_2^2}}$

D. $2\pi\sqrt{\frac{v_1^2 - v_2^2}{x_1^2 - x_2^2}}$

Answer: B

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23. A particle executes simple harmonic motion with a period of $16s$. At time $t = 2s$, the particle crosses the mean position while at $t = 4s$, its velocity is $4ms^{-1}$ amplitude of motion in metre is

A. $\sqrt{2}\pi$

B. $16\sqrt{2}\pi$

C. $24\sqrt{2}\pi$

D. $32\sqrt{2}/\pi$

Answer: D

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24. 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

A. $\frac{A}{4}$

B. $\frac{A}{3}$

C. $\frac{A}{2}$

D. $\frac{A}{\sqrt{2}}$

Answer: D

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25. Two particles A and B execute simple harmonic motions of period T and $5T/4$. They start from mean position. The phase difference between them when the particle A complete an oscillation will be

A. $\pi / 2$

B. zero

C. $2\pi / 5$

D. $\pi / 4$

Answer: A

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26. A particle starts oscillating simple harmonically from its equilibrium position then, the ratio of kinetic energy and potential energy of the particle at the time $T / 12$ is: $(T = \text{time period})$

A. $1:4$

B. $2:1$

C. $3:1$

D. $4:1$

Answer: C

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27. A wooden cube (density of wood $'d'$) of side $'l'$ flotes in a liquid of density $'\rho'$ with its upper and lower surfaces horizonta. If the cube is pushed slightly down and released, it performs simple harmonic motion of period $'T'$. Then, $'T'$ is equal to :-

A. $2\pi\sqrt{\frac{I\rho}{(\rho-d)g}}$

B. $2\pi\sqrt{\frac{Id}{\rho g}}$

C. $2\pi\sqrt{\frac{I\rho}{dg}}$

D. $2\pi\sqrt{\frac{Id}{(\rho-d)g}}$

Answer: B

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28. The ration of kinetic energy to the potential energy of a particle executing SHM at a distance equal to half its amplitude , the distance being measured from its equilibrium position is

A. $2:1$

B. $3:1$

C. $8:1$

D. $4:71$

Answer: B

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29. The dispalcement of an object attached to a spring and excuting simple harmonic motion is given by

$x = 2 \times 10^{-2} \cos \pi t$ metres. The time at which at maximum speed first occurs is :

A. 0.5 s

B. 0.75 s

C. 0.125 s

D. 0.25 s

Answer: A

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30. Find the time taken by the particle in going from $x = \frac{A}{2}$ to $x = A$

Hint : $t_1 =$ Time taken to go from $x = 0$ to $x = A$

$t_2 =$ Time taken to go from $x = 0$ to $x = \frac{A}{2}$

Required time $= t_1 - t_2$

A. $T_1 = T_2$

B. $T_1 > T_2$

C. $T_1 < T_2$

D. $T_1 = \frac{T_2}{2}$

Answer: C

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31. A mass M attached to a horizontal spring executes SHM with an amplitude A_1. When mass M passes through its mean position a smaller mass m is placed over it and both of them move togther with amplitude A_2. Ratio of $\left(\frac{A_1}{A_2}\right)$ is:

A. $\frac{M+m}{M}$

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

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

D. $\frac{M}{M+m}$

Answer: C

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32. A particle oscillates simple harmonically along a straight line with period 8 seconds and amplitude $8\sqrt{2}$m. It starts from the mean position, then the ratio of the distances travelled by it in the second second and first second of its motion is

A. $\sqrt{2}$

B. 2

C. $(\sqrt{2}-1)$

D. $\sqrt{3}$

Answer: C

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33. Two identical springs are connected to mass m as shown (k = spring constant). If the period of the configuration in (a) is 2s, the period of the configuration in (b) is

A. $2\sqrt{2}s$

B. 1s

C. $\frac{1}{\sqrt{2}}$s

D. $\sqrt{2}$s

Answer: B

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34. The distance moved by a particle in simple harmonic motion in one time period is

A. zero

B. 4A

C. 2A

D. A

Answer: B

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35. Two pendulums have time period T and 5T/4. They starts SHM at the same time from the mean position. What will be the phase difference between them after the bigger pendulum completed one oscillation ?

A. 45°

B. 90°

C. 60°

D. 30°

Answer: B

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36. Maximum velocity ini SHM is v_m. The average velocity during motion from one extreme point to the other extreme point will be

A. $\frac{4}{\pi}V_{\max}$

B. $\frac{\pi}{4}V_{\max}$

C. $\frac{2}{\pi}V_{\max}$

D. $\frac{\pi}{2}V_{\max}$

Answer: C

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37. A particle is acted simultaneously by mutally perpendicular simple harmonic motion $x = a\cos\omega t$ and $y = a\sin\omega t$. The trajectory of motion of the particle will be

A. an ellipse

B. a parabola

C. a circle

D. a straight line

Answer: C

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38. The maximum velocity and maximum acceleration of a particle per for ming a linear SHM are α and β respectively. Then path length of the particle is

A. $\frac{\alpha^2}{\beta}$

B. $\frac{\beta}{2\alpha^2}$

C. $\frac{2\alpha^2}{\beta}$

D. $\frac{2\beta}{\alpha^2}$

Answer: C

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39. A pendulum with time period of $1s$ is losing energy due to damping. At time its energy is $45J$. If after completing 15 oscillations, its energy has become $15J$. Its damping constant (in s^{-1}) is :-

A. $\frac{1}{2}$

B. $\frac{1}{30}$ In 3

C. 2

D. $\frac{1}{15}$ In 3

Answer: D

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40. A weakly damped harmonic oscillator of frequency n_1 is driven by an external periodic force of frequency n_2. When the steady state is reached, the frequency of the oscillator will be

A. v_2

B. v_1

C. $\frac{v_1 + v_2}{2}$

D. $\sqrt{v_1 + v_2}$

Answer: A

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

A. $2\sqrt{3}$

B. $\sqrt{3}$ cm

C. 1 cm

D. 2 cm

Answer: D

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42. The displacement of a particle is represented by the equation $y = \sin^3 \omega t$. The motion is

A. non-periodic

B. periodic but not simple harmonic

C. simple harmonic with period $2\pi / \omega$

D. simple harmonic with period π / ω

Answer: B

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43. For a particle performing SHM, equation of motion is given as $\frac{d^2}{dt^2} + 4x = 0$. Find the time period

A. 2π

B. $\frac{1}{3}\pi$

C. $\frac{2}{3}\pi$

D. 4π

Answer: C

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44. For a particle executing SHM, x = displacement from mean position, v = velocity and a = acceleration at any instant, then

A. parabola

B. ellipse

C. circle

D. hyperbola

Answer: B

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45. A particle is executing SHM. Then the graph of acceleration as a function of displacement is

A. circle

B. ellipse

C. straight line

D. hyperbola

Answer: C

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46. The ratio of amplitudes of following SHM is $x_1 = A\sin\omega t$ and $x_2 = A\sin\omega t + A\cos\omega t$

A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. 1

D. 2

Answer: B

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47. A man measures time period of a pendulum (T) in stationary lift. If the lift moves upward with acceleration $\frac{g}{4}$, then new time period will be

A. T/2

B. T/4

C. $\sqrt{3}T/4$

D. $\sqrt{3}T/2$

Answer: D

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

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

where X = displacement at time t

ω = frequency of oscillation

Which one of the following graphs shows correctly the variation a with t ?

A.

B.

C.

D.

Answer: A

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49. The displacement of a linear simple harmonic oscillator is given by $y = \sin\frac{\pi}{2}\left[\frac{t}{2} + \frac{1}{2}\right]$ cm. The maximum acceleration of the oscillator in cms^{-2} is

A. $\frac{\pi}{4}$

B. $\frac{\pi^2}{4}$

C. $\frac{\pi^2}{8}$

D. $\frac{\pi^2}{16}$

Answer: D

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Mht Cet Corner

1. Which of the following quantity does not change due to damping of oscillations?

A. Angular frequency

B. Time period

C. Initial phase

D. Amplitude

Answer: C

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2. The bob of a simple pendulum performs SHM with period T in air and with period T_1 in water. Relation between T and T_1 is (neglect friction due to water, density of the material of the bob is = $\frac{9}{8} \times 10^3 \frac{kg}{m^3}$, density of water = $10^3 \frac{kg}{m^3}$)

A. $T_1 = 3T$

B. $T_1 = 2T$

C. $T_1 = T$

D. $T_1 = \frac{T}{2}$

Answer: A

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3. A particle executes S.H.M. of amplitude 25 cm and time period 3 s. What is the minimum time required for the particle to move between two points 12.5 cm on either side of the mean position ?

A. 0.6 s

B. 0.5 s

C. 0.4 s

D. 0.2 s

Answer: B

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4. A particle is executing SHM of periodic time T the time taken by a particle in moving from mean position to half the maximum displacement is $(\sin 30^\circ = 0.5)$

A. $\frac{T}{2}$

B. $\frac{T}{4}$

C. $\frac{T}{8}$

D. $\frac{T}{12}$

Answer: D

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5. A block rests on a horizontal table which is executing SHM in the horizontal plane with an amplitude A. What will be the frequency of oscillation, the block will just start to slip? Coefficient of friction $= \mu$.

A. $\frac{1}{2\pi}\sqrt{\frac{\mu g}{A}}$

B. $\frac{1}{4\pi}\sqrt{\frac{\mu g}{A}}$

C. $2\pi\sqrt{\frac{A}{\mu g}}$

D. $4\pi\sqrt{\frac{A}{\mu g}}$

Answer: A

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

A. T/2

B. T/4

C. T/8

D. T/12

Answer: D

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7. Two simple harmonic motions of angular frequency $100 rad s^{-1}$ and $1000 rad s^{-1}$ have the same displacement amplitude. The ratio of their maximum accelerations is

A. $1 : 10$

B. $1 : 10^2$

C. $1 : 10^3$

D. $1 : 10^4$

Answer: B

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8. The average acceleration of a particle performing SHM over one complete oscillation is

A. $\frac{\omega^2 A}{2}$

B. $\frac{\omega^2 A}{\sqrt{2}}$

C. zero

D. $A\omega^2$

Answer: C

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9. U is the PE of an oscillating particle and F is the force acting on it at a given instant . Which of the following is true ?

A. $\frac{U}{F} + x = 0$

B. $\frac{2U}{F} + x = 0$

C. $\frac{F}{U} + x = 0$

D. $\frac{F}{2U} + x = 0$

Answer: B

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

A. 0.10 ms^{-1}

B. 0.15 ms^{-1}

C. 0.8 ms^{-1}

D. 0.26 ms^{-1}

Answer: B

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11. The periodic time of a particle doing simple harmonic motion is 4 second . The time taken by it to go from its mean position to half the maximum displacement (amplitude) is

A. 2 s

B. 1 s

C. $\frac{2}{3}$ s

D. $\frac{1}{3}$s

Answer: D

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12. The graph between time period (T) and length (l) of a simple pendulum is

A. straight line

B. curve

C. ellipse

D. parabola

Answer: D

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13. 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. $\frac{1}{4}E$

B. $\frac{1}{2}$E

C. $\frac{2}{3}$E

D. $\frac{1}{8}$E

Answer: A

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14. In SHM restoring force is $F = -kx$, where k is force constant, x is displacement and a is amplitude of motion, then total energy depends upon

A. k, A and M

B. k, x, M

C. k, A

D. k, x

Answer: C

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15. The displacement equation of a simple harmonic oscillator is given by $y = A \sin \omega t - B \cos \omega t$

The amplitude of the oscillator will be

A. A - B

B. A + B

C. $\sqrt{A^2 + B^2}$

D. $(A^2 + B^2)$

Answer: C

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16. Two particles execute SHM of same amplitude and frequency on parallel lines. They pass one another when moving in opposite directions each time their displacement is one third their amplitude. What is the phase difference between them?

A. $\frac{\pi}{3}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{6}$

D. $\frac{2\pi}{3}$

Answer: D

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17. A simple pendulum of length l and mass (bob) m is suspended vertically. The string makes an angle θ with the vertical. The restoring force acting on the pendulum is

A. $mg \tan \theta$

B. $-mg \sin \theta$

C. $mg \sin \theta$

D. $-mg \cos \theta$

Answer: B

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18. SHM given by $x = 6 \sin \omega t + 8 \cos \omega t$. Its amplitude is

A. 10 cm

B. 2 cm

C. 14 cm

D. 3.5 cm

Answer: A

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19. A point mass m is suspended at the end of a massless wire of length l and cross section. If Y is the Young's modulus for the wire, obtain the frequency of oscillation for the simple harmonic motion along the vertical line.

A. $\frac{1}{2\pi}\sqrt{\frac{YA}{mL}}$

B. $2\pi\sqrt{\frac{mL}{YA}}$

C. $\frac{1}{\pi}\sqrt{\frac{YA}{mL}}$

D. $\pi\sqrt{\frac{mL}{YA}}$

Answer: A

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20. Two partical A and B execute simple harmonic motion according to the equation $y_1 = 3\sin\omega t$ and $y_2 = 4\sin[\omega t + (\pi/2)] + 3\sin\omega t$. Find the phase difference between them.

A. $\frac{7\pi}{12}$

B. $\frac{\pi}{12}$

C. $-\frac{\pi}{6}$

D. $\frac{\pi}{6}$

Answer: B

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21. Displacement of a particle executing SHM s $x = 10(\cos \pi t + \sin \pi t)$. Its maximum speed is

A. 10 cm

B. 20 cm

C. $5\sqrt{2}$ cm

D. 50 cm

Answer: A

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

A. decrease the length 2 times

B. decrease the length 4 times

C. increase the length 2 times

D. increase the length 4 times

Answer: D

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23. Two springs, of spring constants k_1 and K_2, have equal highest velocities, when executing SHM. Then, the ratio of their amplitudes (given their masses are in the ratio $1:2$) will be

A. $\left(\frac{k_2}{k_1}\right)^{1/2}$

B. $\left(\frac{k_1}{k_2}\right)^{1/2}$

C. $\frac{k_1}{k_2}$

D. $k_1 k_2$

Answer: A

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

A. infinity

B. zero

C. minimum

D. maximum

Answer: D

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

A. infinity

B. varies

C. maximum

D. zero

Answer: D

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26. A particle starts simple harmonic motion from the mean position. Its amplitude is a and time period is T. what is its displacement when its speed is half of its displacement when its speed is half of its maximum speed?

A. 2a

B. $\frac{a}{2}\sqrt{3}$

C. a

D. $\frac{a}{2}$

Answer: B

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

A. square of amplitude of motion

B. frequency of oscillation

C. velocity in equilibrium position

D. displacement from equilibrium position

Answer: A

28. A particle executes simple harmonic motion of amplitude A. (i) At what distance from the mean positio is its kinetic energy equal to its potential energy? (ii) At what points is its speed half the maximum speed?

A. 0.81 A

B. 0.71 A

C. 0.41 A

D. 0.91 A

Answer: B

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

A. 3 $rads^{-1}$

B. 0.5 $rads^{-1}$

C. 1 $rads^{-1}$

D. 2 $rads^{-1}$

Answer: D

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