Shiksha Classes Bhandara
CHAPTER TEST

Subject : Physics **Topic : Simple Harmonic Motion** **M.M. : 100**

Marking Scheme:

(i) Each question is allotted 4 (four) marks for each correct response.

(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 A point particle of mass 0.1 kg is executing SHM of amplitude of 0.1m. When the particle passes through the mean position, its kinetic energy is 18×10^{-3} J. The equation of motion of this particle when the initial phase of oscillation is 45° can be given by–

(A) $0.1 \cos\left(6t+\frac{\pi}{4}\right)$ (B) $0.1 \sin\left(6t+\frac{\pi}{4}\right)$

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

Q.2 A spring mass system performs S.H.M. If the mass is doubled keeping amplitude same, then the total energy of S.H.M. will become –

(A) double (B) half

(C) unchanged (D) 4 times

Q.3 A particle executing SHM oscillates between two fixed points separated by 20 cm. If its maximum velocity be 30 cm/s, find its velocity when its displacement is 5 cm. from its mean position.

(A) $10\sqrt{3}$ cm/s (B) $20\sqrt{3}$ cm/s

(C) $5\sqrt{3}$ cm/s (D) $2\sqrt{2}$ cm/s

Q.4 A particle performs S.H.M. on x-axis with amplitude A and time period T. The time taken by the particle to travel a distance A/5 starting from rest is :

(A) $\frac{T}{20}$ (B) $\frac{T}{2\pi}\cos^{-1}\left(\frac{4}{5}\right)$

(C) $\frac{T}{2\pi}\cos^{-1}\left(\frac{1}{5}\right)$ (D) $\frac{T}{2\pi}\sin^{-1}\left(\frac{1}{5}\right)$

Q.5 A body is executing simple harmonic motion. At a displacement x from mean position, its potential energy is E_1 = 2J and at a displacement y from mean position, its potential energy is E_2 = 8J. The potential energy E at a displacement (x + y) from mean position is –

(A) 10 J (B) 14 J

(C) 18 J (D) 4 J

Q.6 Starting from the mean position body oscillates simple harmonically with a period of 2s. After what time will its kinetic energy be 75% of the total energy –

(A) $\frac{1}{6}$s (B) $\frac{1}{4}$s

(C) $\frac{1}{3}$s (D) $\frac{1}{12}$s

Q.7 If two SHMs are represented by $y_1 = 10\sin\left(4\pi t+\frac{\pi}{2}\right)$ and $y_2 = 5\sin[2\pi t+\sqrt{8}\cos 2\pi t]$, find the ratio of their amplitudes.

(A) 2 : 3 (B) 1 : 1

(C) 1 : 4 (D) 1 : 4

Q.8 A small spherical steel ball is placed a little away from the centre of a large concave mirror whose radius of curvature R = 2.5 cm. When the ball is released, it begins to oscillate about the centre. Find the period of motion. Neglect friction and take g = 10 m/sec^2.

(A) 4.142 sec. (B) 3.142 sec.

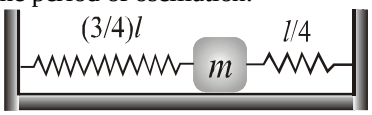
(C) 2.112 sec. (D) 0.142 sec.

Q.9 A tunnel is dug along radius of earth that ends at centre. A body is released from the surface along tunnel. The ball will bounce after first collision at centre up to a height of (radius of earth is R and coefficient of restitution is e)

(A) R (B) eR

(C) e^2R (D)

Q.10 A spring of stiffness constant k and natural length ℓ is cut into two parts of length $3\ell/4$ and $\ell/4$ respectively, and an arrangement is made as shown in the figure. If the mass is slightly displaced, find the time period of oscillation.



(A) $\frac{\pi}{2}\sqrt{\frac{3m}{k}}$ (B) $\frac{\pi}{2}\sqrt{\frac{2m}{k}}$

(C) $\frac{\pi}{2}\sqrt{\frac{m}{k}}$ (D) $\pi\sqrt{\frac{m}{k}}$

Q.11 Two blocks each of mass m, connected by ideal massless spring with force constant K, are placed on smooth horizontal surface. A particle of mass m moving horizontally with velocity v_0 collides one block and gets stuck with it. The system starts oscillation with frequency –

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

(C) $\frac{1}{2\pi}\sqrt{\frac{K}{m}}$ (D) $\frac{1}{2\pi}\sqrt{\frac{3K}{2m}}$

Q.12 A solid sphere of mass 1 kg and diameter 0.3 m is suspended from a wire. If the twisting couple per unit twist for the wire is 6×10^{-3} N-m/radian, then the time period of small oscillations will be-

(A) 0.7 sec (B) 7.7 sec

(C) 77 sec. (D) 777 sec.

Q.13 Two linear simple harmonic motions of equal amplitudes 'a' and frequencies ω and 2ω and are impressed on a particle along x and y axis respectively. If the initial phase difference between

them is $\frac{\pi}{2}$, the resultant trajectory equation of the particle is –

(A) $a^2y^2 = x^2(a^2 - x^2)$ (B) $a^2y^2 = 2x^2(a^2 - x^2)$

(C) $a^2y^2 = 4x^2(a^2 - x^2)$ (D) $a^2y^2 = 8x^2(a^2 - x^2)$

Q.14 A 1 kg body when suspended from the lower end of a light spring produces a vertical extension of 9.8 cm in it. The time period of the oscillations of the spring will be-

(A) 200π (B) $\frac{2\pi}{100}$ cycles/sec

(C) $\frac{2\pi}{10}$ cycles/sec (D) 20π

Q.15 A particle moves simple harmonically along a straight line. It starts from origin without any initial velocity and travels a distance ℓ_1 in 1st second and ℓ_2 in 2nd second in same direction. The amplitude of oscillation is –

(A) $\frac{2\ell_1^2}{3\ell_1 - \ell_2}$ (B) $\frac{3\ell_1^2}{2\ell_1 - \ell_2}$

(C) $\frac{2\ell_2^2}{3\ell_2 - \ell_1}$ (D) $\frac{3\ell_2^2}{3\ell_2 - \ell_1}$

Q.16 What will be the percentage change in the time period of a simple pendulum if its length is increased by 6% -

(A) 3% (B) 9%

(C) 6% (D) 1/9%

Q.17 The height of liquid column in a U tube is 0.3 meter. If the liquid in one of the limbs is depressed and then released, then the time period of liquid column will be-

(A) 1.1 sec (B) 19 sec

(C) 0.11 sec (D) 2 sec

Q.18 A particle is executing simple harmonic motion along a straight line 8 cm long. While passing through mean position its velocity is 16 cm/s. Its time period will be-

(A) 0.157 sec. (B) 1.57 sec

(C) 15.7 sec (D) 0.0157 sec.

Q.19 A simple pendulum with length L and mass M of the bob is vibrating with amplitude a. Then the maximum tension in the string is :

(A) Mg (B) $Mg\left[1+\left(\frac{a}{L}\right)^2\right]$

(C) $Mg\left[1+\frac{a}{L}\right]^2$ (D) $Mg\left[1+\frac{a}{2L}\right]^2$

Q.20 The period of oscillation of simple pendulum of length L suspended from the roof of a vehicle which moves without friction down on inclined plane of inclination α is given by–

(A) $2\pi\sqrt{\frac{L}{g\cos\alpha}}$ (B) $2\pi\sqrt{\frac{L}{g\sin\alpha}}$

(C) $2\pi\sqrt{\frac{L}{g}}$ (D) $2\pi\sqrt{\frac{L}{g\tan\alpha}}$

For Q.21-Q.25 :

The answer to each question is a NUMERICAL VALUE.

Q.21 A loaded vertical spring executes simple harmonic oscillations with period of 4 s. The difference between the kinetic energy and potential energy of this system oscillates with a period (in s) of :

Q.22 Two pendulums of lengths 1.44 and 1 metre length starts swinging together. After how many vibrations of small pendulum they will again start swing together.

Q.23 Two particles execute SHM on same straight line with same mean position, same time period 6 second and same amplitude 5cm. Both the particles start SHM from their mean position (in same direction) with a time gap of 1 second. Find the maximum separation (in cm) between the two particles during their motion.

Q.24 The potential energy of a particle executing SHM changes from maximum to minimum in 5s. Then the time period (in s) of SHM is –

Q.25 A body of mass 0.1 kg is attached to two springs of force constants 6 N/m and 4 N/m and supported by two rigid supports. If the body is displaced along the length of the springs, the frequency of vibrations will be (X/π) vibrations/sec. Find the value of X.