

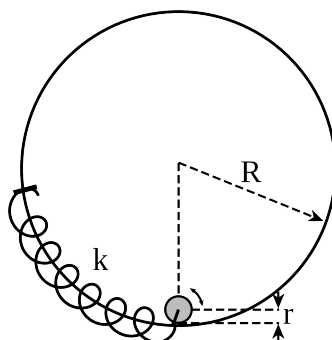
PART 1 - PHYSICS

Topic : Oscillations, System of particles and rotational motion

SECTION-1 : (Maximum Marks : 3)

- This section contains **ONE** question.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme :
 Full Marks : +3 If **ONLY** the correct option is chosen;
 Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
 Negative Marks : -1 In all other cases.

1. The center of a disk of radius r and mass m is attached to a spring of spring constant k , inside a ring of radius $R > r$ as shown in the figure. The other end of the spring is attached on the periphery of the ring. Both the ring and the disk are in the same vertical plane. The disk can only roll along the inside periphery of the ring, without slipping. The spring can only be stretched or compressed along the periphery of the ring, following the Hooke's law. In equilibrium, the disk is at the bottom of the ring. Assuming small displacement of the disc, the time period of oscillation of center of mass of the disk is written as $T = \frac{2\pi}{\omega}$. The correct expression for ω is (g is the acceleration due to gravity): [JEE Advanced 2025 Paper 1]



- (A) $\sqrt{\frac{2}{3} \left(\frac{g}{R-r} + \frac{k}{m} \right)}$ (B) $\sqrt{\frac{2g}{3(R-r)} + \frac{k}{m}}$ (C) $\sqrt{\frac{1}{6} \left(\frac{g}{R-r} + \frac{k}{m} \right)}$ (D) $\sqrt{\frac{1}{4} \left(\frac{g}{R-r} + \frac{k}{m} \right)}$

Scan or tap for the full solution



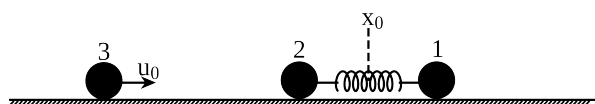
Space for Rough Work

SECTION-2 : (Maximum Marks : 6)

- This section contains **ONE** paragraph.
- Based on each paragraph, there are **TWO** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer (in decimal notation, truncated / rounded-off to the **SECOND DECIMAL PLACE**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme :
Full Marks : +3 If ONLY the correct answer is entered;
Zero Marks : 0 In all other cases.

Paragraph for Questions 2 and 3

Two particles, 1 and 2, each of mass m , are connected by a massless spring, and are on a horizontal frictionless plane, as shown in the figure. Initially, the two particles, with their center of mass at x_0 , are oscillating with amplitude a and angular frequency ω . Thus, their positions at time t are given by $x_1(t) = (x_0 + d) + a \sin \omega t$ and $x_2(t) = (x_0 - d) - a \sin \omega t$, respectively, where $d > 2a$. Particle 3 of mass m moves towards this system with speed $u_0 = a\omega/2$, and undergoes instantaneous elastic collision with particle 2, at time t_0 . Finally, particles 1 and 2 acquire a center of mass speed v_{cm} and oscillate with amplitude b and the same angular frequency ω .



2. If the collision occurs at time $t_0 = 0$, the value of $v_{cm}/(a\omega)$ will be _____. [JEE Advanced 2024 Paper 2]

Scan or tap for the full solution



3. If the collision occurs at time $t_0 = \pi/(2\omega)$, then the value of $4b^2/a^2$ will be _____.

[JEE Advanced 2024 Paper 2]

Scan or tap for the full solution



Space for Rough Work

JEE ADVANCED OSCILLATIONS — SPRING–MASS SYSTEMS
— PYQS

Test Pattern : JEE (Advanced)

ANSWER KEY

SECTION-1																											
Ques.	1																										
Ans.	A																										

SECTION-2																											
Ques.	2	3																									
Ans.	0.75	4.25																									