CHAPTER

16

Oscillations

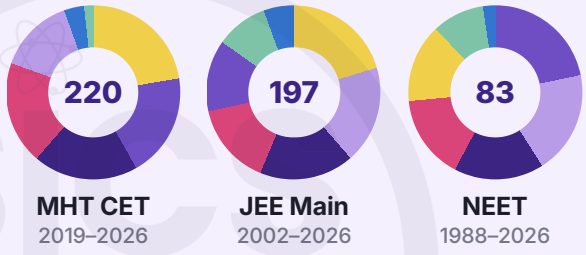
MHT CET · JEE · NEET Physics

PHYSICS CIRCLE

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EXAM WEIGHTAGE



	CET	JEE	NEET
Spring Systems	49 22%	40 20%	12 14%
Simple Pendulum	43 20%	35 18%	14 17%
Velocity & Acceleration in SHM	43 20%	26 13%	18 22%
Energy in SHM	42 19%	30 15%	13 16%
Periodic Motion & SHM Basics	31 14%	36 18%	16 19%
Damped, Forced Oscillations & Superposition	4 2%	19 10%	8 10%
Other SHM Systems	8 4%	11 6%	2 2%

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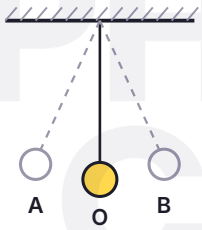
01 CONCEPT Periodic Motion & Basics of SHM

IN ONE LINE

In SHM a body moves to and fro about a mean position, under a restoring force that is **proportional to the displacement**.

16.1.1 Periodic and oscillatory motion

- **Periodic**: repeats after a fixed interval. Example: the earth around the sun.
- **Oscillatory**: to and fro about a fixed point, within limits on both sides.
- Every oscillatory motion is periodic. Not every periodic motion is oscillatory.
- Examples: wall clock pendulum, load on a spring, liquid in a U-tube, loaded wood floating on a liquid.

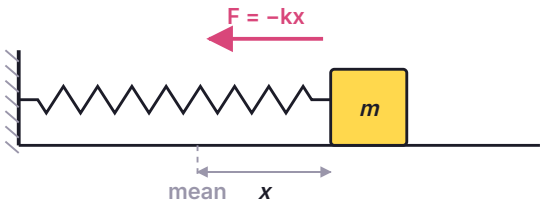


Bob moves between A and B about the mean position O

16.1.2 Harmonic and non-harmonic

- **Harmonic**: a single sine or cosine, $y = a \sin \omega t$ or $y = a \cos \omega t$.
- **Non-harmonic**: a mix of harmonic functions, such as $y = a \sin \omega t + b \sin 2\omega t$.
- $\sin \omega t + \cos \omega t$ is still harmonic: both terms have the same ω.
- $e^{-\omega t}$ and $\log \omega t$ are not periodic.
- A ball bouncing elastically is periodic but not SHM.

16.1.3 Condition for SHM



The force always points to the mean position

$$F = -kx$$

- k = force constant, unit N/m, dimension $[MT^{-2}]$.
- Minus sign: F is opposite to the displacement.
- Angular SHM: restoring torque $\tau = -c\theta$.

16.1.4 Reading ω directly

$$\frac{d^2y}{dt^2} + \omega^2 y = 0$$

$$a = -\omega^2 y \cdot \omega = \sqrt{\left(\frac{k}{m}\right)}$$

- Any equation in this form is SHM.
- Read ω^2 from the coefficient of y.
- Then $T = \frac{2\pi}{\omega}$

$$T = 2\pi\sqrt{\left(\frac{\text{inertia factor}}{\text{spring factor}}\right)}$$

16.1.5 T, n and ω

Quantity	Meaning	Unit
time period T	least time after which motion repeats	s
frequency n	oscillations per second	Hz
angular frequency ω	$\omega = 2\pi n$	rad/s

$$n = \frac{1}{T} \cdot \omega = \frac{2\pi}{T}$$

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16.1.6 Where the particle is, and which way it is going

$$y = a \sin(\omega t + \varphi_0)$$

- $(\omega t + \varphi_0)$ is the **phase** at time t.
- φ_0 is the initial phase, or epoch.
- One full oscillation changes the phase by 2π.
- Phase change in time Δt: $\Delta\varphi = \frac{2\pi}{T}\Delta t$.

	Phase difference	Time difference
same phase	0, 2π, 4π ...	0, T, 2T ...
opposite phase	π, 3π, 5π ...	$\frac{T}{2}, \frac{3T}{2}$ ...

- Same phase: the particles cross the mean position together, in the same direction.
- Opposite phase: they cross it together, in opposite directions.

$$\Delta\varphi = (\omega_2 - \omega_1)t + (\varphi_2 - \varphi_1)$$

- First write both equations with the same function: $\cos \omega t = \sin(\omega t + \frac{\pi}{2})$.
- Two SHMs of the same a and ω: maximum separation = $2a \sin(\frac{\varphi}{2})$.

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Solved Examples 01 Periodic Motion & Basics of SHM

SOLVED 1 MHT CET 2026 · 12 May · Shift 2

A ball released from height h makes a perfectly elastic collision with the ground. The frequency of the periodic vibratory motion is (g = acceleration due to gravity)

(a) $\frac{1}{2\pi}\sqrt{(\frac{2h}{g})}$ (b) $\frac{1}{2}\sqrt{(\frac{g}{2h})}$

(c) $\frac{1}{2}\sqrt{(\frac{2h}{g})}$ (d) $\frac{1}{2\pi}\sqrt{(\frac{g}{2h})}$

STEP 1 Time to fall = $\sqrt{(\frac{2h}{g})}$; time to rise is the same

STEP 2 $T = 2\sqrt{(\frac{2h}{g})}$. The motion is periodic but not SHM

STEP 3 $n = \frac{1}{T} = \frac{1}{2}\sqrt{(\frac{g}{2h})}$

Answer: **(b)**

SOLVED 2 AIPMT 2005

The circular motion of a particle with constant speed is

(a) periodic but not simple harmonic

(b) simple harmonic but not periodic

(c) periodic and simple harmonic

(d) neither periodic nor simple harmonic

STEP 1 The motion repeats every revolution, so it is periodic

STEP 2 The particle is not moving to and fro about a mean position

STEP 3 **Periodic but not simple harmonic**

Answer: **(a)**

SOLVED 3 NEET 2022 · Phase 2

Identify the function which represents a non-periodic motion.

(a) $\sin(\omega t + \frac{\pi}{4})$ (b) $e^{-\omega t}$

(c) $\sin \omega t$ (d) $\sin \omega t + \cos \omega t$

STEP 1 Sine and cosine terms repeat after every 2π

STEP 2 $e^{-\omega t}$ keeps falling and never repeats

STEP 3 $\mathbf{e^{-\omega t}}$ is non-periodic

Answer: **(b)**

SOLVED 4 AIPMT 2009

Which one of the following equations of motion represents simple harmonic motion? (k, k_0, k_1 and a are all positive)

(a) Acceleration = $-k(x + a)$

(b) Acceleration = $k(x + a)$

(c) Acceleration = $-\omega^2 x$

(d) Acceleration = $-k_0 x + k_1 x^2$

STEP 1 SHM needs acceleration $\propto$ displacement

STEP 2 The acceleration must be directed towards the mean position (minus sign)

STEP 3 **Acceleration = $-\omega^2 x$**

Answer: **(c)**

SOLVED 5 MHT CET 2024 · 15 May · Shift 2

The motion of a particle is described by the equation $a = -bx$, where a is the acceleration, x is the displacement from the equilibrium position and b is a constant. The periodic time will be

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

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

STEP 1 Compare with $a = -\omega^2 x$

STEP 2 $\omega^2 = b \Rightarrow \omega = \sqrt{b}$

STEP 3 $T = \frac{2\pi}{\omega} = \mathbf{\frac{2\pi}{\sqrt{b}}}$

Answer: **(b)**

SOLVED 6 MHT CET 2026 · 19 May · Shift 1

The differential equation of a particle performing S.H.M. is $\frac{d^2x}{dt^2} + 64x = 0$, where x is in metre. The period of oscillation of the particle is (in second)

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

(c) $\frac{\pi}{5}$ (d) $\frac{\pi}{8}$

STEP 1 Compare with $\frac{d^2x}{dt^2} + \omega^2 x = 0$

STEP 2 $\omega^2 = 64 \Rightarrow \omega = 8$ rad/s

STEP 3 $T = \frac{2\pi}{8} = \mathbf{\frac{\pi}{4}}$ **s**

Answer: **(b)**

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Solved Examples 01 Periodic Motion & Basics of SHM (contd.)

SOLVED 7 MHT CET 2024 · 3 May · Shift 2

When a particle in linear S.H.M. completes two oscillations, its phase increases by

(a) π rad (b) 2π rad
(c) 3π rad (d) 4π rad

STEP 1 One oscillation changes the phase by 2π
STEP 2 Two oscillations: 2 × 2π
STEP 3 Phase increase = **4π rad**

Answer: **(d)**

SOLVED 8 MHT CET 2025 · 20 Apr · Shift 1

The period of S.H.M. of a particle is 16 second. The phase difference between the positions at t = 2 s and t = 4 s will be

(a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{8}$

STEP 1 $\Delta\varphi = \frac{2\pi}{T} \times \Delta t$
STEP 2 $\Delta\varphi = \frac{2\pi}{16} \times 2$
STEP 3 $\Delta\varphi = \mathbf{\frac{\pi}{4}}$

Answer: **(c)**

SOLVED 9 MHT CET 2025 · 25 Apr · Shift 1

Two particles A and B execute SHMs of periods T and $\frac{3T}{2}$. If they start from the mean position, the phase difference between them when particle A completes two oscillations will be

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$
(c) $\frac{4\pi}{3}$ (d) $\frac{\pi}{4}$

STEP 1 A completes two oscillations in t = 2T, so $\varphi_A = 4\pi$
STEP 2 $\varphi_B = \frac{2\pi}{\frac{3T}{2}} \times 2T = \frac{8\pi}{3}$
STEP 3 $\Delta\varphi = 4\pi - \frac{8\pi}{3} = \mathbf{\frac{4\pi}{3}}$

Answer: **(c)**

SOLVED 10 MHT CET 2026 · 15 Apr · Shift 2

The minimum phase difference between the two simple harmonic motions $x_1 = \frac{1}{\sqrt{2}} \sin \omega t + \frac{1}{\sqrt{2}} \cos \omega t$ and $x_2 = \sin \omega t + \cos \omega t$ is

(a) zero (b) $\frac{\pi}{3}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{5}$

STEP 1 $x_1 = \sin(\omega t + \frac{\pi}{4})$
STEP 2 $x_2 = \sqrt{2} \sin(\omega t + \frac{\pi}{4})$
STEP 3 Both have the same phase, so $\Delta\varphi$ = **zero**

Answer: **(a)**

SOLVED 11 MHT CET 2021 · 20 Sep · Shift 1

Two particles P and Q perform S.H.M. of the same amplitude a and frequency along the same straight line. At a particular instant, the maximum distance between the two particles is √2 a. The initial phase difference between them is

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{2}$
(c) zero (d) $\frac{\pi}{3}$

STEP 1 Maximum separation = $2a \sin(\frac{\varphi}{2})$
STEP 2 $2a \sin(\frac{\varphi}{2}) = \sqrt{2}\, a \Rightarrow \sin(\frac{\varphi}{2}) = \frac{1}{\sqrt{2}}$
STEP 3 $\frac{\varphi}{2} = \frac{\pi}{4} \Rightarrow \varphi = \mathbf{\frac{\pi}{2}}$

Answer: **(b)**

SOLVED 12 NEET 2020 · Phase 2

Identify the function which represents a periodic motion.

(a) $e^{-\omega t}$ (b) $e^{\omega t}$
(c) $\log_e(\omega t)$ (d) sin ωt + cos ωt

STEP 1 Exponential and log functions never repeat
STEP 2 sin ωt + cos ωt = $\sqrt{2} \sin(\omega t + \frac{\pi}{4})$, which repeats
STEP 3 **sin ωt + cos ωt** is periodic

Answer: **(d)**

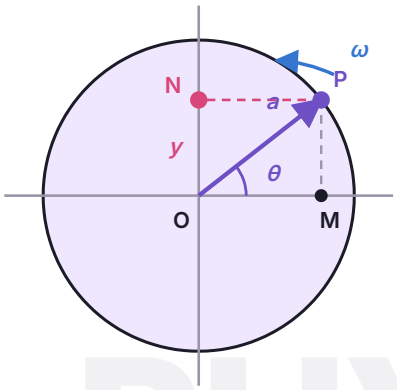
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02 CONCEPT
Equation of SHM, Time & Distance

IN ONE LINE

SHM is the **projection of uniform circular motion** on a diameter. This gives its equation and all its timing results.

16.2.1 SHM from circular motion



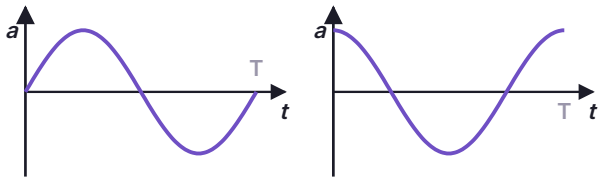
P moves on the circle; its projection N performs SHM

- P moves on a circle of radius a with angular speed ω.
- The foot N of the perpendicular on a diameter performs SHM.
- a = amplitude, ω = angular frequency of the SHM.
- Displacement is always measured from the mean position.

16.2.2 Choosing the right equation

$$y = a \sin(\omega t + \varphi)$$

Time noted from	Equation
mean position	$y = a \sin \omega t$
extreme position	$y = a \cos \omega t$
phase φ ahead	$y = a \sin(\omega t + \varphi)$



Starting from the mean position and from the extreme position

16.2.3 Use the sign of the velocity

- Put t = 0 in $y = a \sin(\omega t + \varphi)$ to get sin φ.
- Moving along +y: cos φ is positive.
- Moving along −y: cos φ is negative.

Start at	Moving	φ
$\frac{a}{2}$	+y	$\frac{\pi}{6}$
$\frac{a}{2}$	−y	$\frac{5\pi}{6}$
a	at rest	$\frac{\pi}{2}$

16.2.4 Given y and v at one instant

$$a^2 = y^2 + \left(\frac{v}{\omega}\right)^2$$

16.2.5 One SHM in disguise

$$y = a \sin \omega t + b \cos \omega t$$

$$A = \sqrt{a^2 + b^2} \cdot \tan \varphi = \frac{b}{a}$$

- The resultant is an SHM of the same ω.
- A constant term, $y = A_0 + a \sin \omega t$, only shifts the mean position.
- The amplitude does not change with such a constant.

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OSCILLATIONS

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

235	28	7
questions	concepts	topics

CONTENTS

01	Periodic Motion & SHM Basics	Q 1–36	36 Qs
02	Velocity & Acceleration in SHM	Q 37–82	46 Qs
03	Energy in SHM	Q 83–133	51 Qs
04	Simple Pendulum	Q 134–183	50 Qs
05	Spring Systems	Q 184–219	36 Qs
06	Other SHM Systems	Q 220–224	5 Qs
07	Damped, Forced Oscillations & Superposition	Q 225–235	11 Qs
	Answer key		

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TOPIC 01

Periodic Motion & SHM Basics

36 PYQs · Easy 36 · Medium 0 · Difficult 0 | MHT CET 10 · NEET 14 · JEE 12

Concepts covered: Periodic and oscillatory motion (7) · Restoring force and differential equation (8) · Phase and phase difference (4) · Displacement equation and circle of reference (6) · Time and distance in SHM (11)

LEVEL 1 · EASY 36 questions

◆ Periodic and oscillatory motion 7 Qs

1. Identify the function which represents a non-periodic motion.
NEET 2022 · PHASE 2
(a) $\sin(\omega t + \pi/4)$ (b) $e^{-\omega t}$
(c) $\sin \omega t$ (d) $\sin \omega t + \cos \omega t$

2. Identify the function which represents a periodic motion.
NEET 2020 · PHASE 2
(a) $e^{-\omega t}$ (b) $e^{\omega t}$
(c) $\log_e(\omega t)$ (d) $\sin \omega t + \cos \omega t$

3. Out of the following functions representing motion of a particle which represents SHM (1) $y = \sin\omega t - \cos\omega t$
(2) $y = \sin 3\omega t$
(3) $y = 5\cos\left(\frac{3\pi}{4} - 3\omega t\right)$
(4) $y = 1 + \omega t + \omega 2t2$
AIPMT 2011 · PRELIMS
(a) Only (1)
(b) Only (4) does not represent SHM
(c) Only (1) and (3)
(d) Only (1) and (2)

4. The displacement of a particle along the x-axis is given by $x = a\sin 2\omega t$. The motion of the particle corresponds to
AIPMT 2010 · PRELIMS
(a) simple harmonic motion of frequency ω/π
(b) simple harmonic motion of frequency $3\omega/2\pi$
(c) non simple harmonic motion
(d) simple harmonic motion of frequency $\omega/2\pi$

5. The circular motion of a particle with constant speed is
AIPMT 2005
(a) periodic but not simple harmonic
(b) simple harmonic but not periodic
(c) period and simple harmonic
(d) neither periodic not simple harmonic.

6. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Knowing initial position x_0 and initial momentum p_0 is enough to determine the position and momentum at any time t for a simple harmonic motion with a given angular frequency ω.
Reason (R): The amplitude and phase can be expressed in terms of x_0 and p_0.
In the light of the above statements, choose the correct answer from the options given below:
JEE MAIN 2025 · 28 JAN · SHIFT 2
(a) (A) is true but (R) is false
(b) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)
(c) (A) is false but (R) is true
(d) Both (A) and (R) are true and (R) is the correct explanation of (A)

7. The function of time representing a simple harmonic motion with a period of $\frac{\pi}{\omega}$ is:
JEE MAIN 2021 · 18 MAR · SHIFT 2
(a) $\cos(\omega t) + \cos(2\omega t) + \cos(3\omega t)$
(b) $\sin 2(\omega t)$
(c) $\sin(\omega t) + \cos(\omega t)$
(d) $3\cos\left(\frac{\pi}{4} - 2\omega t\right)$

◆ Restoring force and differential equation 8 Qs

8. The differential equation of a particle performing S.H.M. is $\frac{d^2x}{dt^2} + 64x = 0$, where x is in meter. The period of oscillation of the particle is (in second)
MHT CET 2026 · 19 MAY · SHIFT 1
(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{5}$ (d) $\frac{\pi}{8}$

9. The motion of a particle is described by the equation $a = -bx$ where ' a ' is the acceleration, x is the displacement from the equilibrium position and b is a constant. The periodic time will be
MHT CET 2024 · 15 MAY · SHIFT 2
(a) $\frac{2\pi}{b}$ (b) $\frac{2\pi}{\sqrt{b}}$ (c) $2\pi\sqrt{b}$ (d) $2\sqrt{\frac{\pi}{b}}$

10. Which one of the following equations of motion represents simple harmonic motion? where k, k0, k1 and a are all positive.
AIPMT 2009
(a) Acceleration = – k (x + a)
(b) Acceleration = k(x + a)
(c) Acceleration = – $\omega 2x$
(d) Acceleration = – k0x + k1x2

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11. A particle executes S.H.M. along x-axis. The force acting on it is given by
AIPMT 1994
(a) $A\cos(kx)$ (b) Ae^{-kx}
(c) Akx (d) $-Akx$

12. A particle executes S.H.M. along x-axis. The force acting on it is given by
AIPMT 1988
(a) $A\cos(kx)$ (b) Ae^{-kx}
(c) Akx (d) $-Akx$

13. In a linear Simple Harmonic Motion (SHM)
(A) Restoring force is directly proportional to the displacement.
(B) The acceleration and displacement are opposite in direction.
(C) The velocity is maximum at mean position.
(D) The acceleration is minimum at extreme points.
Choose the correct answer from the options given below:
JEE MAIN 2023 · 15 APR · SHIFT 1
(a) (A), (B) and (D) only (b) (C) and (D) only
(c) (A), (B) and (C) Only (d) (A), (C) and (D) only

14. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is the displacement and a, b, c are positive constants?
JEE MAIN 2014 · 12 APR · SHIFT 1
(a) a + bx − cx2 (b) bx2
(c) a − bx + cx2 (d) − bx

15. A point mass oscillates along the x-axis according to the law $x = x_0\cos(\omega t - \pi/4)$. If the acceleration of the particle is written as $a = A\cos(\omega t + \delta)$, then
AIEEE 2007
(a) $A = x_0\omega^2, \delta = 3\pi/4$ (b) $A = x_0, \delta = -\pi/4$
(c) $A = x_0\omega^2, \delta = \pi/4$ (d) $A = x_0\omega^2, \delta = -\pi/4$

◆ Phase and phase difference 4 Qs

16. The period of S.H.M. of a particle is 12s. The phase difference between the positions at $t = 3$s and $t = 4$s will be
MHT CET 2026 · 15 MAY · SHIFT 1
(a) $\frac{\pi}{4}$ (b) $\frac{3\pi}{5}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{2}$

17. The minimum phase difference between two simple harmonic motions is
$x_1 = \frac{1}{\sqrt{2}}\sin\omega t + \frac{1}{\sqrt{2}}\cos\omega t$
$x_2 = \sin\omega t + \cos\omega t \quad \left[\sin\frac{\pi}{4} = \cos\frac{\pi}{4} = \frac{1}{\sqrt{2}}\right]$
MHT CET 2026 · 15 APR · SHIFT 2
(a) zero (b) $\frac{\pi^C}{3}$ (c) $\frac{\pi^C}{4}$ (d) $\frac{\pi^C}{5}$

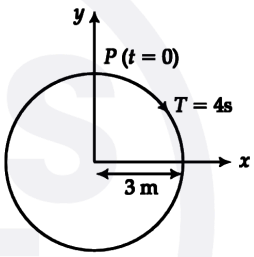
18. The period of S. H.M. of a particle is 16 second. The phase difference between the positions at t = 2 s and t = 4 s will be
MHT CET 2025 · 20 APR · SHIFT 1
(a) π (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{8}$

19. When a particle in linear S.H.M. completes two oscillations, its phase increases by
MHT CET 2024 · 3 MAY · SHIFT 2
(a) π rad. (b) 2π rad.
(c) 3π rad. (d) 4π rad.

◆ Displacement equation and circle of reference 6 Qs

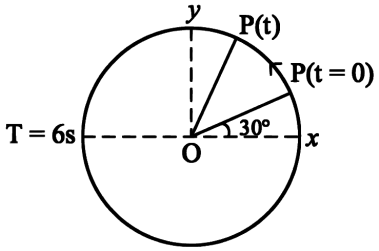
20. If $x = 5\sin\left(\pi t + \frac{\pi}{3}\right)$m represents the motion of a particle executing simple harmonic motion, the amplitude and time period of motion, respectively, are
NEET 2024
(a) 5 cm, 2 s (b) 5 m, 2 s (c) 5 cm, 1 s (d) 5 m, 1 s

21. The radius of circle, the period of revolution, initial position and sense of revolution are indicated is the figure.



y- projection of the radius vector of rotating particle P is:
NEET 2019
(a) y(t) = 4sin $\left(\frac{\pi t}{2}\right)$, where y in m
(b) y(t) = 3cos $\left(\frac{3\pi t}{2}\right)$, where y in m
(c) y(t) = 3cos $\left(\frac{\pi t}{2}\right)$, where y in m
(d) y(t) = -3cos2πt, where y in m

22. For particle P revolving round the centre O with radius of circular path r and angular velocity ω, as shown in below figure, the projection of OP on the x-axis at time t is
JEE MAIN 2023 · 8 APR · SHIFT 2



(a) $x(t) = r\cos\left(\omega t - \frac{\pi}{6}\omega\right)$
(b) $x(t) = r\cos(\omega t)$
(c) $x(t) = r\cos\left(\omega t + \frac{\pi}{6}\right)$
(d) $x(t) = r\sin\left(\omega t + \frac{\pi}{6}\right)$

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23. Y = A sin(ωt + ϕ0) is the time-displacement equation of a SHM. At t = 0 the displacement of the particle is $Y = \frac{A}{2}$ and it is moving along negative x-direction. Then the initial phase angle ϕ_0 will be:

JEE MAIN 2021 · 25 FEB · SHIFT 2

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

24. A simple harmonic motion is represented by:
y = 5 (sin 3 π t + $\sqrt{3}$ cos 3 πt) cm
The amplitude and time period of the motion are:

JEE MAIN 2019 · 12 JAN · SHIFT 2

(a) 10 cm, $\frac{3}{2}$ s (b) 5 cm, $\frac{2}{3}$ s
(c) 5 cm, $\frac{3}{2}$ s (d) 10 cm, $\frac{2}{3}$ s

25. If a simple harmonic motion is represented by $\frac{d^2x}{dt^2} + \alpha x = 0$. its time period is

AIEEE 2005

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

◆ Time and distance in SHM 11 Qs

26. A mass attached to a spring performs S.H.M. whose displacement is $x = 3 \times 10^{-3} \cos 2\pi t$ m. The time taken to obtain maximum speed for the first time is (in s)

MHT CET 2026 · 11 APR · SHIFT 2

(a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\frac{1}{8}$

27. The displacement of particle in S.H.M. is $x = A\cos(\omega t + \pi/6)$. Its speed will be maximum at time $(\sin 90^\circ = 1)$

MHT CET 2025 · 25 APR · SHIFT 1

(a) $\frac{\pi}{3\omega}$ s (b) $\frac{\pi}{2\omega}$ s (c) $\frac{\pi}{\omega}$ s (d) $\frac{\pi}{4\omega}$ s

28. A mass attached to a spring performs S.H.M. whose displacement is $x = 3 \times 10^{-3} \cos 2\pi t$ metre. The time taken to obtain maximum speed for the first time is

MHT CET 2025 · 20 APR · SHIFT 2

(a) $\frac{1}{12}$ s (b) $\frac{1}{8}$ s (c) $\frac{1}{4}$ s (d) $\frac{1}{2}$ s

29. A particle executes the simple harmonic motion with an amplitude ' A '. The distance travelled by it in one periodic time is

MHT CET 2019 · 2 MAY · SHIFT 1

(a) $\frac{A}{2}$ (b) A (c) $2A$ (d) $4A$

30. The distance covered by a particle undergoing SHM in one time period is (amplitude = A),

NEET 2019

(a) $4A$ (b) Zero (c) A (d) $2A$

31. Average velocity of a particle executing SHM in one complete vibration is:

NEET 2019

(a) Aω (b) $\frac{A\omega^2}{2}$ (c) $\frac{A\omega}{2}$ (d) zero

32. A particle executes simple harmonic oscillation with an amplitude a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is

AIPMT 2007

(a) T/8 (b) T/12 (c) T/2 (d) T/4

33. 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

AIPMT 1992

(a) $T/6$ (b) $T/4$ (c) $T/3$ (d) $T/2$

34. The displacement of simple harmonic oscillator after 3 seconds starting from its mean position is equal to half of its amplitude. The time period of harmonic motion is:

JEE MAIN 2022 · 27 JUN · SHIFT 1

(a) 6 s (b) 8 s (c) 12 s (d) 36 s

35. The displacement of an object attached to a spring and executing simple harmonic motion is given by $x = 2 \times 10^{-2}\ cos\ \pi t$ metre. The time at which the maximum speed first occurs is

AIEEE 2007

(a) 0.25 s (b) 0.5 s (c) 0.75 s (d) 0.125 s

36. A particle performs simple harmonic motion with a period of 2 second. The time taken by the particle to cover a displacement equal to half of its amplitude from the mean position is $\frac{1}{a}$s. The value of 'a' to the nearest integer is _____.

JEE MAIN 2021 · 18 MAR · SHIFT 1 *(Numerical)*

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TOPIC 02

Velocity & Acceleration in SHM

46 PYQs · Easy 46 · Medium 0 · Difficult 0 | MHT CET 25 · NEET 12 · JEE 9

Concepts covered: Velocity at a displacement (17) · Maximum velocity and acceleration (19) · Graphs and phase relations (10)

LEVEL 1 · EASY 46 questions

◆ Velocity at a displacement 17 Qs

37. A simple pendulum performs simple harmonic motion about $x = 0$ with an amplitude 'A' and angular frequency ω. The speed of pendulum at $x = \frac{A}{8}$ will be.

MHT CET 2026 · 20 MAY · SHIFT 1

(a) $\frac{\sqrt{61}\,A\omega}{8}$ (b) $\frac{\sqrt{62}\,A\omega}{8}$ (c) $\frac{\sqrt{63}\,A\omega}{8}$ (d) $\frac{\sqrt{65}\,A\omega}{8}$

38. A particle is performing S.H.M. about $x = 0$, with an amplitude a and time period T. The speed of the particle at $x = \frac{a}{3}$ will be

MHT CET 2026 · 20 APR · SHIFT 2

(a) $\frac{2\pi a}{T}$ (b) $\frac{4\pi a}{3T}$ (c) $\frac{\sqrt{3}\,\pi^2 a}{2T}$ (d) $\frac{4\sqrt{2}\,\pi a}{3T}$

39. A particle is performing simple harmonic motion about $x = 0$ with an amplitude 'a' and periodic time T. The speed of the particle at $x = \frac{a}{3}$ will be

MHT CET 2026 · 18 APR · SHIFT 1

(a) $\frac{2\pi a}{T}$ (b) $\frac{4\pi a}{3T}$ (c) $\frac{4\sqrt{2}\,\pi a}{3T}$ (d) $\frac{\sqrt{3}\,\pi^2 a}{2T}$

40. A particle executing simple harmonic motion starts from mean position with amplitude 'A' and periodic time 'T'. At what displacement is its speed one-fourth of the maximum speed?

MHT CET 2026 · 17 APR · SHIFT 1

(a) $\frac{A}{\sqrt{15}}$ (b) $\frac{A}{4}$ (c) $\frac{4A}{\sqrt{15}}$ (d) $\frac{A\sqrt{15}}{4}$

41. A simple pendulum starts oscillating simple harmonically from its mean position ($x = 0$) with amplitude ' a ' and periodic time ' T '. The magnitude of velocity of pendulum at $x = \frac{a}{2}$ is

MHT CET 2025 · 5 MAY · SHIFT 2

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

42. A particle executes S.H.M. starting from the mean position. Its amplitude is ' a ' and its periodic time is ' T '. At a certain instant, its speed ' u ' is half that of maximum speed V_{max}. The displacement of the particle at that instant is

MHT CET 2025 · 22 APR · SHIFT 2

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

43. For a particle executing S.H.M. having amplitude A, the speed of the particle is $\left(\frac{1}{3}\right)^{rd}$ of its maximum speed when the displacement from the mean position is

MHT CET 2024 · 15 MAY · SHIFT 2

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

44. A particle is performing S.H.M. about its mean position with an amplitude ' a ' and periodic time ' T '. The speed of the particle when its displacement from mean position is $\frac{a}{3}$ will be

MHT CET 2024 · 11 MAY · SHIFT 2

(a) $\frac{2\pi a}{T}$ (b) $\frac{4\sqrt{2}\pi a}{3\,T}$ (c) $\frac{4\pi^2 a}{3\,T}$ (d) $\frac{\sqrt{3}\pi^2 a}{2\,T}$

45. A particle is performing S.H.M. with an amplitude 4 cm. At the mean position the velocity of the particle is 12 cm/s. When the speed of the particle becomes 6 cm/s, the distance of the particle from mean position is

MHT CET 2024 · 9 MAY · SHIFT 1

(a) $\sqrt{3}$ cm (b) $\sqrt{6}$ cm (c) $2\sqrt{3}$ cm (d) $2\sqrt{6}$ cm

46. The displacement of a particle executing S.H.M. is $x = a\sin(\omega t - \phi)$. Velocity of the particle at time $t = \frac{\phi}{\omega}$ is $(\cos 0^\circ = 1)$

MHT CET 2023 · 14 MAY · SHIFT 1

(a) $\omega\cos\phi$ (b) $a\omega$
(c) $\omega\cos 2\phi$ (d) $-a\omega\cos 2\phi$

47. A simple pendulum performs simple harmonic motion about x = 0 with an amplitude 'a' and time period 'T'. The speed of the pendulum at $x = \frac{a}{2}$ is

MHT CET 2023 · 12 MAY · SHIFT 1

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

48. A particle executing S.H.M starts from the mean position. Its amplitude is 'A' and time period 'T'. At what displacement its speed is one-fourth of the maximum speed?

MHT CET 2021 · 23 SEP · SHIFT 1

(a) $\frac{A}{\sqrt{15}}$ (b) $\frac{A}{4}$ (c) $\frac{4\,A}{15}$ (d) $\frac{A\sqrt{15}}{4}$

49. 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 = a/2 will be

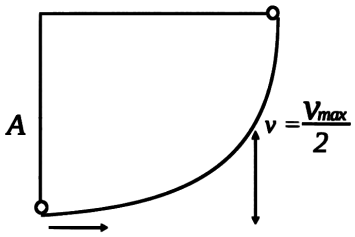
AIPMT 2009

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

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50. A particle starts with S.H.M. from the mean position as shown in the figure. Its amplitude is A and its time period is T. At one time, its speed is half that of the maximum speed. What is this displacement?

AIPMT 1996



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

51. The equation of a particle executing simple harmonic motion is given by $x = \sin\pi\left(t + \frac{1}{3}\right)m$. At t = 1s, the speed of particle will be
(Given: $\pi = 3.14$)

JEE MAIN 2022 · 27 JUN · SHIFT 2

(a) 0 cm s^{-1} (b) 157 cm s^{-1}
(c) 272 cm s^{-1} (d) 314 cm s^{-1}

52. The velocity of a particle executing simple harmonic motion along x-axis is described as $v^2 = 50 - x^2$, where x represents displacement. If the time period of motion is $\frac{x}{7}$ s, the value of x is ____.

JEE MAIN 2026 · 4 APR · SHIFT 1 *(Numerical)*

53. A particle executes S.H.M. with amplitude 'a', and time period 'T'. The displacement of the particle when its speed is half of maximum speed is $\frac{\sqrt{xa}}{2}$. The value of x is _____.

JEE MAIN 2021 · 26 FEB · SHIFT 2 *(Numerical)*

◆ Maximum velocity and acceleration 19 Qs

54. The maximum velocity and maximum acceleration of a particle performing a linear S.H.M. are α and β respectively. Then, path length of the particle is

MHT CET 2026 · 14 MAY · SHIFT 2

(a) $\frac{\alpha^2}{\beta}$ (b) $\frac{\beta}{2\alpha^2}$ (c) $\frac{2\alpha^2}{\beta}$ (d) $\frac{2\beta}{\alpha^2}$

55. Two particles performing simple harmonic motions of maximum accelerations, 1 m/s^2 and 100 m/s^2, have the same amplitudes. The ratio of their angular frequencies is

MHT CET 2026 · 12 MAY · SHIFT 1

(a) 1 : 100 (b) 1 : 10 (c) 1 : 1000 (d) 1 : 1

56. A body of mass 0.4 kg performs simple harmonic motion. It experiences a restoring force of 0.4 N when its displacement from the mean position is 4 cm. The force constant and magnitude of acceleration respectively are

MHT CET 2026 · 15 APR · SHIFT 2

(a) 5 N/m , 0.5 m/s_2 (b) 10 N/m , 1 m/s_2
(c) 15 N/m , 1.5 m/s_2 (d) 20 N/m , 2 m/s_2

57. Two simple harmonic motions of angular frequency 300rad/s and 3000rad/s have same amplitude. The ratio of their maximum accelerations is

MHT CET 2025 · 21 APR · SHIFT 1

(a) 1 : 10 (b) $1 : 10^2$ (c) $1 : 10^3$ (d) $1 : 10^4$

58. The maximum velocity of a particle, executing S.H.M. with an amplitude 7 mm is 4.4 ms^{-1} The period of oscillation is $\left[\pi = \frac{22}{7}\right]$

MHT CET 2024 · 15 MAY · SHIFT 1

(a) 100 s (b) 10 s (c) 0.1 s (d) 0.01 s

59. A particle performing S.H.M. with maximum velocity 'V'. If the amplitude double and periodic time is made, $\left(\frac{1}{3}\right)^{rd}$ then the maximum velocity is

MHT CET 2024 · 10 MAY · SHIFT 1

(a) 6V (b) $\frac{V}{3}$ (c) $\frac{3V}{2}$ (d) $\frac{2\,V}{3}$

60. The maximum velocity and maximum acceleration of a particle performing a linear S.H.M. is 'α' and 'β' respectively. Then the path length of the particle is

MHT CET 2024 · 4 MAY · SHIFT 2

(a) $\frac{\alpha^2}{\beta}$ (b) $\frac{\beta\alpha^2}{2\alpha^2}$ (c) $\frac{2\alpha^2}{\beta}$ (d) $\frac{2\beta}{\alpha^2}$

61. The maximum velocity of a particle performing S.H.M. is 'V'. If the periodic time is made $\left(\frac{1}{3}\right)^{rd}$ and the amplitude is doubled, then the new maximum velocity of the particle will be

MHT CET 2023 · 9 MAY · SHIFT 1

(a) $\frac{V}{6}$ (b) $\frac{3\,V}{2}$ (c) 3 V (d) 6 V

62. The displacement of a particle performing S.H.M. is given by $x = 5\sin(3t + 3)$, where x is in cm and t is in second. The maximum acceleration of the particle will be

MHT CET 2021 · 24 SEP · SHIFT 2

(a) 15 cm s^{-2} (b) 30 cm s^{-2}
(c) 45 cm s^{-2} (d) 90 cm s^{-2}

63. A particle is performing S.H.M. with maximum velocity 'v'. If the amplitude is tripled and periodic time is doubled then maximum velocity will be

MHT CET 2021 · 21 SEP · SHIFT 2

(a) 1.5 v (b) 3 v (c) 2 v (d) v

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64. A particle of mass 5 g is executing S.H.M. with an amplitude 0.3 m and time period $\frac{\pi}{5}$ s. The maximum value of the force acting on the particle is

MHT CET 2021 · 20 SEP · SHIFT 1

(a) 0.15 N (b) 4 N (c) 5 N (d) 0.3 N

65. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is 20 m s–2 at a distance of 5 m from the mean position. The time period of oscillation is

NEET 2018

(a) 2π s (b) π s (c) 2 s (d) 1 s

66. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time period of vibration will be

AIPMT 2015

(a) $\frac{\beta^2}{\alpha}$ (b) $\frac{2\pi\beta}{\alpha}$ (c) $\frac{\beta^2}{\alpha^2}$ (d) $\frac{\alpha}{\beta}$

67. _1

Two simple harmonic motions of angular frequency 100 and 1000 rad s have the same displacement amplitude. The ratio of their maximum acceleration is

AIPMT 2008

(a) $1 : 10^3$ (b) $1 : 10^4$ (c) $1 : 10$ (d) $1 : 10^2$

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

AIPMT 2005

(a) 2 Hz (b) 1.5 Hz (c) 0.5 Hz (d) 1 Hz

69. If a simple harmonic oscillator has got a displacement of 0.02 m and acceleration equal to 2.0 m/s^2 at any time, the angular frequency of the oscillator is equal to

AIPMT 1992

(a) 10 rad/s (b) 0.1 rad/s
(c) 100 rad/s (d) 1 rad/s

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

AIEEE 2006

(a) 0.01 s (b) 10 s (c) 0.1 s (d) 100 s

71. A particle is doing simple harmonic motion of amplitude 0.06 m and time period 3.14 s . The maximum velocity of the particle is _____ cm/s.

JEE MAIN 2024 · 6 APR · SHIFT 1 *(Numerical)*

72. A particle executing SHM has its velocity 20 cm s^{-1} at mean position and acceleration of 25 cm s^{-2} at one of its extreme position. The amplitude of the particle will be ____ cm.

JEE MAIN 2022 · 30 JUL · SHIFT 2 *(Numerical)*

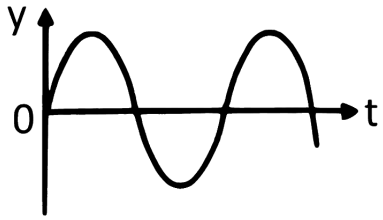
◆ Graphs and phase relations 10 Qs

73. A particle is performing S.H.M. starting from extreme position. Graphical representation shows that between displacement and acceleration, there is a phase difference of

MHT CET 2025 · 26 APR · SHIFT 2

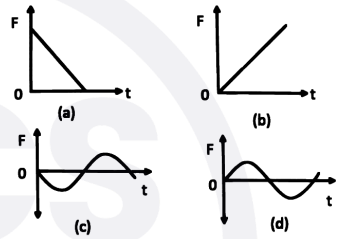
(a) πrad (b) $\frac{\pi}{2}$ra$^{\pi}$ d (c) $\frac{\pi}{4}$ra$^{\pi}$ d (d) 0 rad

74. For a particle performing S.H.M. the displacement - time graph is shown.



For that particle the force - time graph is correctly shown in graph

MHT CET 2025 · 19 APR · SHIFT 2



(a) (a) (b) (b) (c) (c) (d) (d)

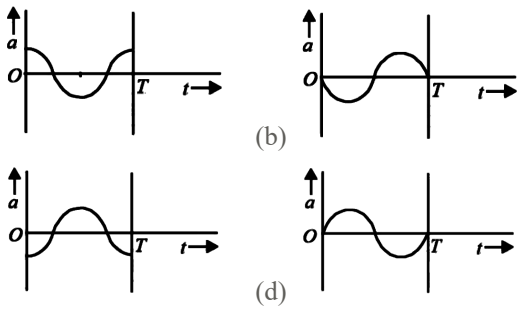
75. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is:

NEET 2020 · PHASE 1

(a) $\frac{\pi}{2}ra^{3\pi}\ d$ (b) $\frac{\pi}{2}ra^{\pi}\ d$
(c) zero (d) π rad

76. The oscillation of a body on a smooth horizontal surface is represented by the equation, X = A cos(ωt)
where X = displacement at time t
ω = frequency of oscillation
Which one of the following graphs shows correctly the variation of a with t?
Here a = acceleration at time t
T = time period

AIPMT 2014



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77. A particle of mass m oscillates along x-axis according to equation $x = a\sin\omega t$. The nature of the graph between momentum and displacement of the particle is

NEET 2013

(a) Circle
(b) Hyperbola
(c) Ellipse
(d) Straight line passing through origin

78. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is

AIPMT 2007

(a) π (b) $0.707\ \pi$ (c) zero (d) $0.5\ \pi$

79. Which one of the following statements is true for the speed v and the acceleration a of a particle executing simple harmonic motion?

AIPMT 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.

80. When a particle executes Simple Harmonic Motion, the nature of graph of velocity as a function of displacement will be:

JEE MAIN 2022 · 26 JUL · SHIFT 1

(a) Circular (b) Elliptical
(c) Sinusoidal (d) Straight line

81. A particle executes S.H.M., the graph of velocity as a function of displacement is:

JEE MAIN 2021 · 26 FEB · SHIFT 2

(a) a parabola (b) a helix
(c) an ellipse (d) a circle

82. When a particle executes SHM, the nature of graphical representation of velocity as a function of displacement is:

JEE MAIN 2021 · 24 FEB · SHIFT 2

(a) circular (b) straight line
(c) parabolic (d) elliptical

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TOPIC 03

Energy in SHM

51 PYQs · Easy 51 · Medium 0 · Difficult 0 | MHT CET 20 · NEET 12 · JEE 19

Concepts covered: Total energy (13) · KE and PE at a displacement (29) · Energy graphs and energy frequency (9)

LEVEL 1 · EASY 51 questions

◆ Total energy 13 Qs

83. The total energy of a particle executing SHM is E. If the amplitude is doubled and the frequency is halved, the new total energy will be

MHT CET 2026 · 19 MAY · SHIFT 2

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

84. There is a body having mass m and performing SHM with amplitude ' a '. There is a restoring force $F=-Kx$, where x is the displacement. The total energy of the body depends upon which of the following?

MHT CET 2026 · 11 APR · SHIFT 1

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

85. A body of mass 'm' performs linear S.H.M. given by equation $x=P\sin\omega t+Q\sin\left(\omega t+\frac{\pi}{2}\right)$. The total energy of the particle at any instant is

MHT CET 2021 · 22 SEP · SHIFT 2

(a) $\frac{1}{2}\ \mathrm{m}\omega^2\mathrm{PQ}$ (b) $\frac{1}{2}\frac{\mathrm{m}\omega^2}{\mathrm{P}^2\mathrm{Q}^2}$

(c) $\frac{1}{2}m\omega^2\left(P^2+Q^2\right)$ (d) $\frac{1}{2}m\omega^2p^2Q^2$

86. If the amplitude of linear S.H.M. is decreased then

MHT CET 2021 · 22 SEP · SHIFT 1

(a) its period and total energy will increase.
(b) its period will increase and total energy will decrease
(c) its period and total energy will decrease.
(d) its period will not change but total energy will decrease

87. The total energy of a simple harmonic oscillaior is proportional to

MHT CET 2019 · 3 MAY · SHIFT 1

(a) square of this ampitude
(b) square root of displacement
(c) amplitude
(d) frequency

88. The quantity which does not vary periodically for a particle performing SHM is

MHT CET 2019 · 2 MAY · SHIFT 1

(a) acceleration (b) total energy
(c) displacement (d) velocity

89. The particle executing simple harmonic motion has a kinetic energy K0cos2ωt. The maximum values of the potential energy and the total energy are respectively

AIPMT 2007

(a) K0/2 and K0 (b) K0 and 2K0
(c) K0 and K0 (d) 0 and 2K0

90. The total energy of particle performing SHM depend on

AIPMT 2001

(a) k, a, m (b) k, a (c) k, a, x (d) k, x

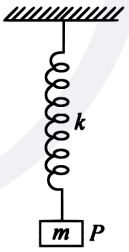
91. A linear harmonic oscillator of force constant $2\times10^6\ \mathrm{N/m}$ and amplitude $0.01\ \mathrm{m}$ has a total mechanical energy of 160 J. Its

AIPMT 1996

(a) P.E. is 160 J (b) P.E. is zero
(c) P.E. is 100 J (d) P.E. is 120 J

92. In simple harmonic motion, the total mechanical energy of given system is E. If mass of oscillating particle P is doubled then the new energy of the system for same amplitude is:

JEE MAIN 2024 · 4 APR · SHIFT 2



(a) $E/\sqrt{2}$ (b) $2E$ (c) $E\sqrt{2}$ (d) E

93. For a body executing S.H.M.:

(1) Potential energy is always equal to its K.E.

(2) Average potential and kinetic energy over any given time interval are always equal. (3) Sum of the kinetic and potential energy at any point of time is constant.

(4) Average K.E. in one time period is equal to average potential energy in one time period. Choose the most appropriate option from the options given below:

JEE MAIN 2021 · 31 AUG · SHIFT 2

(a) (3) and (4) (b) only (3)
(c) (2) and (3) (d) only (2)

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94. The total energy of particle, executing simple harmonic motion is
AIEEE 2004
(a) independent of x (b) $\propto x^2$
(c) $\propto x$ (d) $\propto x^{1/2}$

95. 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.

◆ KE and PE at a displacement 29 Qs

96. For a particle executing S.H.M., the potential energy is n times the kinetic energy when its displacement from mean position is $\left(\frac{2\sqrt{2}}{3}\right)A$, where A is the amplitude of S.H.M. The value of n is
MHT CET 2026 · 20 APR · SHIFT 2
(a) 2 (b) 4 (c) 6 (d) 8

97. For a particle performing linear S.H.M. of amplitude 'r', the potential energy is 'λ' times its total energy. The displacement of particle is
MHT CET 2026 · 17 APR · SHIFT 2
(a) $r\lambda$ (b) $\frac{r}{\lambda}$ (c) $r\sqrt{\lambda}$ (d) $\frac{r}{\sqrt{\lambda}}$

98. For a particle executing S.H.M., its potential energy is 8 times its kinetic energy at a certain displacement 'x' from the mean position. If 'A' is the amplitude of S.H.M., the value of 'x' is
MHT CET 2026 · 17 APR · SHIFT 1
(a) $\frac{2}{\sqrt{3}}A$ (b) $\frac{\sqrt{2}}{3}A$ (c) $\frac{2\sqrt{2}}{3}A$ (d) $\frac{3}{\sqrt{2}}A$

99. The maximum potential energy of a block executing S.H.M. is E and amplitude of oscillation is 'A'. The kinetic energy of the block at amplitude A/2 is
MHT CET 2026 · 16 APR · SHIFT 2
(a) $\frac{3E}{4}$ (b) E (c) $\frac{2E}{4}$ (d) $\frac{5E}{4}$

100. For a particle P performing S.H.M., when displacement is 'x', potential energy and restoring force acting on it is denoted by 'E' and 'F' respectively. The relation between x, E and F is
MHT CET 2026 · 16 APR · SHIFT 1
(a) $\frac{2E}{F} - x = 0$ (b) $\frac{2E}{F} + x = 0$
(c) $\frac{2F}{x} + F = 0$ (d) $\frac{2E}{x} - F = 0$

101. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is (in cm)
MHT CET 2026 · 13 APR · SHIFT 2
(a) 1 (b) 2 (c) 3 (d) 4

102. A particle is executing S.H.M. of amplitude 'A'. When the potential energy of the particle is half of its maximum value during the oscillation, its displacement from the equilibrium position is
MHT CET 2025 · 23 APR · SHIFT 2
(a) $\pm\frac{A}{4}$ (b) $\pm\frac{A}{2}$ (c) $\pm\frac{A}{\sqrt{3}}$ (d) $\pm\frac{A}{\sqrt{2}}$

103. A particle is executing linear S.H.M. starting from mean position. The ratio of the kinetic energy to the potential energy of the particle at a point of half the amplitude is
MHT CET 2025 · 23 APR · SHIFT 1
(a) 2 : 1 (b) 3 : 1 (c) 4 : 1 (d) 8 : 1

104. For a particle executing S.H.M., its potential energy is 8 times its kinetic energy at certain displacement 'x' from the mean position. If 'A' is the amplitude of S.H.M the value of 'x' is
MHT CET 2023 · 11 MAY · SHIFT 1
(a) $\frac{A\sqrt{2}}{3}$ (b) $A\sqrt{3}$ (c) $\frac{2\sqrt{2}A}{3}$ (d) $\frac{A}{\sqrt{2}}$

105. The amplitude of a particle executing S.H.M. is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is
MHT CET 2023 · 10 MAY · SHIFT 1
(a) 1 cm (b) 2 cm (c) 3 cm (d) 4 cm

106. A particle is vibrating in S.H.M. with an amplitude of 4 cm. At what displacement from the equilibrium position is its energy half potential and half kinetic?
MHT CET 2023 · 9 MAY · SHIFT 2
(a) 1 cm (b) $\sqrt{2}$ cm (c) 2 cm (d) $2\sqrt{2}$ cm

107. A particle performing S.H.M. when displacement is 'x', the potential energy and restoring force acting on it are denoted by 'E' and 'F' respectively. The relation between x, E and F is
MHT CET 2021 · 23 SEP · SHIFT 1
(a) $\frac{2E}{F} - x^2 = 0$ (b) $\frac{2E}{F} + x^2 = 0$
(c) $\frac{2E}{F} + x = 0$ (d) $\frac{2E}{F} - x = 0$

108. A body is performing S.H.M. of amplitude 'A'. The displacement of the body from a point where kinetic energy is maximum to a point where potential energy is maximum, is
MHT CET 2021 · 23 SEP · SHIFT 1
(a) zero (b) $\pm A$ (c) $\pm\frac{A}{2}$ (d) $\pm\frac{A}{4}$

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109. For a particle performing SHM when displacement is x, the potential energy and restoring force acting on it is denoted by E and F, respectively. The relation between x, E and F is

MHT CET 2020 · 16 OCT · SHIFT 1

(a) $\frac{E}{F} + x = 0$ (b) $\frac{2E}{F} - x = 0$
(c) $\frac{2E}{F} + x = 0$ (d) $\frac{E}{F} - x = 0$

110. A particle executing simple harmonic motion with amplitude A has the same potential and kinetic energies at the displacement

NEET 2024

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

111. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is

AIPMT 2003

(a) $\frac{2}{3}$ E (b) $\frac{1}{8}$ E (c) $\frac{1}{4}$ E (d) $\frac{1}{2}$ E

112. Displacement between maximum potential energy position and maximum kinetic energy position for a particle executing simple harmonic motion is

AIPMT 2002

(a) $\pm a/2$ (b) $+a$ (c) $\pm a$ (d) -1

113. In a simple harmonic motion, when the displacement is one-half the amplitude, what fraction of the total energy is kinetic?

AIPMT 1995

(a) 1/2 (b) 3/4 (c) zero (d) 1/4

114. A body executes simple harmonic motion with an amplitude A. At what displacement from the mean position is the potential energy of the body is one fourth of its total energy?

AIPMT 1993

(a) $A/4$
(b) $A/2$
(c) $3A/4$
(d) Some other fraction of A

115. A particle executes SHM of amplitude A. The distance from the mean position when its kinetic energy becomes equal to its potential energy is:

JEE MAIN 2023 · 13 APR · SHIFT 2

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

116. A particle is executing simple harmonic motion (SHM). The ratio of potential energy and kinetic energy of the particle when its displacement is half of its amplitude will be

JEE MAIN 2023 · 12 APR · SHIFT 1

(a) 1: 1 (b) 1: 4 (c) 2: 1 (d) 1: 3

117. The maximum potential energy of a block executing simple harmonic motion is 25 J. A is amplitude of oscillation. At A/2, the kinetic energy of the block is

JEE MAIN 2023 · 31 JAN · SHIFT 1

(a) 9.75 J (b) 37.5 J (c) 18.75 J (d) 12.5 J

118. A particle starts executing simple harmonic motion (SHM) of amplitude 'a' and total energy E. At any instant, its kinetic energy is $\frac{3E}{4}$ then its displacement 'y' is given by:

JEE MAIN 2021 · 27 JUL · SHIFT 1

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

119. In a simple harmonic oscillation, what fraction of total mechanical energy is in the form of kinetic energy, when the particle is midway between mean and extreme position.

JEE MAIN 2021 · 25 JUL · SHIFT 2

(a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c) $\frac{1}{3}$ (d) $\frac{1}{4}$

120. For what value of displacement the kinetic energy and potential energy of a simple harmonic oscillation become equal?

JEE MAIN 2021 · 17 MAR · SHIFT 1

(a) x = $\frac{A}{2}$ (b) x = ± A
(c) x = ± $\frac{A}{\sqrt{2}}$ (d) x = 0

121. A particle is executing simple harmonic motion (SHM) of amplitude A, along the x-axis, about x = 0. When its potential Energy (PE) equals kinetic energy (KE), the position of the particle will be:

JEE MAIN 2019 · 9 JAN · SHIFT 2

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

122. 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?

AIEEE 2003

(a) $K.E$ is maximum when $x = 0$
(b) $T.E$ is zero when $x = 0$
(c) $K.E$ is maximum when x is maximum
(d) $P.E$ is maximum when $x = 0$

123. When the displacement of a simple harmonic oscillator is one third of its amplitude, the ratio of total energy to the kinetic energy is $\frac{x}{8}$, where $x =$ _____.

JEE MAIN 2024 · 29 JAN · SHIFT 1 *(Numerical)*

124. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is: _____ cm

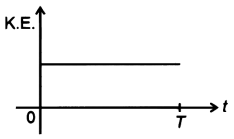
JEE MAIN 2023 · 1 FEB · SHIFT 1 *(Numerical)*

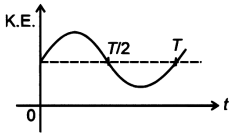
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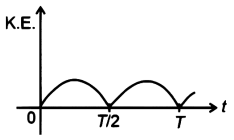
◆ Energy graphs and energy frequency 9 Qs

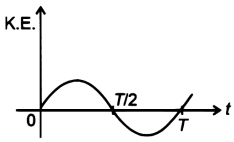
125. For a simple pendulum, having time period T, the variation of kinetic energy (K.E.) with time (t) is represented by:

NEET 2026

(a) 

(b) 

(c) 

(d) 

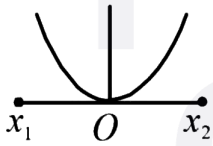
126. A body is executing simple harmonic motion with frequency 'n', the frequency of its potential energy is:

NEET 2021

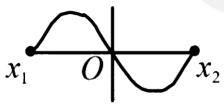
(a) 4n (b) n (c) 2n (d) 3n

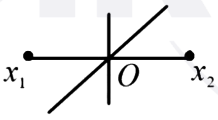
127. A particle of mass m oscillates with simple harmonic motion between points x1 and x2, the equilibrium position being O. Its potential energy is plotted. It will be as given below in the graph

AIPMT 2003

(a) 

(b) 

(c) 

(d) 

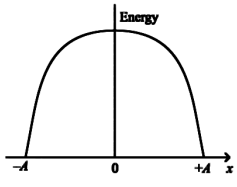
128. A loaded vertical spring executes S.H.M. with a time period of $4\,\text{sec}$. The difference between the kinetic energy and potential energy of this system varies with a period of

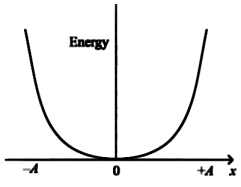
AIPMT 1994

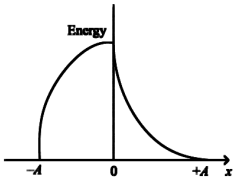
(a) 2 sec (b) 1 sec (c) 8 sec (d) 4 sec

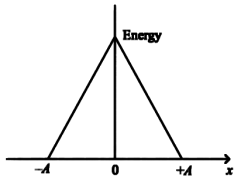
129. Which graph represents the difference between total energy and potential energy of a particle executing SHM vs its distance from mean position?

JEE MAIN 2023 · 13 APR · SHIFT 1

(a) 

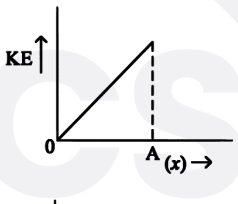
(b) 

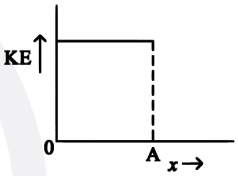
(c) 

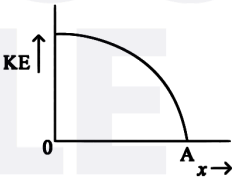
(d) 

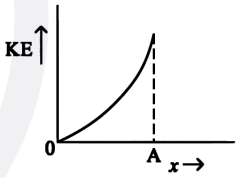
130. The variation of kinetic energy (KE) of a particle executing simple harmonic motion with the displacement (x) starting from mean position to extreme position (A) is given by

JEE MAIN 2023 · 11 APR · SHIFT 1

(a) 

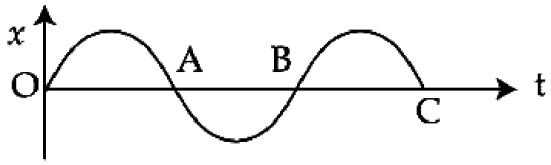
(b) 

(c) 

(d) 

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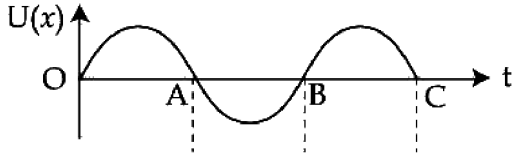
131. The variation of displacement with time of a particle executing free simple harmonic motion is shown in the figure.



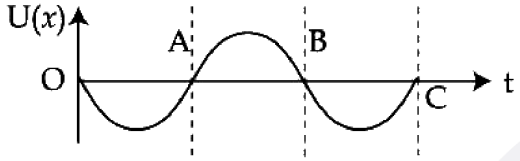
The potential energy U(x) versus time (t) plot of the particle is correctly shown in figure:

JEE MAIN 2021 · 27 AUG · SHIFT 1

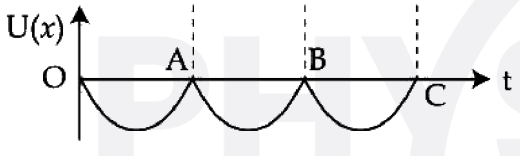
(a)



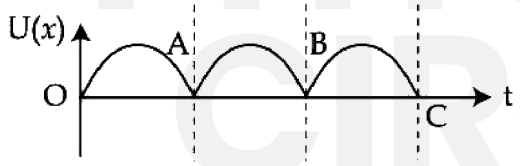
(b)



(c)



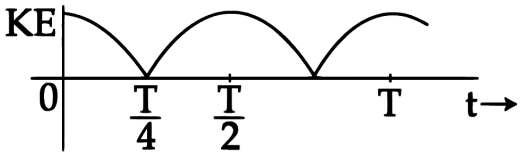
(d)



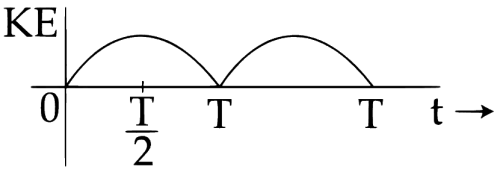
132. A particle is executing simple harmonic motion with a time period T. At time t = 0, it is at its position of equilibrium. The kinetic energy – time graph of the particle will look like:

JEE MAIN 2017

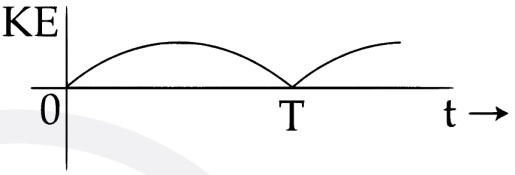
(a)



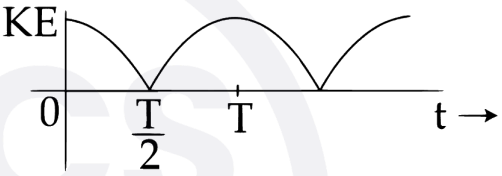
(b)



(c)



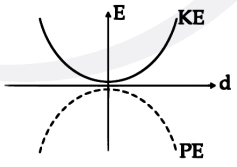
(d)



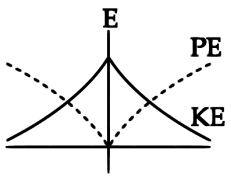
133. For a simple pendulum, a graph is plotted between its kinetic energy (KE) and potential energy (PE) against its displacement d. Which one of the following represents these correctly? (*graphs are schematic and not drawn to scale*)

JEE MAIN 2015

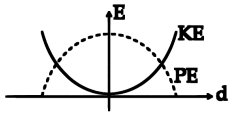
(a)



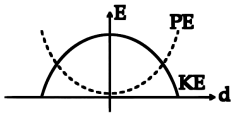
(b)



(c)



(d)



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TOPIC 04

Simple Pendulum

50 PYQs · Easy 50 · Medium 0 · Difficult 0 | MHT CET 21 · NEET 10 · JEE 19

Concepts covered: Time period, length and mass (20) · Two pendulums in phase (2) · Energy, speed and tension of a pendulum (9) · Effect of g and seconds pendulum (7) · Pendulum in a lift or vehicle (10) · Bob in a liquid (2)

LEVEL 1 · EASY 50 questions

◆ Time period, length and mass 20 Qs

134. The bob of a simple pendulum is a hollow sphere with a small hole in the bottom. It is filled with sand and set into oscillation. Its periodic time (T) is measured at regular intervals. As the sand starts coming out we find that.

MHT CET 2026 · 20 MAY · SHIFT 1

(a) T increases with time
(b) T does not change with time
(c) T first decreases and then increases
(d) T first increases and then decreases

135. A simple pendulum consists of a hollow sphere filled with mercury. As the mercury begins to leak out slowly through a small hole at the bottom, the time period of the pendulum will

MHT CET 2026 · 19 MAY · SHIFT 2

(a) decrease continuously until the sphere is empty.
(b) first increase and then decrease to the original value.
(c) remain constant throughout.
(d) increase continuously until the sphere is empty.

136. A pendulum clock is running slow, In order to correct it, we should

MHT CET 2026 · 15 APR · SHIFT 2

(a) reduce the amplitude of oscillation.
(b) reduce the mass of the bob.
(c) reduce the length of pendulum.
(d) increase the length of pendulum.

137. The ratio of the frequencies of two simple pendulums is 4 : 3 at the same place. The ratio of their respective lengths is

MHT CET 2025 · 26 APR · SHIFT 1

(a) 3 : 4 (b) 4 : 3 (c) 9 : 16 (d) 16 : 9

138. The length of the simple pendulum is made 3 times the original length. If ' T ' is its original time period, then the new time period will be

MHT CET 2025 · 21 APR · SHIFT 2

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

139. A simple pendulum of length ' l ' has a brass bob attached at its lower end. It's period is ' T '. A steel bob of the same size, having density ' x ' times that of brass, replaces the brass bob. Its length is then so changed that the period becomes ' 2 T '. What is the new length?

MHT CET 2024 · 10 MAY · SHIFT 2

(a) $4lx$ (b) $\frac{4l}{x}$ (c) $4l$ (d) $2l$

140. The period of a simple pendulum gets doubled when

MHT CET 2024 · 3 MAY · SHIFT 2

(a) its length is doubled.
(b) its length is made four times.
(c) its length is made half.
(d) the mass of the bob is doubled.

141. A rubber ball filled with water, having a small hole is used as the bob of a simple pendulum. The time period of such a pendulum

MHT CET 2023 · 9 MAY · SHIFT 1

(a) is a constant.
(b) decreases with time.
(c) increases with time.
(d) first increases and then decreases, finally having same value as at the beginning.

142. A pendulum clock is running fast. To correct its time, we should

MHT CET 2021 · 21 SEP · SHIFT 2

(a) reduce the mass of the bob.
(b) reduce the amplitude of oscillation.
(c) increase the length of the pendulum.
(d) reduce the length of the pendulum.

143. If the mass of the bob in a simple pendulum is increased to thrice its original mass and its length is made half its original length, then the new time period of oscillation is $\frac{x}{2}$ times its original time period. Then the value of x is:

NEET 2024

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

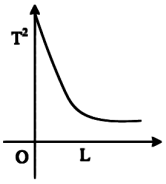
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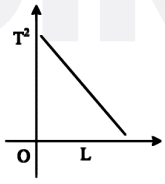
144. Two masses MA and MB are hung from two strings of length lA and lB respectively. They are executing SHM with frequency relation fA = 2fB, then relation
AIPMT 2000
(a) $l_A = \frac{l_B}{4}$ does not depend on mass
(b) $l_A = 4l_B$, does not depend on mass
(c) $l_A = 2l_B$ and $M_A = 2M_B$
(d) $l_A = \frac{l_B}{2}$ and $M_A = \frac{M_B}{2}$.

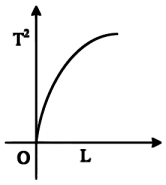
145. The time period of a simple pendulum is 2 s. If its length is increased by 4 times, then its period becomes
AIPMT 1999
(a) 16 s (b) 12 s (c) 8 s (d) 4 s

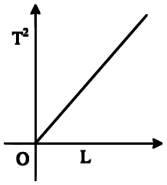
146. If the length of a simple pendulum is increased by 2%, then the time period
AIPMT 1997
(a) increases by 1% (b) decreases by 1%
(c) increases by 2% (d) decreases by 2%

147. A simple pendulum of string length 30 cm performs 20 oscillations in 10 s. The length of the string required for the pendulum to perform 40 oscillations in the same time duration is ____ cm. [Assume that the mass of the pendulum remains same.]
JEE MAIN 2026 · 23 JAN · SHIFT 1
(a) 0.75 (b) 7.5 (c) 15 (d) 120

148. Choose the correct length (L) versus square of the time period (T^2) graph for a simple pendulum executing simple harmonic motion.
JEE MAIN 2023 · 1 FEB · SHIFT 2
(a) 

(b) 

(c) 

(d) 

149. The motion of a simple pendulum executing S.H.M. is represented by the following equation. $y = A\sin(\pi t + \phi)$, where time is measured in second. The length of pendulum is
JEE MAIN 2022 · 29 JUN · SHIFT 2
(a) 97.23 cm (b) 25.3 cm (c) 99.4 cm (d) 406.1 cm

150. T0 is the time period of a simple pendulum at a place. if the length of the pendulum is reduced to $\frac{1}{16}$ times of its initial value, the modified time period is:
JEE MAIN 2021 · 22 JUL · SHIFT 2
(a) 4 T0 (b) $\frac{1}{4}$ T0 (c) T0 (d) 8π T0

151. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillating bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would
AIEEE 2005
(a) first decrease and then increase to the original value
(b) first increase and then decrease to the original value
(c) increase towards a saturation value
(d) remain unchanged

152. 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
AIEEE 2003
(a) 11% (b) 21% (c) 42% (d) 10%

153. A child swinging on a swing in sitting position, stands up, then the time period of the swing will
AIEEE 2002
(a) increase
(b) decrease
(c) remains same
(d) increases of the child is long and decreases if the child is short

◆ Two pendulums in phase 2 Qs

154. Two simple pendulums of length 0.5 m and 2.0 m respectively are given small linear displacement in one direction at the same time. They will again be in the same phase when the pendulum of shorter length has completed oscillations
AIPMT 1998
(a) 5 (b) 1 (c) 2 (d) 3

155. Two simple pendulums of length 1 m and 4 m respectively are both given small displacement in the same direction at the same instant. They will be again in phase after the shorter pendulum has completed number of oscillations equal to:
JEE MAIN 2013 · 9 APR · SHIFT 1
(a) 2 (b) 7 (c) 5 (d) 3

◆ Energy, speed and tension of a pendulum 9 Qs

156. At a place, the length of the oscillating simple pendulum is made $\frac{1}{4}$ times keeping amplitude same then the total energy will be
MHT CET 2025 · 26 APR · SHIFT 1
(a) 2 times (b) 4 times (c) 8 times (d) 16 times

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157. If the length of the oscillating simple pendulum is made $\frac{1}{3}$ times the original keeping amplitude same then increase in its total energy at a place will be

MHT CET 2025 · 19 APR · SHIFT 2

(a) 3 times (b) 2 times (c) 9 times (d) 5 times

158. A simple pendulum of length ' L ' has mass ' M ' and it oscillates freely with amplitude ' A '. At extreme position, its potential energy is

MHT CET 2024 · 11 MAY · SHIFT 1

(a) $\frac{\mathrm{MgA}^2}{\mathrm{L}}$ (b) $\frac{2\mathrm{MgA}^2}{\mathrm{L}}$ (c) $\frac{\mathrm{MgA}}{2\,\mathrm{L}}$ (d) $\frac{\mathrm{MgA}^2}{2\,\mathrm{L}}$

159. A bob of simple pendulum of mass 'm' perform SHM with amplitude 'A' and period 'T'. Kinetic energy of pendulum of displacement $x = \frac{A}{2}$ will be

MHT CET 2021 · 23 SEP · SHIFT 2

(a) $\frac{2\,\mathrm{m}\pi^2 A}{3\,\mathrm{T}^2}$ (b) $\frac{3\mathrm{m}\pi^2\mathrm{A}}{2\mathrm{T}}$ (c) $\frac{2\,\mathrm{m}\pi\mathrm{A}^2}{3\,\mathrm{T}}$ (d) $\frac{3\,\mathrm{m}\pi^2\,\mathrm{A}^2}{2\,\mathrm{T}^2}$

160. A simple pendulum of length L has mass m and it oscillates freely with amplitude A. At extreme position, its potential energy is (g = acceleration due to gravity)

MHT CET 2020 · 16 OCT · SHIFT 1

(a) $\frac{mgA}{L}$ (b) $\frac{mgA}{2l}$ (c) $\frac{mgA^2}{L}$ (d) $\frac{mgA^2}{2L}$

161. The sum of kinetic energy and potential energy of a simple pendulum bob is 0.02 joule. The speed of the simple pendulum bob at equilibrium position is approximately:

(Consider mass of the bob = 20 g)

NEET 2026

(a) 0.2 m/s (b) 1.41 m/s (c) 14.1 m/s (d) 2.0 m/s

162. The bob of simple pendulum having length l, is displaced from mean position to an angular position q with respect to vertical. If it is released, then velocity of bob at equilibrium position

AIPMT 2000

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

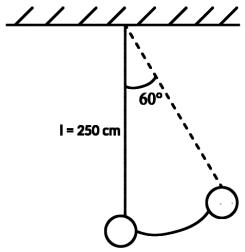
163. The angular velocity and the amplitude of a simple pendulum is ω and a respectively. At a displacement x from the mean position if its kinetic energy is T and potential energy is V, then the ratio of T to V is

AIPMT 1991

(a) $\frac{(a^2-x^2\omega^2)}{x^2\omega^2}$ (b) $\frac{x^2\omega^2}{(a^2-x^2\omega^2)}$
(c) $\frac{(a^2-x^2)}{x^2}$ (d) $\frac{x^2}{(a^2-x^2)}$

164. A pendulum is suspended by a string of length 250 cm. The mass of the bob of the pendulum is 200 g. The bob is pulled aside until the string is at 60° with vertical as shown in the figure. After releasing the bob, the maximum velocity attained by the bob will be _____ ms⁻1. (if g = 10 m/s2)

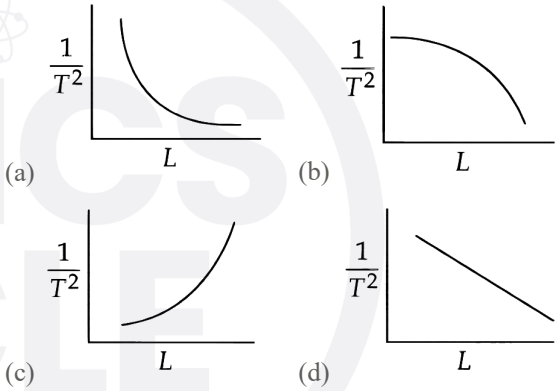
JEE MAIN 2022 · 28 JUN · SHIFT 1 *(Numerical)*



◆ Effect of g and seconds pendulum 7 Qs

165. Using a simple pendulum experiment g is determind by measuring its time period T. Which of the following plots represent the correct relation between the pendulum length L and time period T?

JEE MAIN 2026 · 22 JAN · SHIFT 2



166. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Time period of a simple pendulum is longer at the top of a mountain than that at the base of the mountain.

Reason (R): Time period of a simple pendulum decreases with increasing value of acceleration due to gravity and vice-versa.

In the light of the above statements, choose the most appropriate answer from the options given below:

JEE MAIN 2025 · 29 JAN · SHIFT 1

(a) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(b) (A) is true but (R) is false.
(c) Both (A) and (R) are true and (R) is the correct explanation of (A).
(d) (A) is false but (R) is true.

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167. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): A simple pendulum is taken to a planet of mass and radius, 4 times and 2 times, respectively, that of the Earth. The time period of the pendulum remains same on earth and the planet.
Reason (R): The mass of the pendulum remains unchanged at Earth and the other planet. In the light of the above statements, choose the correct answer from the options given below:
JEE MAIN 2025 · 22 JAN · SHIFT 2
(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) (A) is false but (R) is true
(c) (A) is true but (R) is false
(d) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

168. T is the time period of simple pendulum on the earth's surface. Its time period becomes x T when taken to a height R (equal to earth's radius) above the earth's surface. Then, the value of x will be:
JEE MAIN 2023 · 25 JAN · SHIFT 1
(a) 4 (b) $\frac{1}{2}$ (c) 2 (d) $\frac{1}{4}$

169. Given below are two statements:
Statement I: A second's pendulum has a time period of 1 second.
Statement II: It takes precisely one second to move between the two extreme positions. In the light of the above statements, choose the correct answer from the options given below:
JEE MAIN 2021 · 26 FEB · SHIFT 2
(a) Both Statement I and Statement II are false
(b) Statement I is false but Statement II is true
(c) Both Statement I and Statement II are true
(d) Statement I is true but Statement II is false

170. If the time period of a two meter long simple pendulum is 2s, the acceleration due to gravity at the place where pendulum is executing S.H.M. is:
JEE MAIN 2021 · 25 FEB · SHIFT 1
(a) 16 m/s2 (b) $2\pi^2$ ms^{-2}
(c) π^2 ms^{-2} (d) 9.8 ms^{-2}

171. The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of simple pendulum on the Earth is 2 s. The period of oscillation of the same pendulum on the planet would be:
JEE MAIN 2019 · 11 JAN · SHIFT 2
(a) $\frac{\sqrt{3}}{2}$ s (b) $\frac{3}{2}$ s (c) $\frac{2}{\sqrt{3}}$ s (d) $2\sqrt{3}$ s

◆ Pendulum in a lift or vehicle 10 Qs

172. The time period of a simple pendulum inside a stationary lift is $\sqrt{5}$ s. The time period when the lift moves upwards with an acceleration $\frac{g}{4}$ is (g = acceleration due to gravity)
MHT CET 2026 · 13 MAY · SHIFT 2
(a) $\sqrt{5}$ s (b) $2\sqrt{5}$ s
(c) $(2+\sqrt{5})$ s (d) 2 s

173. The time period of a simple pendulum inside a stationary lift is $\sqrt{3}$ second. When the lift moves upwards with an acceleration $g/3$, the time period will be (g = acceleration due to gravity)
MHT CET 2025 · 19 APR · SHIFT 1
(a) 1.5 s (b) 2 s (c) $\sqrt{3}$ s (d) 3 s

174. Choose the correct answer. When a point of suspension of pendulum is moved vertically upward with acceleration ' a ', its period of oscillation
MHT CET 2024 · 2 MAY · SHIFT 1
(a) decreases
(b) increases
(c) remains same
(d) some times increases and some times decreases

175. In a stationary lift, time period of a simple pendulum is 'T'. The lift starts accelerating downwards with acceleration $\left(\frac{g}{4}\right)$, then the time period of the pendulum will be
MHT CET 2023 · 12 MAY · SHIFT 2
(a) $\frac{\sqrt{3}}{2}$ T (b) $\frac{2}{\sqrt{3}}$ T (c) $\frac{3}{4}$ T (d) $\frac{4}{3}$ T

176. The time period of a simple pendulum inside a stationary lift is 'T'. When the lift starts accelerating upwards with an acceleration $\left(\frac{g}{3}\right)$, the time period of the pendulum will be
MHT CET 2023 · 11 MAY · SHIFT 1
(a) $\frac{\sqrt{5}}{2}$ T (b) $\frac{\sqrt{3}}{2}$ T (c) $\frac{2\,\mathrm{T}}{\sqrt{3}}$ (d) $\frac{2\,\mathrm{T}}{\sqrt{5}}$

177. A person measures a time period of a simple pendulum inside a stationary lift and finds it to be T. If the lift starts accelerating upwards with an acceleration $\left(\frac{g}{3}\right)$, the time period of the pendulum will be
MHT CET 2019 · 3 MAY · SHIFT 1
(a) $\frac{T}{\sqrt{3}}$ (b) $\sqrt{3}\frac{T}{2}$ (c) $\sqrt{3}T$ (d) $\frac{T}{3}$

178. A seconds pendulum is mounted in a rocket. Its period of oscillation will decrease when rocket is
AIPMT 1994
(a) moving down with uniform acceleration
(b) moving around the earth in geostationary orbit
(c) moving up with uniform velocity
(d) moving up with uniform acceleration

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179. An oscillating simple pendulum of time period T_o is placed in a lift which is accelerating upwards with $2.5\ \mathrm{m/s^2}$. The time period of pendulum in the lift will be (if $g = 10\ \mathrm{m/s^2}$)

JEE MAIN 2022 · 30 JUL · SHIFT 2

(a) T_o (b) $\frac{2}{\sqrt{5}}T_o$ (c) $\frac{2}{\sqrt{3}}T_o$ (d) $\frac{T_o}{4}$

180. Time period of a simple pendulum in a stationary lift is 'T'. If the lift accelerates with $\frac{g}{6}$ vertically upwards then the time period will be:
(Where g = acceleration due to gravity)

JEE MAIN 2022 · 26 JUN · SHIFT 1

(a) $\sqrt{\frac{6}{5}}T$ (b) $\sqrt{\frac{5}{6}}T$ (c) $\sqrt{\frac{6}{7}}T$ (d) $\sqrt{\frac{7}{6}}T$

181. Time period of a simple pendulum is T inside a lift when the lift is stationary. If the lift moves upwards with an acceleration g/2, the time period of pendulum will be:

JEE MAIN 2021 · 16 MAR · SHIFT 1

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

◆ Bob in a liquid 2 Qs

182. A simple pendulum has a time period 'T' in air. Its time period when it is completely immersed in a liquid of density one eighth the density of the material of bob is

MHT CET 2023 · 13 MAY · SHIFT 1

(a) $\left(\sqrt{\frac{7}{8}}\right)\mathrm{T}$ (b) $\left(\sqrt{\frac{5}{8}}\right)\mathrm{T}$
(c) $\left(\sqrt{\frac{3}{8}}\right)\mathrm{T}$ (d) $\left(\sqrt{\frac{8}{7}}\right)\mathrm{T}$

183. A simple pendulum oscillating in air has a period of $\sqrt{3}\,\mathrm{s}$. If it is completely immersed in non- viscous liquid, having density $\left(\frac{1}{4}\right)^{\text{th}}$ of the material of the bob, the new period will be :-

NEET 2023

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

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TOPIC 05

Spring Systems

36 PYQs · Easy 36 · Medium 0 · Difficult 0 | MHT CET 14 · NEET 7 · JEE 15

Concepts covered: Spring constant and cut springs (6) · Time period of a spring-mass system (11) · Vertical spring and static extension (1) · Equal masses on different springs (7) · Series and parallel springs (11)

LEVEL 1 · EASY 36 questions

◆ Spring constant and cut springs 6 Qs

184. A spring has a certain mass suspended from it and its period of vertical oscillations is T_1. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillations is now T_2. The ratio of T_2/T_1 is

MHT CET 2024 · 2 MAY · SHIFT 2

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

185. A spring has a certain mass suspended from it and its period for vertical oscillations is 'T_1'. The spring is now cut in to two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillations is now 'T_2'. The ratio T_1/T_2 is

MHT CET 2023 · 9 MAY · SHIFT 2

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

186. The time period of 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

AIPMT 2003

(a) T/4 (b) T (c) T/2 (d) 2T

187. The frequency of oscillation of a mass m suspended by a spring is v_1. If the length of the spring is cut to half, the same mass oscillates with frequency v_2. The value of v_2/v_1 is ____.

JEE MAIN 2026 · 8 APR · SHIFT 2

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

188. A spring of force constant $15\,\mathrm{N/m}$ is cut into two pieces. If the ratio of their length is $1:3$, then the force constant of smaller piece is ____ $\mathrm{N/m}$.

JEE MAIN 2026 · 24 JAN · SHIFT 1

(a) 20 (b) 45 (c) 60 (d) 15

189. 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

◆ Time period of a spring-mass system 11 Qs

190. A spring of force constant 180 N/m is loaded with a mass 0.20 kg. The amplitude of oscillations is 4 cm. When mass comes to equillibrium position, its velocity in m/s is

MHT CET 2026 · 20 MAY · SHIFT 1

(a) 12 (b) 1.2 (c) 0.12 (d) 0.012

191. A body of mass 64 g is made to oscillate turn by turn on two different springs A and B. Spring A and B has force constant 4 N/m and 16 N/m respectively. If T_1 and T_2 are the period of oscillations of springs A and B respectively, then $(T_1+T_2)/(T_1-T_2)$ will be

MHT CET 2026 · 15 MAY · SHIFT 1

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

192. A spring force constant 180 N/m is loaded with a mass 0.2 kg. The amplitude of oscillations is 4 cm. When mass comes to equilibrium position, its velocity is

MHT CET 2026 · 19 APR · SHIFT 2

(a) 0.012 m/s (b) 0.12 m/s
(c) 1.2 m/s (d) 12 m/s

193. If the period of a oscillation of mass ' m ' suspended from a spring is 2 s, then the period of suspended mass ' 4 m ' with the same spring will be

MHT CET 2025 · 20 APR · SHIFT 1

(a) 1 s (b) 3 s (c) 2 s (d) 4 s

194. A body of mass 64 g is made to oscillate turn by turn on two different springs A and B. Spring A and B has force constant $4\frac{\mathrm{N}}{\mathrm{m}}$ and $16\frac{\mathrm{N}}{\mathrm{m}}$ respectively. If T_1 and T_2 are period of oscillations of springs A and B respectively, then $\frac{T_1+T_2}{T_1-T_2}$ will be

MHT CET 2020 · 19 OCT · SHIFT 2

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

195. A spring is stretched by 5 cm by a force 10 N. The time period of the oscillations when a mass of 2 kg is suspended by it is -

NEET 2021

(a) 0.628 s (b) 0.0628 s (c) 6.28 s (d) 3.14 s

196. The period of oscillation of a mass M suspended from a spring of negligible mass is T. If along with it another mass M is also suspended, the period of oscillation will now be

AIPMT 2010 · PRELIMS

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

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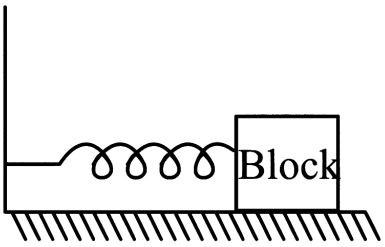
197. A mass m is vertically suspended from a spring of negligible mass; the system oscillates with a frequency n. What will be the frequency of the system, if a mass $4m$ is suspended from the same spring?

AIPMT 1998

(a) $\frac{n}{4}$ (b) $4n$ (c) $\frac{n}{2}$ (d) $2n$

198. For a simple harmonic motion in a mass spring system shown, the surface is frictionless. When the mass of the block is 1 kg, the angular frequency is ω_1. When the mass block is 2 kg the angular frequency is ω_2. The ratio ω_2/ω_1 is

JEE MAIN 2023 · 30 JAN · SHIFT 2



(a) $1/\sqrt{2}$ (b) $1/2$ (c) 2 (d) $\sqrt{2}$

199. 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 SHM of time period T. If the mass is increased by m. the time period becomes $\frac{5T}{3}$. Then the ratio of $\frac{m}{M}$ is

AIEEE 2003

(a) $\frac{3}{5}$ (b) $\frac{25}{9}$ (c) $\frac{16}{9}$ (d) $\frac{5}{3}$

200. A mass m is suspended from a spring of negligible mass and the system oscillates with a frequency f_1. The frequency of oscillations if a mass 9 m is suspended from the same spring is f_2. The value of $\frac{f_1}{f_2}$ is _____.

JEE MAIN 2024 · 1 FEB · SHIFT 2 *(Numerical)*

◆ Vertical spring and static extension 1 Q

201. A block of mass m attached to one end of the vertical spring produces extension x. If the block is pulled and released, the periodic time of oscillation is

MHT CET 2020 · 16 OCT · SHIFT 2

(a) $2\pi\sqrt{\frac{x}{4g}}$ (b) $2\pi\sqrt{\frac{2x}{g}}$ (c) $2\pi\sqrt{\frac{x}{2g}}$ (d) $2\pi\sqrt{\frac{x}{g}}$

◆ Equal masses on different springs 7 Qs

202. Two particles A and B of equal masses are suspended from two massless springs of spring constants K_A and K_B respectively. The maximum velocities of the particles during oscillations are equal. The ratio of the amplitude of 'B' to that of 'A' is

MHT CET 2026 · 18 APR · SHIFT 2

(a) $K_A : K_B$ (b) $\sqrt{K_A} : \sqrt{K_B}$
(c) $K_B : K_A$ (d) $\sqrt{K_B} : \sqrt{K_A}$

203. Two bodies A and B of equal mass are suspended from two separate massless springs of spring constants K_1 and K_2 respectively. The two bodies oscillate vertically such that their maximum velocities are equal. The ratio of the amplitude of B to that of A is

MHT CET 2024 · 4 MAY · SHIFT 1

(a) $\frac{K_1}{K_2}$ (b) $\frac{K_2}{K_1}$ (c) $\sqrt{\frac{K_1}{K_2}}$ (d) $\sqrt{\frac{K_2}{K_1}}$

204. Two bodies A and B of equal mass are suspended from two separate massles springs of force constant k_1 and k_2, respectively. The bodies oscillate vertically such that their maximum velocities are equal. The ratio of the amplitudes of body A to that of body B is

MHT CET 2020 · 19 OCT · SHIFT 2

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

205. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (AQ/A_ρ) of the amplitude AQ of mass Q to the amplitude A_ρ of mass P is

NEET 2025

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

206. Two bodies A and B of equal mass are suspended from two massless springs of spring constant k1 and k2, respectively. If the bodies oscillate vertically such that their amplitudes are equal, the ratio of the maximum velocity of A to the maximum velocity of B is

JEE MAIN 2025 · 29 JAN · SHIFT 2

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

207. Two particles A and B of equal masses are suspended from two massless springs of spring constants K1 and K2 respectively. If the maximum velocities during oscillations are equal, the ratio of the amplitude of A and B is

JEE MAIN 2021 · 17 MAR · SHIFT 2

(a) $\frac{K_1}{K_2}$ (b) $\sqrt{\frac{K_1}{K_2}}$ (c) $\frac{K_2}{K_1}$ (d) $\sqrt{\frac{K_2}{K_1}}$

208. Two particles A and B of equal masses are suspended from two massless springs of spring constant k_1 and k_2, respectively. If the maximum velocities, during oscillation, are equal, the ratio of amplitude of A and B is

AIEEE 2003

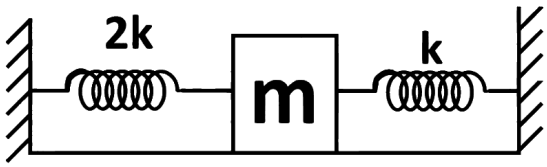
(a) $\sqrt{\frac{k_1}{k_2}}$ (b) $\frac{k_2}{k_1}$ (c) $\sqrt{\frac{k_2}{k_1}}$ (d) $\frac{k_1}{k_2}$

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◆ Series and parallel springs 11 Qs

209. Two springs of force constants '$2k$' and 'k' are connected to a mass 'm' as shown. Mass is displaced slightly to one side and released. The frequency of oscillation of the two springs-mass system is

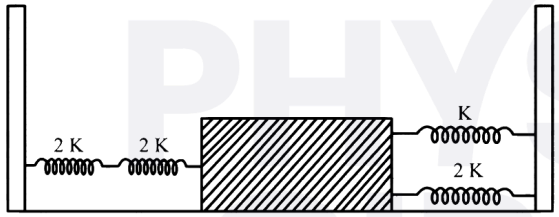
MHT CET 2026 · 20 APR · SHIFT 1



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

210. Four massless springs whose force constants are $2\,\mathrm{K}, 2\,\mathrm{K}, \mathrm{K}$ and $2\,\mathrm{K}$ respectively are attached to a mass M kept on a frictionless plane as shown in figure. If mass M is displaced in horizontal direction then frequency of oscillating system is

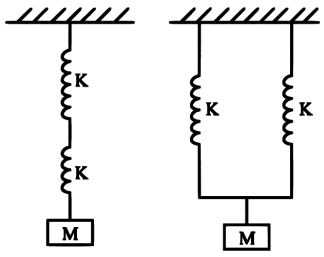
MHT CET 2023 · 12 MAY · SHIFT 1



(a) $\frac{1}{2\pi}\sqrt{\frac{\mathrm{K}}{4\mathrm{M}}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{4\,\mathrm{K}}{\mathrm{M}}}$ (c) $\frac{1}{2\pi}\sqrt{\frac{\mathrm{K}}{7\mathrm{M}}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{7\,\mathrm{K}}{\mathrm{M}}}$

211. Two identical springs of constant 'K' are connected in series and parallel in shown in figure. A mass 'M' is suspended from them. The ratio of their frequencies is series to parallel combination will be

MHT CET 2021 · 24 SEP · SHIFT 1



(a) 1 : 2 (b) 1 : 4 (c) 4 : 1 (d) $1:\sqrt{2}$

212. Two springs of spring constants k1 and k2 are joined in series. The effective spring constant of the combination is given by

AIPMT 2004

(a) $\sqrt{k_1 k_2}$ (b) (k1 + k2)/2
(c) k1 + k2 (d) k1k2/(k1 + k2)

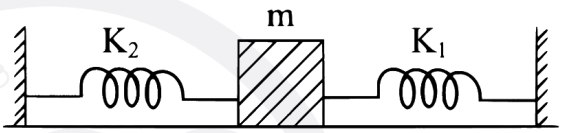
213. A mass m is suspended from the two coupled springs connected in series. The force constant for springs are k_1 and k_2. The time period of the suspended mass will be

AIPMT 1990

(a) $T = 2\pi\sqrt{\frac{m}{k_1 - k_2}}$
(b) $T = 2\pi\sqrt{\frac{mk_1k_2}{k_1 + k_2}}$
(c) $T = 2\pi\sqrt{\frac{m}{k_1 + k_2}}$
(d) $T = 2\pi\sqrt{\frac{m(k_1 + k_2)}{k_1 k_2}}$

214. A mass m is attached to two springs as shown in figure. The spring constants of two springs are K_1 and K_2. For the frictionless surface, the time period of oscillation of mass m is:

JEE MAIN 2023 · 6 APR · SHIFT 1



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

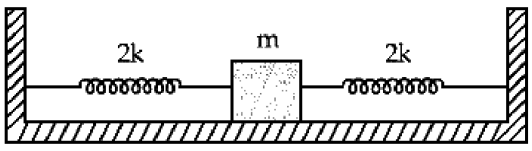
215. If two similar springs each of spring constant K1 are joined in series, the new spring constant and time period would be changed by a factor:

JEE MAIN 2021 · 26 FEB · SHIFT 1

(a) $\frac{1}{2}, 2\sqrt{2}$ (b) $\frac{1}{4}, 2\sqrt{2}$ (c) $\frac{1}{2}, \sqrt{2}$ (d) $\frac{1}{4}, \sqrt{2}$

216. Two identical springs of spring constant '2k' are attached to a block of mass m and to fixed support (see figure). When the mass is displaced from equilibrium position on either side, it executes simple harmonic motion. The time period of oscillations of this system is:

JEE MAIN 2021 · 25 FEB · SHIFT 2

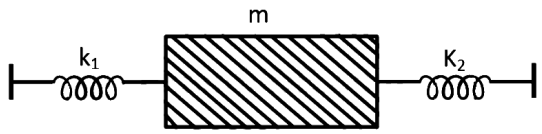


(a) $2\pi\sqrt{\frac{m}{k}}$ (b) $\pi\sqrt{\frac{m}{k}}$ (c) $2\pi\sqrt{\frac{m}{2k}}$ (d) $\pi\sqrt{\frac{m}{2k}}$

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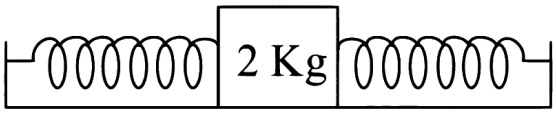
217. Two springs, of force constant k_1 and k_2 are connected to a mass m as shown. The frequency of oscillation of the mass is f. If both k_1 and k_2 are made four times their original values, the frequency of oscillation becomes

AIEEE 2007



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

218.

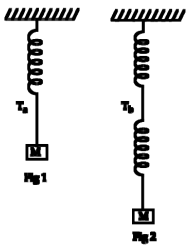


A block of mass 2 kg is attached with two identical springs of spring constant 20 N/m each. The block is placed on a frictionless surface and the ends of the springs are attached to rigid supports (see figure). When the mass is displaced from its equilibrium position, it executes a simple harmonic motion. The time period of oscillation is $\frac{\pi}{\sqrt{x}}$ in SI unit. The value of x is _____.

JEE MAIN 2023 · 24 JAN · SHIFT 1 *(Numerical)*

219. Consider two identical springs each of spring constant k and negligible mass compared to the mass M as shown. Fig. 1 shows one of them and Fig. 2 shows their series combination. The ratios of time period of oscillation of the two SHM is Tb/Ta = $\sqrt{x}$, where value of x is _____. (Round off to the Nearest Integer)

JEE MAIN 2021 · 17 MAR · SHIFT 1 *(Numerical)*



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TOPIC 06

Other SHM Systems

5 PYQs · Easy 5 · Medium 0 · Difficult 0 | MHT CET 3 · NEET 1 · JEE 1

Concepts covered: Floating bodies and liquid columns (2) · Bowl, piston, tunnel and wire (3)

LEVEL 1 · EASY 5 questions

◆ Floating bodies and liquid columns 2 Qs

220. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium it undergoes with a time period T, then

AIPMT 2006

(a) $T \propto \frac{1}{\sqrt{m}}$ (b) $T \propto \sqrt{\rho}$ (c) $T \propto \frac{1}{\sqrt{A}}$ (d) $T \propto \frac{1}{\rho}$

221. A cylindrical block of mass M and area of cross section A is floating in a liquid of density ρ and with its axis vertical. When depressed a little and released the block starts oscillating. The period of oscillation is

JEE MAIN 2026 · 24 JAN · SHIFT 1

(a) $2\pi\sqrt{\frac{\rho A}{Mg}}$ (b) $\pi\sqrt{\frac{2M}{\rho Ag}}$

(c) $2\pi\sqrt{\frac{M}{\rho Ag}}$ (d) $\pi\sqrt{\frac{\rho A}{Mg}}$

◆ Bowl, piston, tunnel and wire 3 Qs

222. A small sphere oscillates simple harmonically in a watch glass whose radius of curvature is 1.6 m. The period of Oscillation of the sphere is (Acceleration due to gravity $g = 10\ \text{m/s}^2$)

MHT CET 2026 · 15 APR · SHIFT 1

(a) 0.2π (b) 0.4π (c) 0.8π (d) π

223. A small sphere oscillates simple harmonically in a watch glass whose radius of curvature is 1.6 m. The period of oscillation of the sphere is (acceleration due to gravity $g = 10\ \text{m/s}^2$)

MHT CET 2025 · 25 APR · SHIFT 1

(a) 0.2π s (b) 0.4π s (c) 0.6π s (d) 0.8π s

224. A small sphere oscillates simple harmonically in a watch glass whose radius of curvature is 1.6 m. The period of oscillation of the sphere in second is (acceleration due to gravity, $g = 10\ \text{m/s}^2$)

MHT CET 2024 · 3 MAY · SHIFT 1

(a) 0.8π (b) 0.6π (c) 0.4π (d) $0 \cdot 2\pi$

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TOPIC 07

Damped, Forced Oscillations & Superposition

11 PYQs · Easy 11 · Medium 0 · Difficult 0 | MHT CET 3 · NEET 6 · JEE 2

Concepts covered: Damped oscillations (3) · Forced oscillations and resonance (4) · Superposition along one line (1) · Perpendicular SHMs and Lissajous figures (3)

LEVEL 1 · EASY 11 questions

◆ Damped oscillations 3 Qs

225. A particle is performing simple harmonic motion and if the oscillations are damped oscillations then the angular frequency is given by

MHT CET 2024 · 2 MAY · SHIFT 1

(a) $\sqrt{\frac{k}{m}+\left(\frac{b}{2m}\right)^2}$ (b) $\frac{\mathrm{k}}{\mathrm{m}}+\left(\frac{\mathrm{b}}{2\,\mathrm{m}}\right)^2$

(c) $\sqrt{\frac{k}{m}-\left(\frac{b}{2m}\right)^2}$ (d) $\frac{\mathrm{k}}{\mathrm{m}}-\left(\frac{\mathrm{b}}{2\,\mathrm{m}}\right)^2$

226. The damping force of an oscillator is directly proportional to the velocity. The unit of constant of proportionality is

MHT CET 2020 · 16 OCT · SHIFT 2

(a) $\mathrm{kg\ ms^{-1}}$ (b) $\mathrm{kg\ s^{-1}}$

(c) $\mathrm{kg\ ms^{-2}}$ (d) kg-s

227. In damped SHM, the SI unit of damping constant is

MHT CET 2019 · 3 MAY · SHIFT 1

(a) $\frac{\mathrm{N}}{\mathrm{s}}$ (b) $\frac{\mathrm{kg}}{\mathrm{s}}$ (c) $\frac{\mathrm{kg}}{\mathrm{m}}$ (d) $\frac{N}{m}$

◆ Forced oscillations and resonance 4 Qs

228. In case of a forced vibration, the resonance peak becomes very sharp when the

AIPMT 2003

(a) damping force is small
(b) restoring force is small
(c) applied periodic force is small
(d) quality factor is small

229. 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 $\omega_0 \rightarrow$ natural angular frequency of oscillations of particle)

AIPMT 1998

(a) $\omega_1=\omega_0$ and $\omega_2\neq\omega_0$ (b) $\omega_1=\omega_0$ and $\omega_2=\omega_0$

(c) $\omega_1\neq\omega_0$ and $\omega_2=\omega_0$ (d) $\omega_1\neq\omega_0$ and $\omega_2\neq\omega_0$

230. 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

AIPMT 1989

(a) $\omega_1\neq\omega_0$ and $\omega_2=\omega_0$ (b) $\omega_1=\omega_0$ and $\omega_2=\omega_0$

(c) $\omega_1=\omega_0$ and $\omega_2\neq\omega_0$ (d) $\omega_1\neq\omega_0$ and $\omega_2\neq\omega_0$

231. In forced oscillation of a particle the amplitude is maximum for a frequency ω_1 of the force while the energy is maximum for a frequency ω_2 of the force; then

AIEEE 2004 *(Not in current JEE/NEET syllabus)*

(a) $\omega_1<\omega_2$ when damping is small and $\omega_1>\omega_2$ when damping is large
(b) $\omega_1>\omega_2$
(c) $\omega_1=\omega_2$
(d) $\omega_1<\omega_2$

◆ Superposition along one line 1 Q

232. When two displacements represented by y1 = a $\sin(\omega t)$ and y2 = b $\cos(\omega t)$ aresuperimposed the motion is

AIPMT 2015 · CANCELLED PAPER

(a) simple harmonic with amplitude $\sqrt{a^2+b^2}$
(b) simple harmonic with amplitude $\frac{(a+b)}{2}$
(c) not a simple harmonic
(d) simple harmonic with amplitude $\frac{a}{b}$

◆ Perpendicular SHMs and Lissajous figures 3 Qs

233. Two SHM's with same amplitude and time period, when acting together in perpendicular directions with a phase difference of $\pi/2$, give rise to

AIPMT 1997

(a) straight motion (b) elliptical motion
(c) circular motion (d) none of these

234. 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

AIPMT 1990

(a) circle (b) figure of eight
(c) straight line (d) ellipse

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235. Motion of a particle in x-y plane is described by a set of following equations $x = 4\sin\left(\frac{\pi}{2} - \omega t\right) m$ and $y = 4\sin(\omega t)\, m$. The path of the particle will be:

JEE MAIN 2022 · 28 JUN · SHIFT 1

(a) circular
(b) helical
(c) parabolic
(d) elliptical

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ANSWER KEY

Shaded by level: **Easy**

01 Periodic Motion & SHM Basics

1. (b)	2. (d)	3. (c)	4. (c)	5. (a)	6. (d)	7. (d)	8. (b)	9. (b)	10. (c)
11. (d)	12. (d)	13. (c)	14. (d)	15. (a)	16. (c)	17. (a)	18. (c)	19. (d)	20. (b)
21. (c)	22. (c)	23. (a)	24. (d)	25. (a)	26. (c)	27. (a)	28. (c)	29. (d)	30. (a)
31. (d)	32. (b)	33. (a)	34. (d)	35. (b)	36. 6				

02 Velocity & Acceleration in SHM

37. (c)	38. (d)	39. (c)	40. (d)	41. (d)	42. (d)	43. (c)	44. (b)	45. (c)	46. (b)
47. (c)	48. (d)	49. (c)	50. (d)	51. (b)	52. 44	53. 3	54. (c)	55. (b)	56. (b)
57. (b)	58. (d)	59. (a)	60. (c)	61. (d)	62. (c)	63. (a)	64. (a)	65. (b)	66. (b)
67. (d)	68. (d)	69. (a)	70. (a)	71. 12	72. 16	73. (a)	74. (c)	75. (d)	76. (c)
77. (c)	78. (d)	79. (d)	80. (b)	81. (c)	82. (d)				

03 Energy in SHM

83. (b)	84. (d)	85. (c)	86. (d)	87. (a)	88. (b)	89. (c)	90. (b)	91. (c)	92. (d)
93. (a)	94. (a)	95. (c)	96. (d)	97. (c)	98. (c)	99. (a)	100. (b)	101. (b)	102. (d)
103. (b)	104. (c)	105. (b)	106. (d)	107. (c)	108. (b)	109. (b)	110. (c)	111. (c)	112. (c)
113. (b)	114. (b)	115. (a)	116. (d)	117. (c)	118. (d)	119. (b)	120. (c)	121. (c)	122. (a)
123. 9	124. 2	125. (c)	126. (c)	127. (a)	128. (a)	129. (a)	130. (c)	131. (d)	132. (a)
133. (d)									

04 Simple Pendulum

134. (d)	135. (b)	136. (c)	137. (c)	138. (b)	139. (c)	140. (b)	141. (d)	142. (c)	143. (b)
144. (a)	145. (d)	146. (a)	147. (b)	148. (d)	149. (c)	150. (b)	151. (b)	152. (d)	153. (b)
154. (c)	155. (a)	156. (b)	157. (b)	158. (d)	159. (d)	160. (d)	161. (b)	162. (a)	163. (c)
164. 5	165. (a)	166. (c)	167. (d)	168. (c)	169. (b)	170. (b)	171. (d)	172. (d)	173. (a)
174. (a)	175. (b)	176. (b)	177. (b)	178. (d)	179. (b)	180. (c)	181. (b)	182. (d)	183. (c)

05 Spring Systems

184. (b)	185. (b)	186. (c)	187. (c)	188. (c)	189. (b)	190. (b)	191. (c)	192. (c)	193. (d)
194. (c)	195. (a)	196. (d)	197. (c)	198. (a)	199. (c)	200. 3	201. (d)	202. (b)	203. (c)
204. (a)	205. (b)	206. (b)	207. (d)	208. (c)	209. (d)	210. (b)	211. (a)	212. (d)	213. (d)
214. (a)	215. (c)	216. (b)	217. (a)	218. 5	219. 2				

06 Other SHM Systems

220. (c)	221. (c)	222. (c)	223. (d)	224. (a)					

07 Damped, Forced Oscillations & Superposition

225. (c)	226. (b)	227. (b)	228. (a)	229. (c)	230. (b)	231. (c)	232. (a)	233. (c)	234. (c)
235. (a)									

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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