DPP No: 18

Maximum Time 50 Min

PHYSICS

TARGET JEE-MAINS

SYLLABUS : SIMPLE HARMONIC MOTION

1. The equation of motion of a particle of mass 1 g is $\frac{d^2x}{dt^2} + \pi^2 x = 0$ where x is displacement(in m) from mean position . The frequency of oscillation is (in Hz) :

(A) $\frac{1}{2}$ (B) 2 (C) $5\sqrt{10}$ (D) $\frac{1}{5\sqrt{10}}$

2. 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 :

(A) as x increases c also increases (B) as x increases c decreases

(C) as x increases c remains constant (D) the motion cannot be SHM

3. The displacement of a particle in simple harmonic motion in one time period is

(A) A (B) 2A (C) 4A (D) zero

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

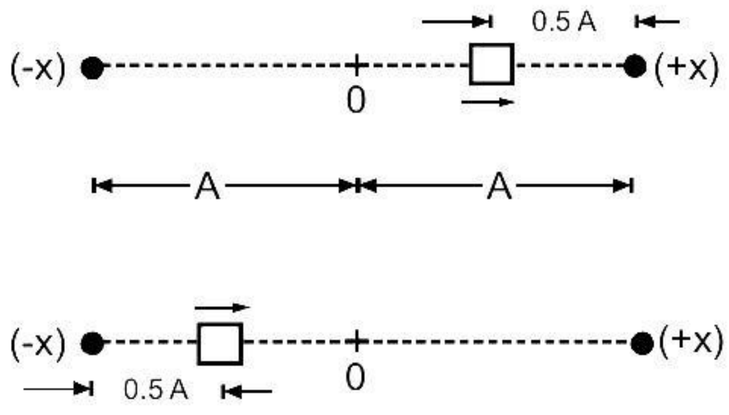
(A) An extreme position

(B) The mean position

(C) Between positive extreme and mean position

(D) Between negative extreme and mean position

5. Two bodies performing S.H.M. have same amplitude and frequency. Their phases at a certain instant are as shown in the figure. The phase difference between them is



(A) $\frac{11}{6}\pi$ (B) π (C) $\frac{5}{3}\pi$ (D) $\frac{3}{5}\pi$

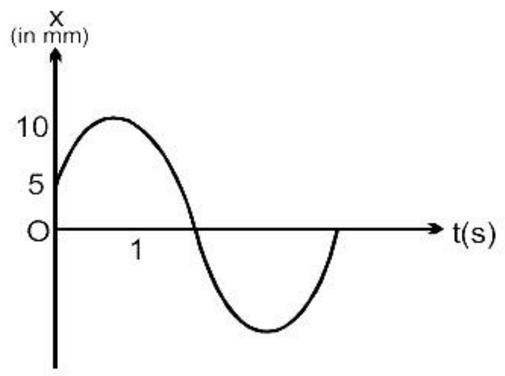
6. Which of the following quantities are always non-positive in a simple harmonic motion along a straight line?

(A) $\vec{F}.\vec{a}$ (B) $\vec{v}.\vec{r}$ (C) $\vec{a}.\vec{r}$ (D) $\vec{F}.\vec{r}$

7. The quantities which are always Zero for a particle performing linear SHM :

(A) $\vec{a}\times\vec{F}$ (B) $\vec{r}\times\vec{v}$ (C) $\vec{r}\times\vec{a}$ (D) $\vec{r}\times\vec{F}$

8. The figure shows the displacement time graph of a particle executing S.H.M. If the time period of oscillation is 2 s the equation of motion of its SHM is



(A) $x = 10\sin(\pi t + \pi/3)$ (B) $x = 10\sin \pi t$

(C) $x = 10\sin(\pi t + \pi/6)$ (D) $x = 10 \sin (2\pi t + \pi/6)$

9. 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 :

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{6}$ (D) $\frac{3\pi}{4}$

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

(A) $\omega^2 A$ (B) $\frac{\omega^2 A}{2}$ (C) $\frac{\omega^2 A}{\sqrt{2}}$ (D) zero

11. A small mass executes linear S.H.M. about O with amplitude 'a' and period 'T'. Its displacement from O at time T/8 after passing through O is

(A) a/8 (B) $\frac{a}{2\sqrt{2}}$ (C) a/2 (D) $\frac{a}{\sqrt{2}}$

12. A particle performing SHM on the y axis according to equation $y = A + B \sin\omega t$. Its amplitude is:

(A) A (B) B (C) A + B (D) $\sqrt{A^2 + B^2}$

13. Two particles execute S.H.M. of same amplitude and frequency along the same straight line from same mean position. They cross one another without collision, when going in opposite directions, each time their displacement is half of their amplitude. The phase-difference between them is

(A) 0° (B) 120° (C) 180° (D) 135°

14. The displacement of a particle executing SHM is given by $x = 0.01 \sin 100\pi(t + 0.05)$. The time period is in seconds and amplitude of the particle is in meters

(A) Time period of the particle is 0.02 sec. (B) Amplitude of the particle is 0.01 m

(C) Time period of the particle is 0.01 sec. (D) Amplitude of the particle is 0.02 m

15. Displacement of a particle is $x = 3 \sin 2t + 4\cos 2t$, the amplitude and the maximum velocity will be :–

(A) 5, 10 (B) 3, 2 (C) 4, 2 (D) 3, 8

16. A body executing SHM passes through its equilibrium. At this instant, it has

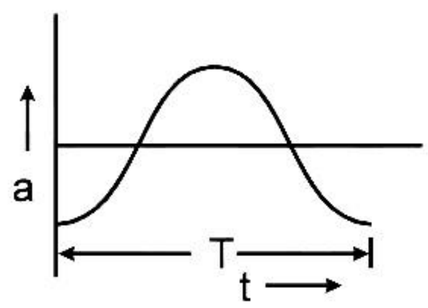
(A) maximum potential energy (B) maximum kinetic energy

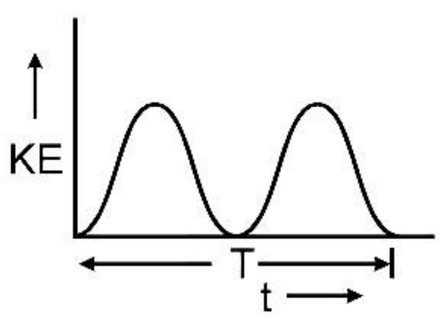
(C) minimum kinetic energy (D) maximum acceleration

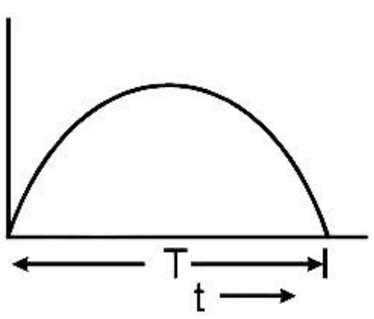
17. A point particle of mass 0.1 kg is executing S.H.M. of amplitude of 0.1 m. When the particle passes through the mean position, its kinetic energy is 8×10^{-3} J. The equation of motion of this particle when the initial phase of oscillation is 45° can be given by

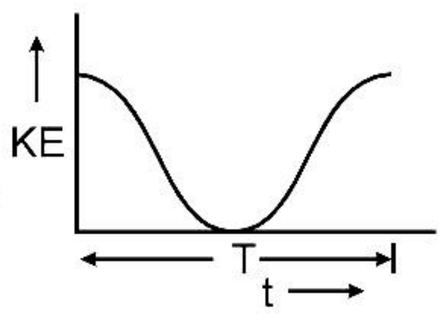
(A) $0.1 \cos\left(4t + \frac{\pi}{4}\right)$ (B) $0.1 \sin\left(4t + \frac{\pi}{4}\right)$ (C) $0.4 \sin\left(t + \frac{\pi}{4}\right)$ (D) $0.2 \sin\left(\frac{\pi}{2} + 2t\right)$

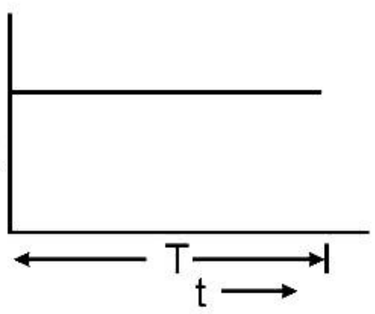
18. Acceleration a versus time t graph of a body in SHM is given by a curve shown below. T is the time period. Then corresponding graph between kinetic energy KE and time t is correctly represented by



(A)


(B)


(C)


(D)


19. In SHM particle oscillates with frequency υ then find the frequency of oscillation of its kinetic energy.

(A) υ (B) $\upsilon/2$ (C) 2υ (D) zero

20. A particle performs S.H.M. of amplitude A along a straight line. When it is at a distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increased by an amount $\frac{1}{2}$ $m\omega^2 A^2$ due to an impulsive force. Then its new amplitude becomes:

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

21. A particle performing SHM with amplitude 10cm. At What distance from mean position the kinetic energy of the particle is thrice of its potential energy?

(A) ± 2 cm (B) ± 3 cm (C) ± 5 cm (D) None of these

22. 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 :

(A) $\sqrt{k_1/k_2}$ (B) k_1/k_2 (C) k_2/k_1 (D) $\sqrt{k_2/k_1}$

23. A mass of 1 kg attached to the bottom of a spring has a certain frequency of vibration. The following mass has to be added to it in order to reduce the frequency by half :

(A) 1 kg (B) 2 kg (C) 3 kg (D) 4 kg

24. Frequency of a block in spring mass system is υ. If it is taken in a lift moving with constant acceleration upward, then frequency will :

(A) decrease (B) increase (C) remain constant (D) none

25. The length of a spring is α when a force of 4 N is applied on it and the length is β when 5 N force is applied. Then the length of spring when 9 N force is applied is-

(A) $5\beta - 4\alpha$ (B) $\beta - \alpha$ (C) $5\alpha - 4\beta$ (D) $9(\beta - \alpha)$

ANSWER KEY

1.	(A)	**2.**	(A)	**3.**	(D)	**4.**	(A)	**5.**	(C)
6.	(CD)	**7.**	(ABCD)	**8.**	(C)	**9.**	(A)	**10.**	(D)
11.	(D)	**12.**	(B)	**13.**	(B)	**14.**	(AB)	**15.**	(A)
16.	(B)	**17.**	(B)	**18.**	(A)	**19.**	(C)	**20.**	(C)
21.	(C)	**22.**	(D)	**23.**	(C)	**24.**	(C)	**25.**	(A)