

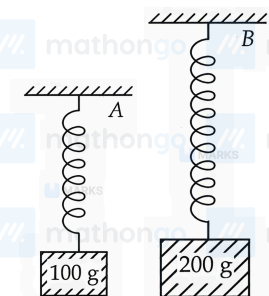
Q1. JEE Main 2026 (21 January Shift 2)

The kinetic energy of a simple harmonic oscillator is oscillating with angular frequency of 176 rad/s . The frequency of this simple harmonic oscillator is ____ Hz. [take $\pi = \frac{22}{7}$]

- (1) 14 (2) 28 (3) 176 (4) 88

Q2. JEE Main 2026 (23 January Shift 1)

Two blocks with masses 100 g and 200 g are attached to the ends of springs A and B as shown in figure. The energy stored in A is E . The energy stored in B , when spring constants k_A, k_B of A and B , respectively satisfy the relation $4k_A = 3k_B$, is :



- (1) $\frac{4}{3}E$ (2) $4E$ (3) $3E$ (4) $2E$

Q3. JEE Main 2026 (23 January Shift 1)

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.]

- (1) 7.5 (2) 0.75 (3) 120 (4) 15

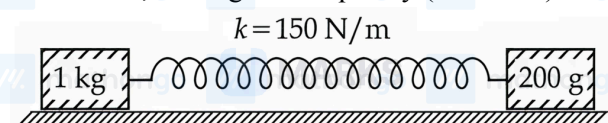
Q4. JEE Main 2026 (28 January Shift 2)

The time period of a simple harmonic oscillator is $T = 2\pi\sqrt{\frac{m}{k}}$. Measured value of mass (m) of the object is 10 g with an accuracy of 10 mg and time for 50 oscillations of the spring is found to be 60 s using a watch of 2 s resolution. Percentage error in determination of spring constant (k) is ____ %.

- (1) 7.60 (2) 3.35 (3) 3.43 (4) 6.76

Q5. JEE Main 2026 (28 January Shift 2)

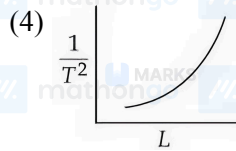
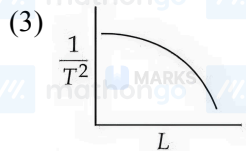
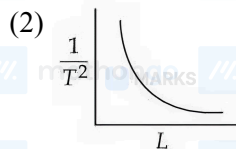
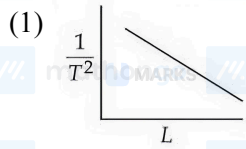
As shown in the figure, a spring is kept in a stretched position with some extension by holding the masses 1 kg and 0.2 kg with a separation more than spring natural length and are released. Assuming the horizontal surface to be frictionless, the angular frequency (in SI unit) of the system is : $k = 150\text{ N/m}$



- (1) 5 (2) 27 (3) 20 (4) 30

Q6. JEE Main 2026 (22 January Shift 2)

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

**Q7. JEE Main 2026 (28 January Shift 1)**

The displacement of a particle, executing simple harmonic motion with time period T , is expressed as

$x(t) = A \sin \omega t$, where A is the amplitude. The maximum value of potential energy of this oscillator is found at $t = T/2\beta$. The value of β is _____.

Q8. JEE Main 2026 (24 January Shift 1)

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 _____.

(1) $\pi \sqrt{\frac{2M}{\rho Ag}}$

(2) $\pi \sqrt{\frac{\rho A}{Mg}}$

(3) $2\pi \sqrt{\frac{\rho A}{Mg}}$

(4) $2\pi \sqrt{\frac{M}{\rho Ag}}$

ANSWERS AND SOLUTIONS

1. (1) 2. (3) 3. (1) 4. (4) 5. (4) 6. (2) 7. 2 8. (4)

1. (1) In a simple harmonic oscillator, if the displacement is $x = A \sin(\omega t + \phi)$, the velocity is $v = A\omega \cos(\omega t + \phi)$.

The kinetic energy is given by $K = \frac{1}{2}mv^2 = \frac{1}{2}mA^2\omega^2 \cos^2(\omega t + \phi)$.

Using the identity $\cos^2 \theta = \frac{1 + \cos 2\theta}{2}$, we get $K = \frac{1}{4}mA^2\omega^2[1 + \cos(2\omega t + 2\phi)]$.

The angular frequency of the kinetic energy oscillation is $\omega_{KE} = 2\omega$, where ω is the angular frequency of the SHM.

Given $\omega_{KE} = 176 \text{ rad/s}$, we have $2\omega = 176$, which gives $\omega = 88 \text{ rad/s}$.

The frequency of the simple harmonic oscillator is $f = \frac{\omega}{2\pi}$.

Substituting the values: $f = \frac{88}{2 \times \frac{22}{7}} = \frac{88 \times 7}{44} = 2 \times 7 = 14 \text{ Hz}$.

2. (3) For blocks hanging in equilibrium, spring extensions are:

$$x_A = \frac{m_A g}{k_A} = \frac{100g}{k_A} \text{ and } x_B = \frac{m_B g}{k_B} = \frac{200g}{k_B}.$$

Energy stored:

$$E = \frac{1}{2}k_A x_A^2 = \frac{5000g^2}{k_A} \text{ and } U_B = \frac{1}{2}k_B x_B^2 = \frac{20000g^2}{k_B}.$$

$$\text{Taking ratio: } \frac{U_B}{E} = 4 \cdot \frac{k_A}{k_B}.$$

$$\text{Given } 4k_A = 3k_B, \text{ we have } \frac{k_A}{k_B} = \frac{3}{4}.$$

$$\text{Therefore: } U_B = 4E \cdot \frac{3}{4} = 3E.$$

3. (1) Period of simple pendulum: $T = \frac{\text{time}}{\text{number of oscillations}}$

$$\text{Initial period: } T_1 = \frac{10}{20} = 0.5 \text{ s}$$

$$\text{Required period: } T_2 = \frac{10}{40} = 0.25 \text{ s}$$

$$\text{Using } T = 2\pi\sqrt{\frac{L}{g}}, \text{ the ratio is: } \frac{T_2}{T_1} = \sqrt{\frac{L_2}{L_1}}$$

$$\frac{0.25}{0.5} = \sqrt{\frac{L_2}{30}} \Rightarrow 0.5 = \sqrt{\frac{L_2}{30}}$$

$$0.25 = \frac{L_2}{30} \Rightarrow L_2 = 7.5 \text{ cm}$$

4. (4) The given formula for time period is

$$T = 2\pi\sqrt{\frac{k}{m}}.$$

$$\text{Squaring both sides, we get } T^2 = 4\pi^2 \frac{k}{m}, \text{ which gives } k = \frac{4\pi^2 m}{T^2}.$$

$$\text{The relative error in } k \text{ is given by } \frac{\Delta k}{k} = \frac{\Delta m}{m} + 2 \frac{\Delta T}{T}.$$

$$\text{Given: } m = 10 \text{ g}, \Delta m = 10 \text{ mg} = 0.01 \text{ g}.$$

$$\text{Total time for } n = 50 \text{ oscillations is } t = 60 \text{ s with resolution } \Delta t = 2 \text{ s}.$$

$$\text{Since } T = t/n, \text{ the relative error in } T \text{ is the same as in } t: \frac{\Delta T}{T} = \frac{\Delta t}{t}.$$

$$\text{Substituting the values: } \frac{\Delta k}{k} = \frac{0.01}{10} + 2 \left(\frac{2}{60} \right).$$

$$\frac{\Delta k}{k} = 0.001 + \frac{2}{30} = 0.001 + 0.0666...$$

$$\text{Percentage error} = \left(0.001 + \frac{1}{15}\right) \times 100 = 0.1 + \frac{100}{15} = 0.1 + 6.666... = 6.766...\%$$

Rounding to two decimal places, we get 6.76%.

5. (4) Two masses (1 kg and 0.2 kg) connected by a spring ($k = 150 \text{ N/m}$) on a frictionless surface undergo oscillation about their center of mass.

This two-body problem reduces to SHM with reduced mass $\mu = \frac{m_1 m_2}{m_1 + m_2} = \frac{1 \times 0.2}{1.2} = \frac{1}{6} \text{ kg}$.

The angular frequency is $\omega = \sqrt{\frac{k}{\mu}} = \sqrt{\frac{150}{1/6}} = \sqrt{900} = 30 \text{ rad/s}$.

6. (2) The time period T of a simple pendulum of length L is given by the formula:

$$T = 2\pi \sqrt{\frac{L}{g}}$$

Squaring both sides, we get:

$$T^2 = 4\pi^2 \frac{L}{g}$$

Rearranging the equation to find the relationship between $\frac{1}{T^2}$ and L :

$$\frac{1}{T^2} = \frac{g}{4\pi^2 L}$$

Let $y = \frac{1}{T^2}$ and $x = L$. The equation becomes:

$$y = \frac{k}{x} \text{ where } k = \frac{g}{4\pi^2} \text{ is a constant.}$$

This is the equation of a rectangular hyperbola in the first quadrant.

As L increases, $\frac{1}{T^2}$ decreases non-linearly, approaching the axes asymptotically.

Comparing this with the given plots, option (2) correctly represents a hyperbolic relationship between $\frac{1}{T^2}$ and L .

7. (2) For SHM with $x(t) = A \sin(\omega t)$, the potential energy is

$$U = \frac{1}{2} m \omega^2 x^2 = \frac{1}{2} m \omega^2 A^2 \sin^2(\omega t).$$

Maximum potential energy occurs when $\sin^2(\omega t) = 1$, i.e., when $\omega t = \frac{\pi}{2}, \frac{3\pi}{2}, \dots$

The first maximum occurs at $\omega t = \frac{\pi}{2}$, giving $t = \frac{\pi}{2\omega} = \frac{\pi}{2} \cdot \frac{T}{2\pi} = \frac{T}{4}$.

Since this is given as $t = \frac{T}{2\beta}$.

We have $\frac{T}{4} = \frac{T}{2\beta}$, so $\beta = 2$.

8. (4) When the block is depressed by distance x , the additional buoyant force is $F = \rho A g x$ acting upward as restoring force.

Equation of motion: $M \frac{d^2 x}{dt^2} = -\rho A g x$.

This gives $\omega^2 = \frac{\rho A g}{M}$.

Period of oscillation: $T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{M}{\rho A g}}$