DAY - 1

Bridge Course TYM

Aakash

Medical | IIT-JEE | Foundations

(Divisions of Aakash Educational Services Limited)

## PHYSICS TUTORIAL - 1

**Oscillations-I :** Idea of periodic motion and oscillatory motion, Spring mass system, Simple Pendulum, Physical pendulum, Velocity and acceleration in simple harmonic motion

1. A simple pendulum of length $l$ is in a vehicle moving on horizontal surface with acceleration $\sqrt{3}$ g. The time period of pendulum will be

(1) $2\pi\sqrt{\frac{l}{g}}$

(2) $2\pi\sqrt{\frac{l}{2g}}$

(3) $2\pi\sqrt{\frac{l}{(\sqrt{3}-1)g}}$

(4) $\pi\sqrt{\frac{l}{g}}$

2. The maximum acceleration of a particle in SHM is made two times keeping the maximum speed to be constant. It is possible when

(1) amplitude of oscillation is doubled while frequency remains constant

(2) amplitude is doubled while frequency is halved

(3) frequency is doubled while amplitude is halved

(4) frequency is doubled while amplitude remains constant.

3. A particle in SHM 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 its amplitude is

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

(3) 2 cm (4) 2.5 cm

4. Two particles $P$ and $Q$ describe simple harmonic motions of same period, same amplitude, along the same line about the same equilibrium position $O$. When $P$ and $Q$ are on opposite sides of $O$ at the same distance from $O$, they have the same speed of 1.2 m/s in the same direction. When their displacements are the same, they have the same speed of 1.6 m/s in opposite directions. The maximum velocity in m/s of either particles is

(1) 2. 8 (2) 2.5

(3) 2.4 (4) 2

5. 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

(1) $\sqrt{3}$ cm (2) $\sqrt{5}$ cm

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

6. A particle is executing SHM according to the equation $x = A\cos\omega t$. Average speed of the particle during the interval $0 \le t \le \frac{\pi}{6\omega}$.

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

(3) $\frac{3A\omega}{\pi}$ (3) $\frac{3A\omega}{\pi}(2-\sqrt{3})$

7. A particle moving along the $y$-axis executes simple harmonic motion about origin then the force acting on it is proportional to

(1) $-y$ (2) $\cos y$

(3) $+y$ (4) $\sin y$

8. A pendulum has time period T in air. When it is made to oscillate in water, it acquired a time period $T = \sqrt{2}T$. The specific gravity of the pendulum bob is equal to :

(1) $\sqrt{2}$

(2) 2

(2) $2\sqrt{2}$

(3) None of these

9. A disc of radius $R$ and mass $M$ is pivoted at the rim and is set for small oscillations in vertical plane. If simple pendulum has to have the same period as that of the disc, the length of the simple pendulum should be :

(1) $\left(\frac{5}{4}\right)R$
(2) $\left(\frac{2}{3}\right)R$
(3) $\left(\frac{3}{4}\right)R$
(4) $\left(\frac{3}{2}\right)R$

10. **A cabin is moving in a gravity free space vertically with an acceleration $a$. What is the time period of oscillation of a particle of mass $m$ attached with an inextensible string of length $l$, in this cabin?**

(1) $2\pi\sqrt{\frac{l}{g}}$
(2) $2\pi\sqrt{\frac{l}{a}}$
(3) $2\pi\sqrt{\frac{l}{a+g}}$
(4) $2\pi\sqrt{\frac{l}{g-a}}$

11. The phase difference between two SHM given by $x_1 = A\sin pt$ and $x_2 = B\cos 2pt$ at $t = 1$ s is

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

12. According to a scientists, he applied a force $F= cx^{1/3}$ on a particle and the particle is performing SHM. No other force acted on the particle. He refuses to tell whether c is a constant or not. Assume that he had worked only with positive x then :

(1) as x increases c also increases
(2) as x increases c decreases
(3) as x increases c remains constant
(4) the motion cannot be SHM

13. A simple pendulum is suspended from the roof of train which moves in a north direction with constant acceleration $a$, then the time period is given by $T = 2\pi\sqrt{\frac{l}{g'}}$ when $g'$ is equal to

(1) $\sqrt{g^2+a^2}$
(2) $\sqrt{g^2+\sqrt{a}}$
(3) $\sqrt{g^2+a}$
(4) $g + a$

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

(1) A
(2) 2A
(3) 4A
(4) zero

15. A particle performing SHM takes time equal to T (time period of SHM) in consecutive appearances at a perticular point. This point is:

(1) An extreme position
(2) The mean position
(3) Between positive extreme and mean position
(4) Between negative extreme and mean position

16. A particle of mass 40 kg executes a simple harmonic motion. The restoring force is provided by a spring of spring constant 160 N/m. The time period in seconds is

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

17. Which of the following quantities are always non-negative in a simple harmonic motion along a straight line?

(1) $\vec{F}\cdot\vec{a}$
(2) $\vec{v}\cdot\vec{r}$
(3) $\vec{a}\cdot\vec{r}$
(4) $\vec{F}\cdot\vec{r}$

18. If $B$ is amplitude of a particle in simple harmonic motion, then displacement of a particle in simple harmonic motion in one time period is

(1) $B$
(2) $2B$
(3) $4B$
(4) Zero

19. Two SHM's are represented by $y = a\sin(\omega t - kx)$ and $y = b\cos(\omega t - kx)$. The phase difference between the two is :

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

20. A particle is made to under go simple harmonic motion. Find its average acceleration in one time period.

(1) $\omega^2 A$
(2) $\frac{\omega^2 A}{2}$
(3) $\frac{\omega^2 A}{\sqrt{2}}$
(4) zero

21. The magnitude of average acceleration in half time period from equilibrium position in a simple harmonic motion is

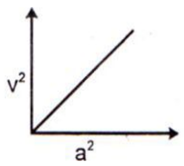
(1) $\frac{2A\omega^2}{\pi}$
(2) $\frac{A\omega^2}{2\pi}$
(3) $\frac{A\omega^2}{\sqrt{2}\pi}$
(4) zero

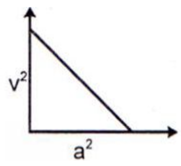
22. Equation of SHM is $x = 10 \sin 10\pi t$ Find the distance between the two points where speed is $50\pi$ cm/sec. x is in cm and t is in seconds.

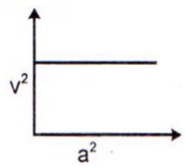
(1) 10 cm (2) 20 cm

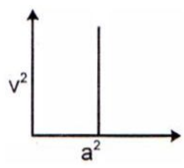
(3) 17.32 cm (4) 8.66 cm

23. A mass M is performing linear simple harmonic motion, then correct graph for acceleration a and corresponding linear velocity v is

(1) 


(2) 


(3) 


(4) 


24. Two spring mass systems having equal mass and spring constant $k_1$ and $k_2$. If the maximum velocities in two systems are equal then ratio of amplitude of 1st to that of 2nd is:

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

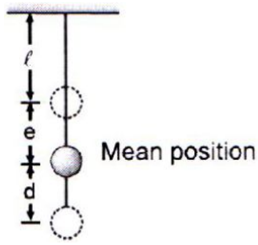
(3) $k_2/k_1$ (4) $\sqrt{k_2/k_1}$

25. A toy car of mass m is having two similar rubber ribbons attached to it as shown in the figure. The force constant of each rubber ribbon is k and surface is frictionless. The car is displaced from mean position by x cm and released. At the mean position the ribbons are undeformed. Vibration period is

(1) $2\pi\sqrt{\frac{m(2k)}{k^2}}$ (2) $\frac{1}{2\pi}\sqrt{\frac{m(2k)}{k^2}}$

(3) $2\pi\sqrt{\frac{m}{k}}$ (4) $2\pi\sqrt{\frac{m}{k+k}}$

26. An elastic string of length $\ell$ supports a heavy particle of mass m and the system is in equilibrium with elongation produced being e as shown in figure. The particle is now pulled down below the equilibrium position through a distance d $(\le e)$ and released. The angular frequency and maximum amplitude for SHM is




(1) $\sqrt{\frac{g}{e}}$, e (2) $\sqrt{\frac{g}{\ell}}$, 2e

(3) $\sqrt{\frac{g}{d+e}}$, d (4) $\sqrt{\frac{g}{e}}$, 2d

27. The position of a particle in motion is given by $y = C\sin\omega t + D\cos\omega t$ w.r.t. origin. Then motion of the particle is :

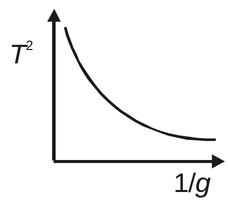
(1) SHM with amplitude C+D

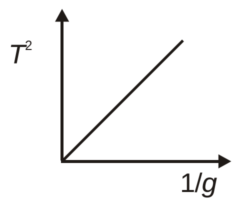
(2) SHM with amplitude $\sqrt{C^2+D^2}$

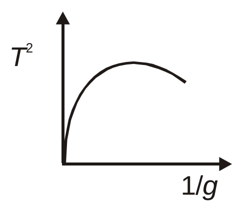
(3) SHM with amplitude $\frac{(C+D)}{2}$

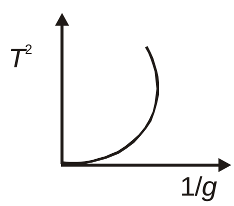
(4) not SHM

28. If $T$ is time period of simple pendulum and $g$ is acceleration due to gravity, then the graph between $T^2$ and $\frac{1}{g}$ is

(1) 


(2) 


(3) 


(4) 


29. The length of a Second's pendulum is

(1) 1 m approximately

(2) 2 m approximately

(3) 0.5 m approximately

(4) 3 m approximately

30. The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is:

(1) 11% (2) 21%
(3) 42% (4) 12%

31. 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

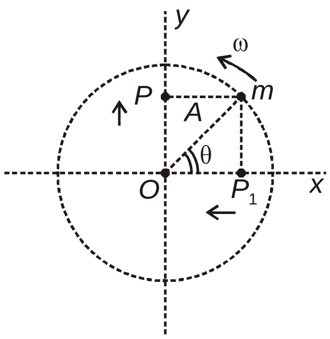
(1) $T = t_1 + t_2$ (2) $T^2 = t_1^2 + t_2^2$
(3) $T^{-1} = t_1^{-1} + t_2^{-2}$ (4) $T^{-2} = t_1^{-2} + t_2^{-2}$

32. What is the phase constant d in SHM represented as $y = A \sin (wt + d)$, if the position of the oscillating particle at time $t = 0$ as $\frac{A}{2}$?

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

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

33. A particle of mass *m* moving in circle with constant angular speed w, then




(1) Motion of particle is simple harmonic motion
(2) Projection along *y*-axis only represent SHM
(3) Projection along *x*-axis only represent SHM
(4) Projection along *x*-axis and *y*-axis both represent SHM

34. What is length of second pendulum at pole of earth?

(1) 1 m (2) 2 m
(3) 10 m (4) 20 m

35. The time period of oscillation represented by equation $y = A\sin^2 \frac{2\pi}{T}t$

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

(3) $2T$ (4) $4T$

36. The velocity-position graph of a particle in SHM

(1) May be circular
(2) May be elliptical
(3) May be straight line
(4) Both (1) & (2)

37. Find the distance covered by a particle from $t = 0$ to $t = 6$ s, when the equation of particle is represented as $y = a\cos\frac{\pi}{4}t$

(1) $a$ (2) $3a$
(3) $2a$ (4) $4a$

38. The speed of particle executing SHM with amplitude of displacement 10 cm is 10 cm/s at a distance 5 cm from mean position. What will be angular frequency?

(1) $\frac{\sqrt{3}}{2}$ radian/s (2) $\frac{2}{\sqrt{3}}$ radian/s

(3) $\sqrt{3}$ radian/s (4) 2 radian/s

39. The phase difference between displacement and acceleration of a particle in SHM is

(1) Zero (2) $\frac{\pi}{2}$

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

40. A spring of froce constnat *k* is cut into two pieces such that one piece is 3 times the length of the other. Then the spring constant of longer spring is

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

(3) $\frac{4k}{3}$ (4) $4k$

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**PHYSICS TUTORIAL - 1**

**Oscillations-I :** Idea of periodic motion and oscillatory motion, Spring mass system, Simple Pendulum, Physical pendulum, Velocity and acceleration in simple harmonic motion

## ANSWER

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|---|---|---|---|
| 1. | (1) | 21. | (1) |
| 2. | (3) | 22. | (3) |
| 3. | (2) | 23. | (2) |
| 4. | (4) | 24. | (4) |
| 5. | (3) | 25. | (3) |
| 6. | (4) | 26. | (1) |
| 7. | (1) | 27. | (2) |
| 8. | (2) | 28. | (2) |
| 9. | (4) | 29. | (1) |
| 10. | (2) | 30. | (1) |
| 11. | (3) | 31. | (2) |
| 12. | (1) | 32. | (2) |
| 13. | (1) | 33. | (4) |
| 14. | (3) | 34. | (1) |
| 15. | (1) | 35. | (2) |
| 16. | (1) | 36. | (4) |
| 17. | (1) | 37. | (2) |
| 18. | (4) | 38. | (2) |
| 19. | (1) | 39. | (3) |
| 20. | (4) | 40. | (3) |