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PHYSICS · JEE MAIN

Rotational Motion

Previous Year Questions with answers

315 questions · **194** papers · **2002–2026** · newest paper first

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What is in this PDF: every Rotational Motion question we hold from past JEE Main and AIEEE papers, with its options and answer. Where an answer comes from a source other than the official final key, it says so next to the answer.

Step-by-step solutions for every question are free in the EdLoop JEE app (Google Play) and on app.edloop.in. More chapters: pyq.edloop.in/free-pdfs/

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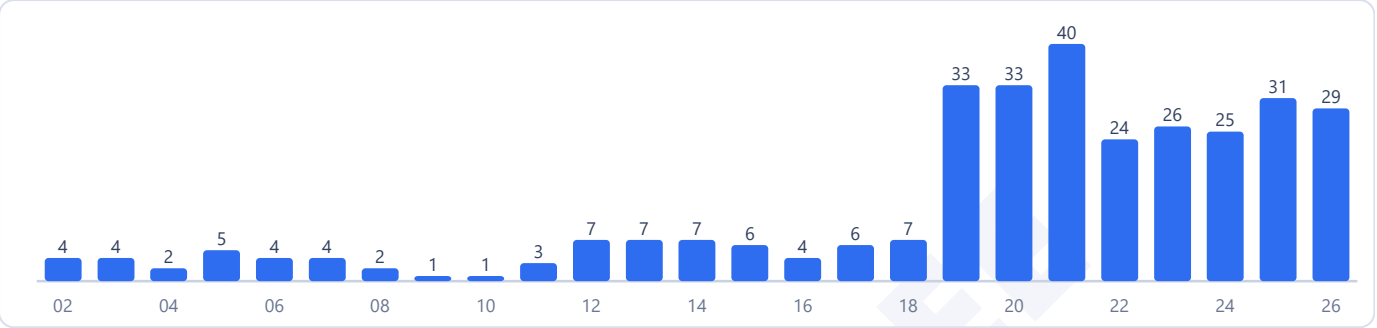
Chapter at a glance

5.3%	315	158 of 162	213 / 102
of Physics questions, 2019–2026	questions, 2002–2026	papers asked it, 2019–2026	MCQ / numerical, 2002–2026

Trend. Steady: 1.5 questions per paper in 2024–2026 against 1.5 in 2019–2023.

Questions per year



Counts are the questions we hold: 315 in 194 papers. No question in this chapter was found repeated across papers.

Most-asked topics in this chapter (2002–2026)



How often it comes up

Rotational Motion is one of the steadiest chapters in JEE Main Physics. Across the papers we hold from 2019 to 2026, it gave **241 questions in 162 papers**, about **1.5 questions per paper**, and it appeared in 158 of those 162 papers. That makes it the **3rd largest of 29 Physics chapters** in that period, with 5.3% of all Physics questions.

The share has not moved much over two decades. In the AIEEE and early JEE Main years (2002 to 2018) it was 5.5% of Physics, and in the last three exam years (2024 to 2026) it is again 5.5%: 85 questions in 58 papers. Since 2019 there has been no year without it, and it was missing from only a handful of the 162 papers. If you are planning JEE Main 2027, treat it as a chapter you cannot leave out.

It is a Class 11 chapter (NTA's Unit 5: Rotational Motion), but it leans on Laws of Motion and Work, Energy and Power, so it rewards students who are already comfortable with forces and energy.

Most-asked topics

From 2019 to 2026, the questions split across five topics:

- **Moment of Inertia**: 71 questions. The single most-asked topic in the chapter.
- **Torque & Angular Momentum**: 63 questions. Over the whole archive (89 questions) it is just ahead of moment of inertia.
- **Rolling Motion**: 44 questions.
- **Rotational Dynamics**: 35 questions.
- **Centre of Mass**: 28 questions.

All five topics were asked in 2026, so none of them is safe to skip.

What the questions look like

Most moment of inertia questions are built from shapes you already know: rods joined into a T or a square frame, discs and rings, spheres touching each other. The work is in choosing the axis and using the parallel or perpendicular axis theorem cleanly, not in long algebra.

Torque and angular momentum questions often hide the rotation. A classic version asks for the angular momentum of one moving car about another on a parallel track, or of masses stuck to a free bar. If you remember that angular momentum about a point is defined for straight-line motion too, these become short.

Rolling questions usually combine energy and rotation: a body rolls up a curve or down an incline and you must find how far it gets or which body it is. Rotational dynamics questions put a pulley with mass, or a rod that suddenly loses a support, into a Newton's-laws problem.

A large part of this chapter now comes as numerical-answer questions: 102 of the 241 questions since 2019 had no options at all, so you need the exact value, not an elimination trick.

How to practise it

Start with moment of inertia, because the other topics reuse it. Learn the standard results for a rod, ring, disc, cylinder and sphere, then practise only the axis theorems until combined shapes feel routine.

Next, do torque and angular momentum together with conservation of angular momentum, since many questions switch between the two. Leave rolling for after you are confident with energy conservation, then mix all topics in timed sets. Because so many questions are numerical, check units and powers of ten before you enter an answer.

Going year by year through the list below is a good way to see how the style has changed from AIEEE to NTA's online papers.

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Q1 JEE Main 2026 · 8 Apr · Shift 2 MCQ

A solid cylinder having radius R and length L is slipping on a rough horizontal plane. At time $t = 0$ the cylinder has a translational velocity $v_o = 49$ m/s, perpendicular to its axis and a rotational velocity $v_o/4R$ about the centre. The time taken by the cylinder to start rolling is _____ seconds. (coefficient of kinetic friction $\mu_K = 0.25$ and $g = 9.8$ m/s^2)

(A) 15
(B) 5
(C) 10
(D) 7.5

Answer: (B) 5 · Official NTA final key

Q2 JEE Main 2026 · 6 Apr · Shift 1 MCQ

A solid sphere of radius 4 cm and mass 5 kg is rotating (rotation axis is passing through the centre of the sphere) with an angular velocity of 1200 rpm. It is brought to rest in 10 s by applying a constant torque. The torque applied and the number of rotations it made before it comes to rest are _____ and _____ respectively.

(A) $0.128\,\pi$ Nm, 100
(B) $0.0128\,\pi$ Nm, 50
(C) $0.128\,\pi$ Nm, 50
(D) $0.0128\,\pi$ Nm, 100

Answer: (D) $0.0128\,\pi$ Nm, 100 · Official NTA final key

Q3 JEE Main 2026 · 6 Apr · Shift 1 MCQ

The position of center of mass of three masses 2 kg, 3 kg and 15 kg placed with respect to mid point (p) of normal bisector, as shown in the figure is _____.

(see the figure above)

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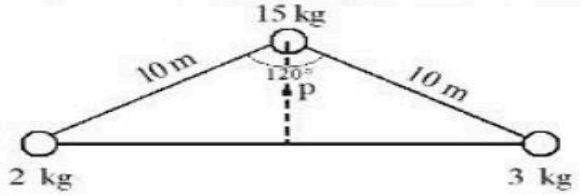
The position of center of mass of three masses 2 kg, 3 kg and 15 kg placed with respect to mid point (p) of normal bisector, as shown in the figure is_____.



Options :

6952787609. $\left(\frac{\sqrt{3}}{4}, 1.25\right)$

6952787610. $\left(\frac{\sqrt{3}}{4}, 1.0\right)$

6952787611. $(0,0)$

6952787612. $(1.25,0)$

(A) $\left(\frac{\sqrt{3}}{4},\ 1.25\right)$

(B) $\left(\frac{\sqrt{3}}{4},\ 1.0\right)$

(C) $(0, 0)$

(D) $(1.25, 0)$

Answer: (A) $\left(\frac{\sqrt{3}}{4},\ 1.25\right)$ · Official NTA final key

Q4 JEE Main 2026 · 6 Apr · Shift 2 MCQ

A solid sphere (A) of mass $5m$ and a spherical shell (B) of mass m, both having same radius, are placed on a rough surface. When a force of same magnitude is applied tangentially at the highest points of A and B, they start rolling without slipping with an acceleration of a_A and a_B, respectively. The ratio of a_A and a_B is _____.

(A) 5 : 21

(B) 6 : 10

(C) 21 : 25

(D) 1 : 5

Answer: (A) 5 : 21 · Official NTA final key

Q5 JEE Main 2026 · 6 Apr · Shift 2 MCQ

Two identical bodies A and B of equal masses have initial velocities $\vec{v}_1 = 4\hat{i}$ m/s and $\vec{v}_2 = 4\hat{j}$ m/s respectively. The body A has acceleration $\vec{a}_1 = 6\hat{i} + 6\hat{j}$ m/s^2 while the acceleration of the other body B is zero. The centre of mass of the two bodies moves in _____ path.

(A) circular
(B) parabolic
(C) straight line
(D) elliptical

Answer: (C) straight line · Official NTA final key

Q6 JEE Main 2026 · 5 Apr · Shift 2 MCQ

A wheel initially at rest is subjected to a uniform angular acceleration about its axis. In the first 2 s it rotates through an angle θ_1 and in the next 2 s it rotates through an angle θ_2. The ratio $\frac{\theta_2}{\theta_1}$ is _____.

(A) 6
(B) 3
(C) 4
(D) $\frac{1}{3}$

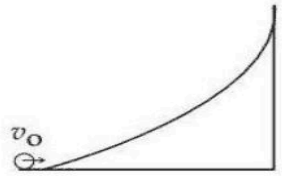
Answer: (B) 3 · Official NTA final key

Q7 JEE Main 2026 · 5 Apr · Shift 2 MCQ

An object of uniform density rolls up the curved path with the initial velocity v_o as shown in the figure. If the maximum height attained by an object is $\frac{7v_o^2}{10\,g}$ (g = acceleration due to gravity), the object is a _____.

(see the figure above)

An object of uniform density rolls up the curved path with the initial velocity v_o as shown in the figure. If the maximum height attained by an object is $\frac{7v_o^2}{10\,g}$ (g = acceleration due to gravity), the object is a _____.



Options :

6911211636. solid cylinder

6911211637. ring

6911211638. disc

6911211639. solid sphere

(A) solid cylinder
(B) ring
(C) disc
(D) solid sphere

Answer: (D) solid sphere · Official NTA final key

Q8 JEE Main 2026 · 4 Apr · Shift 1 MCQ

A solid sphere of mass M and radius R is divided into two unequal parts. The smaller part having mass $M/8$ is converted into a sphere of radius r and the larger part is converted into a circular disc of thickness t and radius $2R$. If I_1 is moment of inertia of a sphere having radius r about an axis through its centre and I_2 is the moment of inertia of a disc about its diameter, the ratio of their moment of inertia $I_2/I_1 =$ _____.

(A) 35
(B) 70
(C) 140
(D) 210

Answer: (B) 70 · Official NTA final key

Q9 JEE Main 2026 · 2 Apr · Shift 1 MCQ

The position of an object having mass 0.1 kg as a function of time t is given as $\vec{r} = \left(10t^2\hat{i} + 5t^3\hat{j}\right)$ m. At $t = 1$ s, which of the following statements are **correct** ?

A. The linear momentum $\vec{p} = \left(2\hat{i} + 1.5\hat{j}\right)$ kg·m/s.

B. The force acting on the object $\vec{F} = \left(2\hat{i} + 3\hat{j}\right)$ N.

C. The angular momentum of the object about its origin $\vec{L} = 15\,\hat{k}$ J s.

D. The torque acting on the object about its origin $\vec{\tau} = 20\,\hat{k}$ N m.

Choose the **correct** answer from the options given below :

(A) A, B and C only
(B) B, C and D only
(C) A, C and D only
(D) A, B and D only

Answer: (D) A, B and D only · Official NTA final key

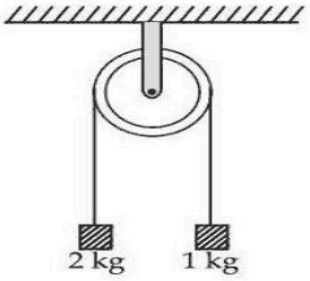
Q10 JEE Main 2026 · 2 Apr · Shift 2 MCQ

Two blocks of masses 2 kg and 1 kg respectively, are tied to the ends of a string which passes over a light frictionless pulley as shown in the figure below. The masses are held at rest at the same

horizontal level and then released. The distance traversed by the centre of mass in 2 s is _____ m. (Take g = 10 m/s^2)

(see the figure above)

Two blocks of masses 2 kg and 1 kg respectively, are tied to the ends of a string which passes over a light frictionless pulley as shown in the figure below. The masses are held at rest at the same horizontal level and then released. The distance traversed by the centre of mass in 2 s is _____m. (Take $g = 10$ m/s^2)



Options :

691121604. 3.33

691121605. 3.12

691121606. 2.22

691121607. 1.42

(A) 3.33

(B) 3.12

(C) 2.22

(D) 1.42

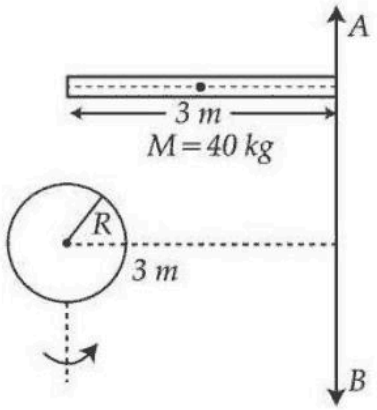
Answer: (C) 2.22 · Official NTA final key

Q11 JEE Main 2026 · 2 Apr · Shift 2 Numerical

Moment of inertia about an axis AB for a rod of mass 40 kg and length 3 m is same as that of a solid sphere of mass of 10 kg and radius R about an axis parallel to AB axis with separation of 3 m as shown in figure below. The value of R is given as $\sqrt{\frac{\alpha}{2}}$. The value of α is _____.

(see the figure above)

Moment of inertia about an axis AB for a rod of mass 40 kg and length 3 m is same as that of a solid sphere of mass of 10 kg and radius R about an axis parallel to AB axis with separation of 3 m as shown in figure below. The value of R is given as $\sqrt{\frac{\alpha}{2}}$. The value of α is _____.



Numerical value type: the answer is a number.

Answer: 60. · Official NTA final key

Q12 JEE Main 2026 · 28 Jan · Shift 1 MCQ

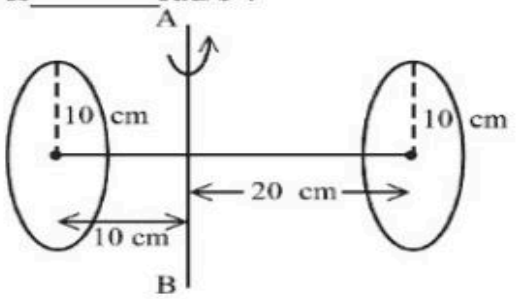
Two circular discs of radius each 10 cm are joined at their centres by a rod of length 30 cm and mass 600 gm as shown in figure.

If the mass of each disc is 600 gm and applied torque between two discs is 43×10^5 dyne.cm, the angular acceleration of the discs about the given axis AB is _____ rad/s^2.

(see the figure above)

Q.36 Two circular discs of radius each 10 cm are joined at their centres by a rod of length 30 cm and mass 600 gm as shown in figure.

If the mass of each disc is 600 gm and applied torque between two discs is 43×10^5 dyne.cm, the angular acceleration of the discs about the given axis AB is_____ rad/s^2.



Options
1. 22
2. 100
3. 27
4. 11

(A) 22
(B) 100
(C) 27
(D) 11

Answer: (D) 11 · Official NTA final key

Q13 JEE Main 2026 · 28 Jan · Shift 1 Numerical

A solid sphere of radius 10 cm is rotating about an axis which is at a distance 15 cm from its centre. The radius of gyration about this axis is $\sqrt{n}$ cm. The value of n is

Numerical value type: the answer is a number.

Answer: 265. · Official NTA final key

Q14 JEE Main 2026 · 28 Jan · Shift 2 Numerical

A fly wheel having mass 3 kg and radius 5 m is free to rotate about a horizontal axis. A string having negligible mass is wound around the wheel and the loose end of the string is connected to 3 kg mass. The mass is kept at rest initially and released. Kinetic energy of the wheel when the mass descends by 3 m is _____ J. (g=10 m/s^2)

Numerical value type: the answer is a number.

Answer: 30. · Official NTA final key

Q15 JEE Main 2026 · 24 Jan · Shift 1 MCQ

Two masses 400 g and 350 g are suspended from the ends of a light string passing over a heavy pulley of radius 2 cm. When released from rest the heavier mass is observed to fall 81 cm in 9 s. The rotational inertia of the pulley is _____ kg.m^2.

($g = 9.8$ m/s^2)

(A) 9.5×10^{-3}
(B) 1.86×10^{-2}
(C) 8.3×10^{-3}
(D) 4.75×10^{-3}

Answer: (A) 9.5×10^{-3} · Official NTA final key

Q16 JEE Main 2026 · 24 Jan · Shift 2 MCQ

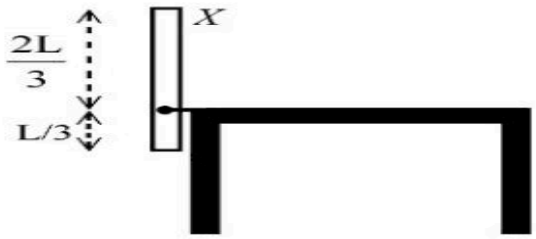
A thin uniform rod (X) of mass M and length L is pivoted at a height $\left(\frac{L}{3}\right)$ as shown in the figure.

The rod is allowed to fall from a vertical position and lie horizontally on the table. The angular velocity of this rod when it hits the table top, is _____.

(g = gravitational acceleration)

(see the figure above)

Q.44 A thin uniform rod (X) of mass M and length L is pivoted at a height $\left(\frac{L}{3}\right)$ as shown in the figure. The rod is allowed to fall from a vertical position and lie horizontally on the table. The angular velocity of this rod when it hits the table top, is _____.
(g = gravitational acceleration)



Options

1. $\sqrt{\frac{3}{2}\frac{g}{L}}$
2. $\frac{3}{\sqrt{2}}\sqrt{\frac{g}{L}}$
3. $\sqrt{\frac{3g}{L}}$
4. $\frac{1}{\sqrt{2}}\sqrt{\frac{g}{L}}$

(A) $\sqrt{\frac{3}{2}\frac{g}{L}}$
(B) $\frac{3}{\sqrt{2}}\sqrt{\frac{g}{L}}$
(C) $\sqrt{\frac{3g}{L}}$
(D) $\frac{1}{\sqrt{2}}\sqrt{\frac{g}{L}}$

Answer: (C) $\sqrt{\frac{3g}{L}}$ · Official NTA final key

Q17 JEE Main 2026 · 24 Jan · Shift 2 Numerical

A uniform solid cylinder of length L and radius R has moment of inertia about its axis equal to I_1. A small co-centric cylinder of length $L/2$ and radius $R/3$ carved from this cylinder has moment of inertia about its axis equals to I_2. The ratio I_1/I_2 is _____.

Numerical value type: the answer is a number.

Answer: 162. · Official NTA final key

Q18 JEE Main 2026 · 23 Jan · Shift 1 MCQ

The moment of inertia of a square loop made of four uniform solid cylinders, each having radius R and length L $(R < L)$ about an axis passing through the mid points of opposite sides, is (Take the mass of the entire loop as M) :

(A) $\frac{3}{4}MR^2 + \frac{1}{6}ML^2$
(B) $\frac{3}{8}MR^2 + \frac{7}{12}ML^2$
(C) $\frac{3}{8}MR^2 + \frac{1}{6}ML^2$
(D) $\frac{3}{4}MR^2 + \frac{7}{12}ML^2$

Answer: (C) $\frac{3}{8}MR^2 + \frac{1}{6}ML^2$ · Official NTA final key

Q19 JEE Main 2026 · 23 Jan · Shift 1 MCQ

Two small balls with masses m and $2m$ are attached to both ends of a rigid rod of length d and negligible mass. If angular momentum of this system is L about an axis (A) passing through its centre of mass and perpendicular to the rod then angular velocity of the system about A is :

(A) $\frac{2L}{5md^2}$
(B) $\frac{4}{3}\frac{L}{md^2}$
(C) $\frac{3}{2}\frac{L}{md^2}$
(D) $\frac{2L}{md^2}$

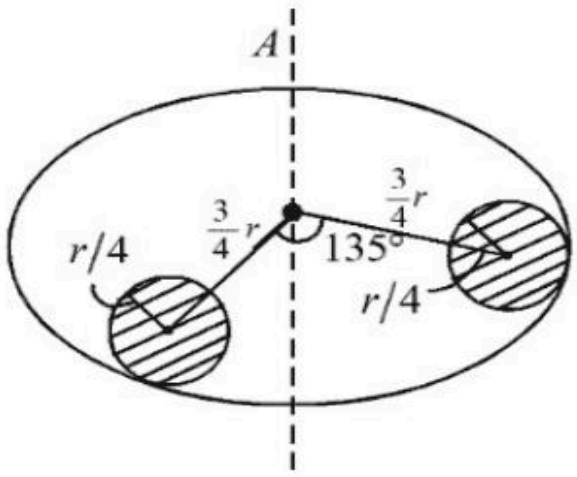
Answer: (C) $\frac{3}{2}\frac{L}{md^2}$ · Official NTA final key

Q20 JEE Main 2026 · 23 Jan · Shift 2 Numerical

Suppose there is a uniform circular disc of mass M kg and radius r m shown in figure. The shaded regions are cut out from the disc. The moment of inertia of the remainder about the axis A of the disc is given by $\frac{x}{256}Mr^2$. The value of x is _____.

(see the figure above)

Q.47 Suppose there is a uniform circular disc of mass M kg and radius r m shown in figure. The shaded regions are cut out from the disc. The moment of inertia of the remainder about the axis A of the disc is given by $\frac{x}{256}Mr^2$. The value of x is_____.



Numerical value type: the answer is a number.

Answer: 109. · Official NTA final key

Q21 JEE Main 2026 · 22 Jan · Shift 1 MCQ

A solid sphere of mass 5 kg and radius 10 cm is kept in contact with another solid sphere of mass 10 kg and radius 20 cm. The moment of inertia of this pair of spheres about the tangent passing through the point of contact is _____ kg.m^2.

(A) 0.18
(B) 0.63
(C) 0.72
(D) 0.36

Answer: (B) 0.63 · Official NTA final key

Q22 JEE Main 2026 · 22 Jan · Shift 1 Numerical

A circular disc has radius R_1 and thickness T_1. Another circular disc made of the same material has radius R_2 and thickness T_2. If the moment of inertia of both discs are same and $\frac{R_1}{R_2} = 2$ then $\frac{T_1}{T_2} = \frac{1}{\alpha}$. The value of α is _____.

Numerical value type: the answer is a number.

Answer: 16. · Official NTA final key

Q23 JEE Main 2026 · 22 Jan · Shift 2 MCQ

Given below are two statements :

Statement I : For a mechanical system of many particles total kinetic energy is the sum of kinetic energies of all the particles.

Statement II : The total kinetic energy can be the sum of kinetic energy of the center of mass w.r.t to the origin and the kinetic energy of all the particles w.r.t. the center of mass as the reference.

In the light of the above statements, choose the **correct** answer from the options given below :

(A) Both **Statement I** and **Statement II** are true
(B) Both **Statement I** and **Statement II** are false
(C) **Statement I** is false but **Statement II** is true
(D) **Statement I** is true but **Statement II** is false

Answer: (A) Both **Statement I** and **Statement II** are true · Official NTA final key

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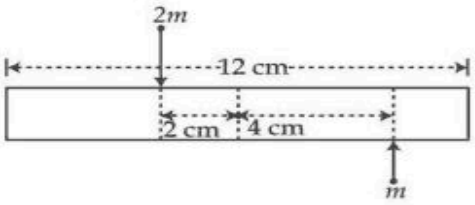
Q24 JEE Main 2026 · 22 Jan · Shift 2 MCQ

A uniform bar of length 12 cm and mass 20 m lies on a smooth horizontal table. Two point masses m and $2m$ are moving in opposite directions with same speed of v and in the same plane as the bar, as shown in figure. These masses strike the bar simultaneously and get stuck to it. After collision the entire system is rotating with angular frequency ω. The ratio of v and ω is :

(see the figure above)

Q.42 A uniform bar of length 12 cm and mass 20 m lies on a smooth horizontal table. Two point masses m and $2m$ are moving in opposite directions with same speed of v and in the same plane as the bar, as shown in figure. These masses strike the bar simultaneously and get stuck to it. After collision the entire system is rotating with angular frequency ω. The ratio of v and ω is :



Options

1. 32
2. $2\sqrt{88}$
3. 66
4. 33

(A) 32
(B) $2\sqrt{88}$
(C) 66
(D) 33

Answer: (D) 33 · Official NTA final key

Q25 JEE Main 2026 · 22 Jan · Shift 2 Numerical

Two masses m and $2m$ are connected by a light string going over a pulley (disc) of mass $30m$ with radius $r = 0.1$ m. The pulley is mounted in a vertical plane and it is free to rotate about its axis. The $2m$ mass is released from rest and its speed when it has descended through a height of 3.6 m is _____ m/s. (Assume string does not slip and g $= 10$ m/s^2)

Numerical value type: the answer is a number.

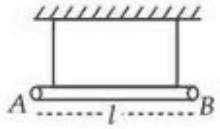
Answer: 2. · Official NTA final key

Q26 JEE Main 2026 · 21 Jan · Shift 1 MCQ

A uniform rod of mass m and length l suspended by means of two identical inextensible light strings as shown in figure. Tension in one string immediately after the other string is cut, is _____. (g acceleration due to gravity)

(see the figure above)

Q.34 A uniform rod of mass m and length l suspended by means of two identical inextensible light strings as shown in figure. Tension in one string immediately after the other string is cut, is _____. (g acceleration due to gravity)



Options

1. $mg/3$
2. $mg/2$
3. $mg/4$
4. mg

(A) $mg/3$
(B) $mg/2$
(C) $mg/4$
(D) mg

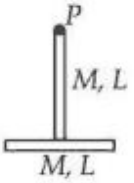
Answer: (C) $mg/4$ · Official NTA final key

Q27 JEE Main 2026 · 21 Jan · Shift 1 Numerical

Two identical thin rods of mass M kg and length L m are connected as shown in figure. Moment of inertia of the combined rod system about an axis passing through point P and perpendicular to the plane of the rods is $\frac{x}{12}ML^2$ kg m^2. The value of x is _____.

(see the figure above)

Q.46 Two identical thin rods of mass M kg and length L m are connected as shown in figure. Moment of inertia of the combined rod system about an axis passing through point P and perpendicular to the plane of the rods is $\frac{x}{12}ML^2$ kg m^2. The value of x is _____.



Numerical value type: the answer is a number.

Answer: 17. · Official NTA final key

Q28 JEE Main 2026 · 21 Jan · Shift 2 MCQ

Two cars A and B each of mass 10^3 kg are moving on parallel tracks separated by a distance of 10 m, in same direction with speeds 72 km/h and 36 km/h. The magnitude of angular momentum of car A with respect to car B is _____ J.s.

(A) 3×10^5

(B) 10^5

(C) 3.6×10^5

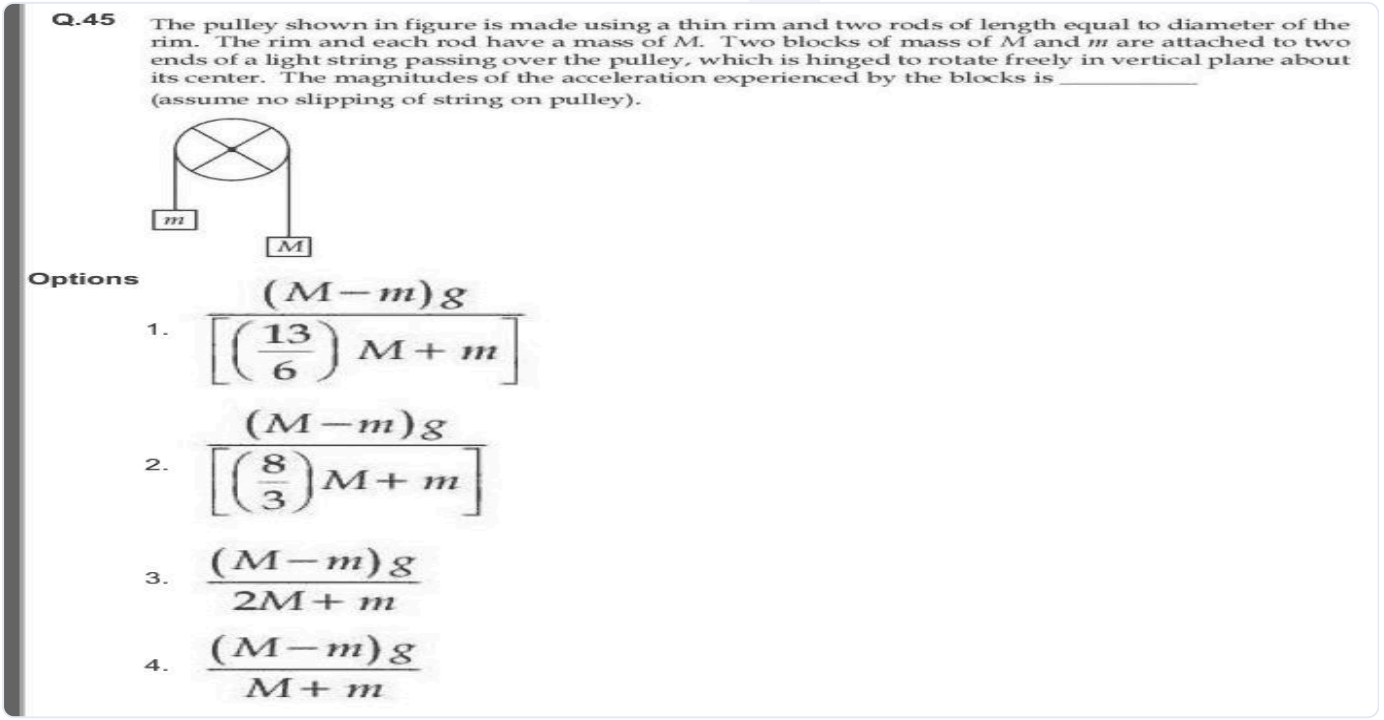
(D) 2×10^5

Answer: (B) 10^5 · Official NTA final key

Q29 JEE Main 2026 · 21 Jan · Shift 2 MCQ

The pulley shown in figure is made using a thin rim and two rods of length equal to diameter of the rim. The rim and each rod have a mass of M. Two blocks of mass of M and m are attached to two ends of a light string passing over the pulley, which is hinged to rotate freely in vertical plane about its center. The magnitudes of the acceleration experienced by the blocks is _____ (assume no slipping of string on pulley).

(see the figure above)



(A) $\frac{(M-m)g}{\left[\left(\frac{13}{6}\right)M+m\right]}$
(B) $\frac{(M-m)g}{\left[\left(\frac{8}{3}\right)M+m\right]}$
(C) $\frac{(M-m)g}{2M+m}$
(D) $\frac{(M-m)g}{M+m}$

Answer: (B) $\frac{(M-m)g}{\left[\left(\frac{8}{3}\right)M+m\right]}$ · Official NTA final key

Q30 JEE Main 2025 · 8 Apr · Shift 2 MCQ

A rod of linear mass density 'λ' and length 'L' is bent to form a ring of radius 'R'. Moment of inertia of ring about any of its diameter is.

(A) $\frac{\lambda L^3}{8\pi^2}$
(B) $\frac{\lambda L^3}{4\pi^2}$
(C) $\frac{\lambda L^3}{16\pi^2}$
(D) $\frac{\lambda L^3}{12}$

Answer: (A) $\frac{\lambda L^3}{8\pi^2}$ · Key from source paper

Q31 JEE Main 2025 · 8 Apr · Shift 2 Numerical

A thin solid disk of 1 kg is rotating along its diameter axis at the speed of 1800 rpm. By applying an external torque of $25\pi\ Nm$ for 40s, the speed increases to 2100 rpm. The diameter of the disk is _____ m.

Numerical value type: the answer is a number.

Answer: 40. · Key from source paper

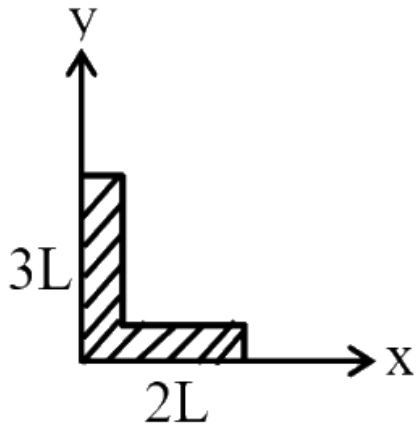
Q32 JEE Main 2025 · 7 Apr · Shift 1 MCQ

A rod of length 5 L is bent right angle keeping one side length as 2 L .

(see the figure above)

The position of the centre of mass of the system: (Consider $L = 10cm$)

2. A rod of length 5 L is bent right angle keeping one side length as 2 L .



The position of the centre of mass of the system: (Consider $L = 10\,cm$)

(1) $3\hat{i} + 7\hat{j}$ (2) $5\hat{i} + 8\hat{j}$ (3) $4\hat{i} + 9\hat{j}$ (4) $2\hat{i} + 3\hat{j}$

(A) $3\hat{i} + 7\hat{j}$
(B) $5\hat{i} + 8\hat{j}$
(C) $4\hat{i} + 9\hat{j}$
(D) $2\hat{i} + 3\hat{j}$

Answer: (C) $4\hat{i} + 9\hat{j}$ · Key from source paper

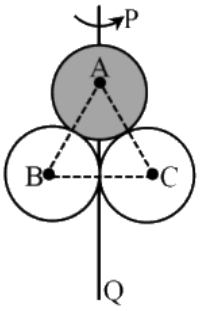
Q33 JEE Main 2025 · 7 Apr · Shift 1 Numerical

A, B and C are disc, solid sphere and spherical shell respectively with same radii and masses. These masses are placed as shown in figure.

(see the figure above)

The moment of inertia of the given system about PQ axis is $\frac{x}{15}I$, where I is the moment of inertia of the disc about its diameter. The value of x is _____ .

25. A, B and C are disc, solid sphere and spherical shell respectively with same radii and masses. These masses are placed as shown in figure.



The moment of inertia of the given system about PQ axis is $\frac{x}{15}$ I, where I is the moment of inertia of the disc about its diameter. The value of x is _____.

Numerical value type: the answer is a number.

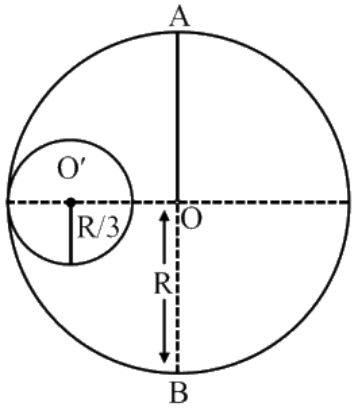
Answer: 199. · Key from source paper

Q34 JEE Main 2025 · 7 Apr · Shift 2 Numerical

M and R be the mass and radius of a disc. A small disc of radius R/3 is removed from the bigger disc as shown in figure. The moment of inertia of remaining part of bigger disc about an axis AB passing through the centre O and perpendicular to the plane of disc is $\frac{4}{x}MR^2$. The value of x is _____ .

(see the figure above)

22. M and R be the mass and radius of a disc. A small disc of radius R/3 is removed from the bigger disc as shown in figure. The moment of inertia of remaining part of bigger disc about an axis AB passing through the centre O and perpendicular to the plane of disc is $\frac{4}{x}\mathrm{MR}^2$. The value of x is _____.



Numerical value type: the answer is a number.

Answer: 9. · Key from source paper

Q35 JEE Main 2025 · 4 Apr · Shift 1 MCQ

Which of the following are correct expression for torque acting on a body?

A. $\vec{\tau} = \vec{r} \times \vec{L}$ B. $\vec{\tau} = \frac{d}{dt}(\vec{r} \times \vec{p})$ C. $\vec{\tau} = \vec{r} \times \frac{d\vec{p}}{dt}$ D. $\vec{\tau} = I\vec{\alpha}$ E. $\vec{\tau} = \vec{r} \times \vec{F}$

($\vec{r}$ = position vector; $\vec{p}$ = linear momentum; $\vec{L}$ = angular momentum; $\vec{\alpha}$ = angular acceleration; I = moment of inertia; $\vec{F}$ = force; t = time)

Choose the correct answer from the options given below:

(A) A, B, D and E Only
(B) C and D Only
(C) B, D and E Only
(D) B, C, D and E Only

Dropped by NTA. Full marks to everyone. · Key from source paper

Q36 JEE Main 2025 · 4 Apr · Shift 1 Numerical

A circular ring and a solid sphere having same radius roll down on an inclined plane from rest without slipping. The ratio of their velocities when reached at the bottom of the plane is $\sqrt{\frac{x}{5}}$ where x = _____

Numerical value type: the answer is a number.

Answer: 4. · Key from source paper

Q37 JEE Main 2025 · 4 Apr · Shift 2 MCQ

A wheel is rolling on a plane surface. The speed of a particle on the highest point of the rim is $8m/s$. The speed of the particle on the rim of the wheel at the same level as the centre of wheel, will be :

(A) $4\sqrt{2}m/s$
(B) $8\sqrt{2}m/s$
(C) $8m/s$
(D) $4m/s$

Answer: (A) $4\sqrt{2}m/s$ · Key from source paper

Q38 JEE Main 2025 · 4 Apr · Shift 2 Numerical

A solid sphere with uniform density and radius R is rotating initially with constant angular velocity (ω_1) about its diameter. After some time during the rotation its starts loosing mass at a uniform rate, with no change in its shape. The angular velocity of the sphere when its radius become $R/2$ is $x\omega_1$. The value of x is _____ .

Numerical value type: the answer is a number.

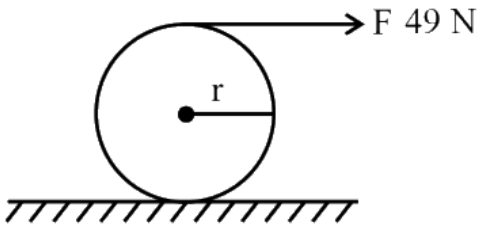
Answer: 32. · Key from source paper

Q39 JEE Main 2025 · 3 Apr · Shift 1 MCQ

A force of 49 N acts tangentially at the highest point of a sphere (solid) of mass 20 kg , kept on a rough horizontal plane. If the sphere rolls without slipping, then the acceleration of the center of the sphere is

(see the figure above)

19. A force of 49 N acts tangentially at the highest point of a sphere (solid) of mass 20 kg , kept on a rough horizontal plane. If the sphere rolls without slipping, then the acceleration of the center of the sphere is



(1) $3.5\,\mathrm{m/s^2}$ (2) $0.25\,\mathrm{m/s^2}$ (3) $2.5\,\mathrm{m/s^2}$ (4) $0.35\,\mathrm{m/s^2}$

(A) $3.5m/s^2$
(B) $0.25m/s^2$
(C) $2.5m/s^2$
(D) $0.35m/s^2$

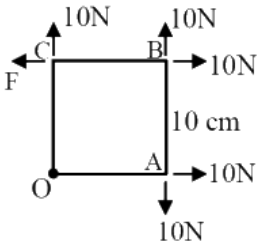
Answer: (A) $3.5m/s^2$ · Key from source paper

Q40 JEE Main 2025 · 2 Apr · Shift 1 MCQ

A square Lamina OABC of length 10 cm is pivoted at ' O '. Forces act at Lamina as shown in figure. If Lamina remains stationary, then the magnitude of F is:

(see the figure above)

3. A square Lamina OABC of length 10 cm is pivoted at ' O '. Forces act at Lamina as shown in figure. If Lamina remains stationary, then the magnitude of F is:



(1) 20 N (2) 10 N (3) $10\sqrt{2}N$ (4) 0 (zero)

(A) 20 N
(B) 10 N
(C) $10\sqrt{2}N$
(D) 0 (zero)

Answer: (B) 10 N · Key from source paper

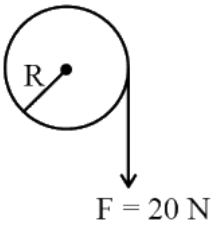
Q41 JEE Main 2025 · 2 Apr · Shift 1 MCQ

A cord of negligible mass is wound around the rim of a wheel supported by spokes with negligible mass. The mass of wheel is 10 kg and radius is 10 cm and it can freely rotate without any friction. Initially the wheel is at rest. If a steady pull of 20 N is applied on the cord, the angular velocity of the wheel, after the cord is unwound by 1 m, would be :

(see the figure above)

PHYSICS **02-04-2025 (MORNING SESSION)**

14. A cord of negligible mass is wound around the rim of a wheel supported by spokes with negligible mass. The mass of wheel is 10 kg and radius is 10 cm and it can freely rotate without any friction. Initially the wheel is at rest. If a steady pull of 20 N is applied on the cord, the angular velocity of the wheel, after the cord is unwound by 1 m, would be :



(1) 10 rad/s (2) 30 rad/s (3) 20 rad/s (4) 0 rad/s

(A) 10 rad/s
(B) 30 rad/s
(C) 20 rad/s
(D) 0 rad/s

Answer: (C) 20 rad/s · Key from source paper

Q42 JEE Main 2025 · 2 Apr · Shift 1 MCQ

Moment of inertia of a rod of mass 'M' and length 'L' about an axis passing through its center and normal to its length is ' α'. Now the rod is cut into two equal parts and these parts are joined symmetrically to form a cross shape. Moment of inertia of cross about an axis passing through its center and normal to plane containing cross is :

(A) $\alpha/4$
(B) $\alpha/2$
(C) α
(D) $\alpha/8$

Answer: (A) $\alpha/4$ · Key from source paper

Q43 JEE Main 2025 · 2 Apr · Shift 2 MCQ

The moment of inertia of a circular ring of mass M and diameter r about a tangential axis lying in the plane of the ring is :

(A) $\frac{3}{8}Mr^2$
(B) $\frac{3}{2}Mr^2$
(C) $2Mr^2$
(D) $\frac{1}{2}Mr^2$

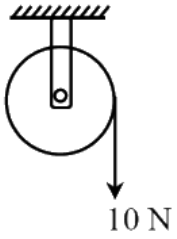
Answer: (A) $\frac{3}{8}Mr^2$ · Key from source paper

Q44 JEE Main 2025 · 2 Apr · Shift 2 Numerical

A wheel of radius 0.2 m rotates freely about its center when a string that is wrapped over its rim is pulled by force of 10 N as shown in figure. The established torque produces an angular acceleration of $2rad/s^2$. Moment of intertia of the wheel is _____ kgm^2. (Acceleration due to gravity $= 10m/s^2$)

(see the figure above)

22. A wheel of radius 0.2 m rotates freely about its center when a string that is wrapped over its rim is pulled by force of 10 N as shown in figure. The established torque produces an angular acceleration of $2rad/s^2$. Moment of intertia of the wheel is _____ kgm^2. (Acceleration due to gravity $=10m/s^2$)



Numerical value type: the answer is a number.

Answer: 1. · Key from source paper

Q45 JEE Main 2025 · 29 Jan · Shift 1 Numerical

The coordinates of a particle with respect to origin in a given reference frame is $(1, 1, 1)$ meters. If a force of $\vec{F} = \hat{i} - \hat{j} + \hat{k}$ acts on the particle, then the magnitude of torque (with respect to origin) in z-direction is _____ .

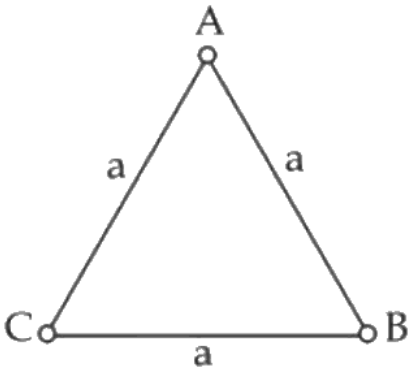
Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q46 JEE Main 2025 · 29 Jan · Shift 2 MCQ

see figure

Q34.



Three equal masses m are kept at vertices (A, B, C) of an equilateral triangle of side a in free space. At $t = 0$, they are given an initial velocity $\vec{V}_A = V_0\overrightarrow{AC}, \vec{V}_B = V_0\overrightarrow{BA}$ and $\vec{V}_C = V_0\overrightarrow{CB}$. Here, $\overrightarrow{AC}, \overrightarrow{CB}$ and $\overrightarrow{BA}$ are unit vectors along the edges of the triangle. If the three masses interact gravitationally, then the magnitude of the net angular momentum of the system at the point of collision is :

(1) $3amV_0$
(2) $\frac{3}{2}$ a mV_0
(3) $\frac{\sqrt{3}}{2}$ a mV_0
(4) $\frac{1}{2}$ a mV_0

(A) $3amV_0$
(B) $\frac{3}{2}$ a mV_0
(C) $\frac{\sqrt{3}}{2}$ a mV_0
(D) $\frac{1}{2}$ a mV_0

Answer: (C) $\frac{\sqrt{3}}{2}$ a mV_0 · Key from source paper

Q47 JEE Main 2025 · 28 Jan · Shift 1 MCQ

The center of mass of a thin rectangular plate (fig - x) with sides of length a and b, whose mass per unit area (σ) varies as $\sigma = \frac{\sigma_0 x}{ab}$ (where σ_0 is a constant), would be

(see the figure above)

Q42. The center of mass of a thin rectangular plate (fig - x) with sides of length a and b, whose mass per unit area

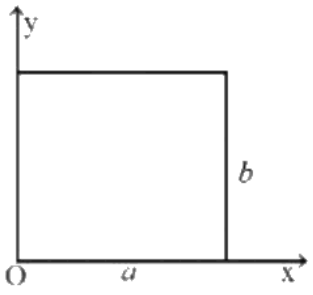


fig-x

(σ) varies as $\sigma = \frac{\sigma_0 x}{ab}$ (where σ_0 is a constant), would be

(1) $\left(\frac{2}{3}a, \frac{b}{2}\right)$
(2) $\left(\frac{a}{2}, \frac{b}{2}\right)$
(3) $\left(\frac{1}{3}a, \frac{b}{2}\right)$
(4) $\left(\frac{2}{3}a, \frac{2}{3}b\right)$

(A) $\left(\frac{2}{3}a, \frac{b}{2}\right)$
(B) $\left(\frac{a}{2}, \frac{b}{2}\right)$
(C) $\left(\frac{1}{3}a, \frac{b}{2}\right)$
(D) $\left(\frac{2}{3}a, \frac{2}{3}b\right)$

Answer: (A) $\left(\frac{2}{3}a, \frac{b}{2}\right)$ · Key from source paper

Q48 JEE Main 2025 · 28 Jan · Shift 1 Numerical

Two iron solid discs of negligible thickness have radii R_1 and R_2 and moment of intertia I_1 and I_2, respectively. For $R_2 = 2R_1$, the ratio of I_1 and I_2 would be $1/x$, where x = _____ .

Numerical value type: the answer is a number.

Answer: 16. · Key from source paper

Q49 JEE Main 2025 · 28 Jan · Shift 1 Numerical

The moment of inertia of a solid disc rotating along its diameter is 2.5 times higher than the moment of inertia of a ring rotating in similar way. The moment of inertia of a solid sphere which has same radius as the disc and rotating in similar way, is n times higher than the moment of inertia of the given ring. Here, n = _____ Consider all the bodies have equal masses.

Numerical value type: the answer is a number.

Answer: 4. · Key from source paper

Q50 JEE Main 2025 · 28 Jan · Shift 2 MCQ

A uniform rod of mass 250 g having length 100 cm is balanced on a sharp edge at 40 cm mark. A mass of 400 g is suspended at 10 cm mark. To maintain the balance of the rod, the mass to be suspended at 90 cm mark, is

(A) 190 g
(B) 200 g
(C) 300 g
(D) 290 g

Answer: (A) 190 g · Key from source paper

Q51 JEE Main 2025 · 24 Jan · Shift 1 MCQ

A uniform solid cylinder of mass ' m ' and radius ' r ' rolls along an inclined rough plane of inclination 45°. If it starts to roll from rest from the top of the plane then the linear acceleration of the cylinder's axis will be

(A) $\frac{1}{\sqrt{2}}$ g
(B) $\frac{1}{3\sqrt{2}}$ g
(C) $\frac{\sqrt{2}g}{3}$
(D) $\sqrt{2}g$

Answer: (C) $\frac{\sqrt{2}g}{3}$ · Key from source paper

Q52 JEE Main 2025 · 24 Jan · Shift 1 MCQ

An object of mass ' m ' is projected from origin in a vertical xy plane at an angle 45° with the x axis with an initial velocity v_0. The magnitude and direction of the angular momentum of the object with respect to origin, when it reaches at the maximum height, will be [g is acceleration due to gravity]

(A) $\frac{mv_o^3}{2\sqrt{2}g}$ along negative z-axis
(B) $\frac{mv_o^3}{4\sqrt{2}g}$ along positive z-axis
(C) $\frac{mv_o^3}{4\sqrt{2}g}$ along negative z-axis
(D) $\frac{mv_o^3}{2\sqrt{2}g}$ along positive z-axis

Answer: (C) $\frac{mv_o^3}{4\sqrt{2}g}$ **along negative** z**-axis** · Key from source paper

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Q53 JEE Main 2025 · 24 Jan · Shift 2 MCQ

A solid sphere and a hollow sphere of the same mass and of same radius are rolled on an inclined plane. Let the time taken to reach the bottom by the solid sphere and the hollow sphere be t_1 and t_2, respectively, then

(A) $t_1 > t_2$
(B) $t_1 = t_2$
(C) $t_1 < t_2$
(D) $t_1 = 2t_2$

Answer: (C) $t_1 < t_2$ · Key from source paper

Q54 JEE Main 2025 · 24 Jan · Shift 2 MCQ

A solid sphere is rolling without slipping on a horizontal plane. The ratio of the linear kinetic energy of the centre of mass of the sphere and rotational kinetic energy is :

(A) $\frac{3}{4}$
(B) $\frac{4}{3}$
(C) $\frac{5}{2}$
(D) $\frac{2}{5}$

Answer: (C) $\frac{5}{2}$ · Key from source paper

Q55 JEE Main 2025 · 23 Jan · Shift 1 MCQ

Consider a circular disc of radius 20 cm with centre located at the origin. A circular hole of radius 5 cm is cut from this disc in such a way that the edge of the hole touches the edge of the disc. The distance of centre of mass of residual or remaining disc from the origin will be

(A) 2.0 cm
(B) 1.5 cm
(C) 1.0 cm
(D) 0.5 cm

Answer: (C) 1.0 cm · Key from source paper

Q56 JEE Main 2025 · 23 Jan · Shift 1 MCQ

A solid sphere of mass ' m ' and radius ' r ' is allowed to roll without slipping from the highest point of an inclined plane of length ' L ' and makes an angle 30° with the horizontal. The speed of the particle at the bottom of the plane is v_1. If the angle of inclination is increased to 45° while keeping L constant. Then the new speed of the sphere at the bottom of the plane is v_2. The ratio $v_1^2 : v_2^2$ is

(A) $1 : \sqrt{2}$
(B) $1 : \sqrt{3}$
(C) $1 : 3$
(D) $1 : 2$

Answer: (A) $1 : \sqrt{2}$ · Key from source paper

Q57 JEE Main 2025 · 23 Jan · Shift 2 MCQ

A circular disk of radius R meter and mass M kg is rotating around the axis perpendicular to the disk. An external torque is applied to the disk such that $\theta(t) = 5t^2 - 8t$, where $\theta(t)$ is the angular position of the rotating disc as a function of time t. How much power is delivered by the applied torque, when $t = 2$ s ?

(A) $72\mathrm{MR}^2$
(B) $8\mathrm{MR}^2$
(C) $108\mathrm{MR}^2$
(D) $60\mathrm{MR}^2$

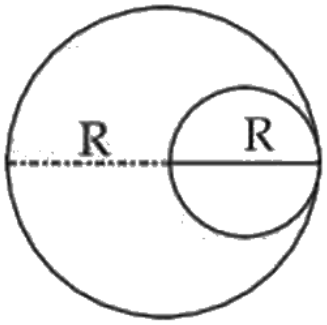
Answer: (D) $60\mathrm{MR}^2$ · Key from source paper

Q58 JEE Main 2025 · 22 Jan · Shift 1 MCQ

A uniform circular disc of radius ' R ' and mass ' M ' is rotating about an axis perpendicular to its plane and passing through its centre. A small circular part of radius R/2 is removed from the original disc as shown in the figure. Find the moment of inertia of the remaining part of the original disc about the axis as given above.

(see the figure above)

Q28. A uniform circular disc of radius ' R ' and mass ' M ' is rotating about an axis perpendicular to its plane and passing through its centre. A small circular part of radius $R/2$ is removed from the original disc as shown in the figure. Find the moment of inertia of the remaining part of the original disc about the axis as given above.



(1) $\frac{7}{32}MR^2$
(2) $\frac{9}{32}MR^2$
(3) $\frac{17}{32}MR^2$
(4) $\frac{13}{32}MR^2$

(A) $\frac{7}{32}MR^2$
(B) $\frac{9}{32}MR^2$
(C) $\frac{17}{32}MR^2$
(D) $\frac{13}{32}MR^2$

Answer: (D) $\frac{13}{32}MR^2$ · Key from source paper

Q59 JEE Main 2025 · 22 Jan · Shift 1 Numerical

The position vectors of two 1 kg particles, (A) and (B), are given by $\overrightarrow{r_A} = \left(\alpha_1 t^2\hat{i} + \alpha_2 t\hat{j} + \alpha_3 t\hat{k}\right)$m and $\overrightarrow{r_B} = \left(\beta_1 t\hat{i} + \beta_2 t^2\hat{j} + \beta_3 t\hat{k}\right)$m, respectively;
$\left(\alpha_1 = 1\ \text{m/s}^2, \alpha_2 = 3\text{nm/s}, \alpha_3 = 2\ \text{m/s}, \beta_1 = 2\ \text{m/s}, \beta_2 = -1\ \text{m/s}^2, \beta_3 = 4\text{pm/s}\right)$, where t is time, n and p are constants. At $t = 1$ s, $\left|\overrightarrow{V_A}\right| = \left|\overrightarrow{V_B}\right|$ and velocities $\vec{V}_A$ and $\vec{V}_B$ of the particles are orthogonal to each other. At $t = 1$ s, the magnitude of angular momentum of particle (A) with respect to the position of particle (B) is $\sqrt{\text{L}}\,\text{kgm}^2\,\text{s}^{-1}$. The value of L is _____ .

Numerical value type: the answer is a number.

Answer: 90. · Key from source paper

Q60 JEE Main 2025 · 22 Jan · Shift 2 MCQ

The torque due to the force $(2\hat{i} + \hat{j} + 2\hat{k})$ about the origin, acting on a particle whose position vector is $(\hat{i} + \hat{j} + \hat{k})$, would be

(A) $\hat{i}-\hat{k}$
(B) $\hat{i}+\hat{k}$
(C) $\hat{j}+\hat{k}$
(D) $\hat{i}-\hat{j}+\hat{k}$

Answer: (A) $\hat{i}-\hat{k}$ · Key from source paper

Q61 JEE Main 2024 · 9 Apr · Shift 1 MCQ

A heavy iron bar, of weight W is having its one end on the ground and the other on the shoulder of a person. The bar makes an angle θ with the horizontal. The weight experienced by the person is :

(A) W cos θ
(B) $\frac{W}{2}$
(C) W
(D) W sin θ

Answer: (B) $\frac{W}{2}$ · Key from source paper

Q62 JEE Main 2024 · 9 Apr · Shift 1 Numerical

A string is wrapped around the rim of a wheel of moment of inertia 0.40kgm^2 and radius 10 cm. The wheel is free to rotate about its axis. Initially the wheel is at rest. The string is now pulled by a force of 40 N. The angular velocity of the wheel after 10 s is $x$rad/s, where x is _____

Numerical value type: the answer is a number.

Answer: 100. · Key from source paper

Q63 JEE Main 2024 · 9 Apr · Shift 2 Numerical

A circular disc reaches from top to bottom of an inclined plane of length l. When it slips down the plane, if takes t s. When it rolls down the plane then it takes $\left(\frac{\alpha}{2}\right)^{1/2} t$ s, where α is _____.

Numerical value type: the answer is a number.

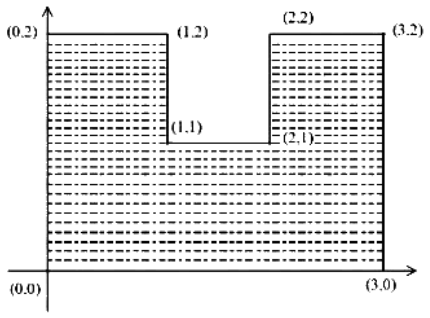
Answer: 3. · Key from source paper

Q64 JEE Main 2024 · 8 Apr · Shift 1 Numerical

A uniform thin metal plate of mass 10 kg with dimensions is shown. The ratio of x and y coordinates of center of mass of plate in $\frac{n}{9}$. The value of n is _____

(see the figure above)

Q22. A uniform thin metal plate of mass 10 kg with dimensions is shown. The ratio of x and y coordinates of center



of mass of plate in $\frac{n}{9}$. The value of n is _____

Numerical value type: the answer is a number.

Answer: 15. · Key from source paper

Q65 JEE Main 2024 · 8 Apr · Shift 2 MCQ

A thin circular disc of mass M and radius R is rotating in a horizontal plane about an axis passing through its centre and perpendicular to its plane with angular velocity ω. If another disc of same dimensions but of mass M/2 is placed gently on the first disc co-axially, then the new angular velocity of the system is :

(A) $\frac{3}{2}\omega$
(B) $\frac{5}{4}\omega$
(C) $\frac{2}{3}\omega$
(D) $\frac{4}{5}\omega$

Answer: (C) $\frac{2}{3}\omega$ · Key from source paper

Q66 JEE Main 2024 · 6 Apr · Shift 1 Numerical

If the radius of earth is reduced to three-fourth of its present value without change in its mass then value of duration of the day of earth will be _____ hours 30 minutes.

Numerical value type: the answer is a number.

Answer: 13. · Key from source paper

Q67 JEE Main 2024 · 6 Apr · Shift 2 Numerical

Three balls of masses 2 kg, 4 kg and 6 kg respectively are arranged at centre of the edges of an equilateral triangle of side 2 m. The moment of intertia of the system about an axis through the centroid and perpendicular to the plane of triangle, will be _____ kgm^2.

Numerical value type: the answer is a number.

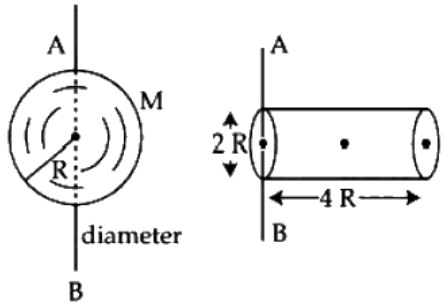
Answer: 4. · Key from source paper

Q68 JEE Main 2024 · 5 Apr · Shift 1 MCQ

Ratio of radius of gyration of a hollow sphere to that of a solid cylinder of equal mass, for moment of Inertia about their diameter axis AB as shown in figure is $\sqrt{8/x}$. The value of x is :

(see the figure above)

Q6. Ratio of radius of gyration of a hollow sphere to that of a solid cylinder of equal mass, for moment of Inertia about their diameter axis AB as shown in figure is $\sqrt{8/x}$. The value of x is :



(1) 51
(2) 34
(3) 17
(4) 67

(A) 51
(B) 34
(C) 17
(D) 67

Answer: (D) 67 · Key from source paper

Q69 JEE Main 2024 · 5 Apr · Shift 2 Numerical

A hollow sphere is rolling on a plane surface about its axis of symmetry. The ratio of rotational kinetic energy to its total kinetic energy is $\frac{x}{5}$. The value of x is _____ .

Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q70 JEE Main 2024 · 4 Apr · Shift 1 Numerical

A solid sphere and a hollow cylinder roll up without slipping on same inclined plane with same initial speed v. The sphere and the cylinder reaches upto maximum heights h_1 and h_2, respectively, above the initial level. The ratio $h_1 : h_2$ is $\frac{n}{10}$. The value of n is _____.

Numerical value type: the answer is a number.

Answer: 7. · Key from source paper

Q71 JEE Main 2024 · 4 Apr · Shift 2 Numerical

In a system two particles of masses $m_1 = 3$ kg and $m_2 = 2$ kg are placed at certain distance from each other. The particle of mass m_1 is moved towards the center of mass of the system through a distance

2 cm. In order to keep the center of mass of the system at the original position, the particle of mass m_2 should move towards the center of mass by the distance _____ cm.

Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q72 JEE Main 2024 · 1 Feb · Shift 1 Numerical

The identical spheres each of mass $2M$ are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 4 m each. Taking point of intersection of these two sides as origin, the magnitude of position vector of the centre of mass of the system is $\frac{4\sqrt{2}}{x}$, where the value of x is _____.

Numerical value type: the answer is a number.

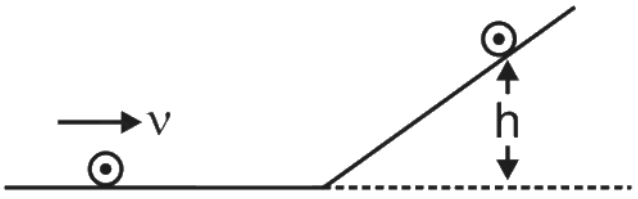
Answer: 3. · Key from source paper

Q73 JEE Main 2024 · 1 Feb · Shift 2 MCQ

A disc of radius R and mass M is rolling horizontally without slipping with speed v. It then moves up an inclined smooth surface as shown in figure. The maximum height that the disc can go up the incline is:

(see the figure above)

Q5. A disc of radius R and mass M is rolling horizontally without slipping with speed v. It then moves up an inclined smooth surface as shown in figure. The maximum height that the disc can go up the incline is:



(1) $\frac{v^2}{g}$ (2) $\frac{3}{4}\frac{v^2}{g}$

(3) $\frac{1}{2}\frac{v^2}{g}$ (4) $\frac{2}{3}\frac{v^2}{g}$

(A) $\frac{v^2}{g}$

(B) $\frac{3}{4}\frac{v^2}{g}$

(C) $\frac{1}{2}\frac{v^2}{g}$

(D) $\frac{2}{3}\frac{v^2}{g}$

Answer: (C) $\frac{1}{2}\frac{v^2}{g}$ · Key from source paper

Q74 JEE Main 2024 · 1 Feb · Shift 2 Numerical

A uniform rod AB of mass 2 kg and Length 30 cm at rest on a smooth horizontal surface. An impulse of force 0.2 N s is applied to end B. The time taken by the rod to turn through at right angles will be $\frac{\pi}{x}$ s, where x = _____.

Numerical value type: the answer is a number.

Answer: 4. · Key from source paper

Q75 JEE Main 2024 · 31 Jan · Shift 1 Numerical

A solid circular disc of mass 50 kg rolls along a horizontal floor so that its center of mass has a speed of 0.4 m s^{-1}. The absolute value of work done on the disc to stop it is _____ J.

Numerical value type: the answer is a number.

Answer: 6. · Key from source paper

Q76 JEE Main 2024 · 31 Jan · Shift 2 Numerical

Two identical spheres each of mass 2 kg and radius 50 cm are fixed at the ends of a light rod so that the separation between the centers is 150 cm. Then, moment of inertia of the system about an axis perpendicular to the rod and passing through its middle point is $\frac{x}{20}$ kg m^2, where the value of x is

Numerical value type: the answer is a number.

Answer: 53. · Key from source paper

Q77 JEE Main 2024 · 31 Jan · Shift 2 Numerical

A body of mass m is projected with a speed u making an angle of 45° with the ground. The angular momentum of the body about the point of projection, at the highest point is expressed as $\frac{\sqrt{2}mu^3}{Xg}$. The value of X is _____.

Numerical value type: the answer is a number.

Answer: 8. · Key from source paper

Q78 JEE Main 2024 · 30 Jan · Shift 1 MCQ

A particle of mass m projected with a velocity u making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is :

(A) $\frac{\sqrt{3}}{16}\frac{mu^3}{g}$
(B) $\frac{\sqrt{3}}{2}\frac{mu^2}{g}$
(C) $\frac{mu^3}{\sqrt{2}g}$
(D) zero

Answer: (A) $\frac{\sqrt{3}}{16}\frac{mu^3}{g}$ · Key from source paper

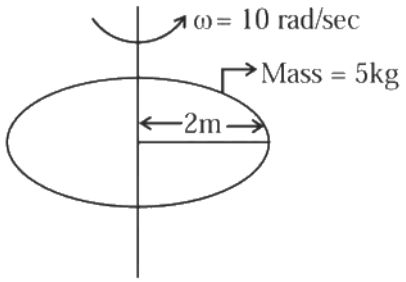
Q79 JEE Main 2024 · 30 Jan · Shift 1 Numerical

Consider a disc of mass 5 kg, radius 2 m, rotating with angular velocity of 10 rad s^{-1} about an axis perpendicular to the plane of rotation. An identical disc is kept gently over the rotating disc along the

same axis. The energy dissipated so that both the discs continue to rotate together without slipping is _____ J.

(see the figure above)

Q22. Consider a disc of mass 5 kg, radius 2 m, rotating with angular velocity of 10 rad s^{-1} about an axis perpendicular to the plane of rotation. An identical disc is kept gently over the rotating disc along the same axis. The energy dissipated so that both the discs continue to rotate together without slipping is _____J.



Numerical value type: the answer is a number.

Answer: 250. · Key from source paper

Q80 JEE Main 2024 · 30 Jan · Shift 2 Numerical

Two discs of moment of inertia $I_1 = 4\ \text{kg m}^2$ and $I_2 = 2\ \text{kg m}^2$ about their central axes & normal to their planes, rotating with angular speeds 10 rad s^{-1} & 4 rad s^{-1} respectively are brought into contact face to face with their axe of rotation coincident. The loss in kinetic energy of the system in the process is _____ J.

Numerical value type: the answer is a number.

Answer: 24. · Key from source paper

Q81 JEE Main 2024 · 29 Jan · Shift 1 Numerical

A cylinder is rolling down on an inclined plane of inclination 60°. Its acceleration during rolling down will be $\frac{x}{\sqrt{3}}$ m s^{-2}, where x = _____ (use $g = 10$ m s^{-2}).

Numerical value type: the answer is a number.

Answer: 10. · Key from source paper

Q82 JEE Main 2024 · 29 Jan · Shift 2 Numerical

A body of mass 5 kg moving with a uniform speed $3\sqrt{2}$ m s^{-1} in $X - Y$ plane along the line $y = x + 4$. The angular momentum of the particle about the origin will be _____ kg m^2 s^{-1}.

Numerical value type: the answer is a number.

Answer: 60. · Key from source paper

Q83 JEE Main 2024 · 27 Jan · Shift 1 Numerical

Four particles, each of mass 1 kg are placed at four corners of a square of side 2 m. The moment of inertia of the system about an axis perpendicular to its plane and passing through one of its vertex is _____ kg m^2.

Numerical value type: the answer is a number.

Answer: 16. · Key from source paper

Q84 JEE Main 2024 · 27 Jan · Shift 2 MCQ

A heavy iron bar of weight 12 kg is having its one end on the ground and the other on the shoulder of a man. The rod makes an angle 60° with the horizontal, the normal force applied by the man on bar is:

(A) 6 kg - wt
(B) 12 kg - wt
(C) 3 kg - wt
(D) $6\sqrt{3}$ kg - wt

Answer: (C) 3 kg - wt · Key from source paper

Q85 JEE Main 2024 · 27 Jan · Shift 2 Numerical

A ring and a solid sphere roll down the same inclined plane without slipping. They start from rest. The radii of both bodies are identical and the ratio of their kinetic energies is $\frac{7}{x}$, where x is _____.

Numerical value type: the answer is a number.

Answer: 7. · Key from source paper

Q86 JEE Main 2023 · 15 Apr · Shift 1 Numerical

A solid sphere and a solid cylinder of same mass and radius are rolling on a horizontal surface without slipping. The ratio of their radius of gyrations respectively (k_{sph} : k_{cyl}) is 2 : $\sqrt{x}$. The value of x is _____.

Numerical value type: the answer is a number.

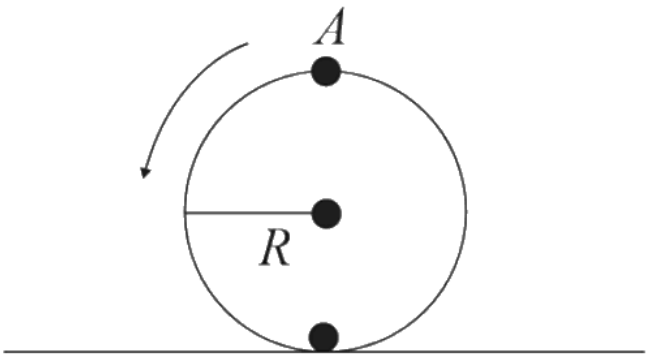
Answer: 5. · Key from source paper

Q87 JEE Main 2023 · 13 Apr · Shift 1 MCQ

A disc is rolling without slipping on a surface. The radius of the disc is R. At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is

(see the figure above)

Q2. A disc is rolling without slipping on a surface. The radius of the disc is R. At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is



(1) $2R$
(2) $R\sqrt{(\pi^2+4)}$
(3) $\mathrm{R}\sqrt{(\pi^2+1)}$
(4) $2R\sqrt{(1+4\pi^2)}$

(A) $2R$
(B) $R\sqrt{\pi^2+4}$
(C) $R\sqrt{\pi^2+1}$
(D) $2R\sqrt{1+4\pi^2}$

Answer: (B) $R\sqrt{\pi^2+4}$ · Key from source paper

Q88 JEE Main 2023 · 13 Apr · Shift 1 Numerical

A solid sphere is rolling on a horizontal plane without slipping. If the ratio of angular momentum about axis of rotation of the sphere to the total energy of moving sphere is $\pi : 22$ then, the value of its angular speed will be _____ rad s^{-1}.

Numerical value type: the answer is a number.

Answer: 4. · Key from source paper

Q89 JEE Main 2023 · 13 Apr · Shift 2 Numerical

A light rope is wound around a hollow cylinder of mass 5 kg and radius 70 cm. The rope is pulled with a force of 52.5 N. The angular acceleration of the cylinder will be _____ rad s^{-2}.

Numerical value type: the answer is a number.

Answer: 15. · Key from source paper

Q90 JEE Main 2023 · 12 Apr · Shift 1 Numerical

For rolling spherical shell, the ratio of rotational kinetic energy and total kinetic energy is $\frac{x}{5}$. The value of x is _____.

Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q91 JEE Main 2023 · 11 Apr · Shift 1 Numerical

A solid sphere of mass 500 g radius 5 cm is rotated about one of its diameter with angular speed of $10\ \mathrm{rad\ s^{-1}}$. If the moment of inertia of the sphere about its tangent is $x \times 10^{-2}$ times its angular momentum about the diameter. Then the value of x will be

Numerical value type: the answer is a number.

Answer: 35. · Key from source paper

Q92 JEE Main 2023 · 11 Apr · Shift 2 Numerical

A circular plate is rotating in horizontal plane, about an axis passing through its centre and perpendicular to the plate, with an angular velocity ω. A person sits at the centre having two dumbbells in his hands. When he stretched out his hands, the moment of inertia of the system becomes triple. If E be the initial Kinetic energy of the system, then final Kinetic energy will be $\frac{E}{x}$. The value of x is

Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q93 JEE Main 2023 · 10 Apr · Shift 1 Numerical

If the earth suddenly shrinks to $\frac{1}{64}$th of its original volume with its mass remaining the same, the period of rotation of earth becomes $\frac{24}{x}$h. The value of x is _____

Numerical value type: the answer is a number.

Answer: 16. · Key from source paper

Q94 JEE Main 2023 · 10 Apr · Shift 2 Numerical

A force of $-P\hat{k}$ acts on the origin of the coordinate system. The torque about the point $(2, -3)$ is $P(a\hat{i} + b\hat{j})$, The ratio of $\frac{a}{b}$ is $\frac{x}{2}$. The value of x is

Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q95 JEE Main 2023 · 8 Apr · Shift 1 Numerical

The moment of inertia of a semicircular ring about an axis, passing through the center and perpendicular to the plane of ring, is $\frac{1}{x}\mathrm{MR}^2$, where R is the radius and M is the mass of the semicircular ring. The value of x will be _____.

Numerical value type: the answer is a number.

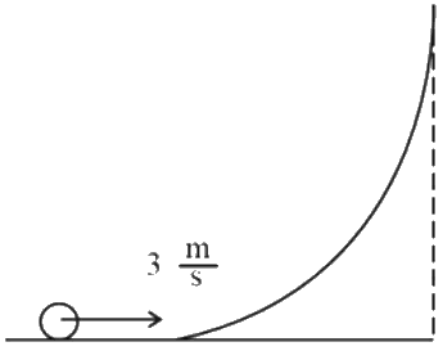
Answer: 1. · Key from source paper

Q96 JEE Main 2023 · 8 Apr · Shift 2 Numerical

A hollow spherical ball of uniform density rolls up a curved surface with an initial velocity $3\ \mathrm{m\,s^{-1}}$ (as shown in figure). Maximum height with respect to the initial position covered by it will be _____ cm (take, $g = 10\ \mathrm{m\,s^{-2}}$)

(see the figure above)

Q6. A hollow spherical ball of uniform density rolls up a curved surface with an initial velocity $3\ \mathrm{m\,s^{-1}}$ (as shown in figure). Maximum height with respect to the initial position covered by it will be _____ cm (take, $g = 10\ \mathrm{m\,s^{-2}}$)



Numerical value type: the answer is a number.

Answer: 75. · Key from source paper

Q97 JEE Main 2023 · 6 Apr · Shift 1 Numerical

Two identical solid spheres each of mass $2\ \mathrm{kg}$ and radii $10\ \mathrm{cm}$ are fixed at the ends of a light rod. The separation between the centres of the spheres is $40\ \mathrm{cm}$. The moment of inertia of the system about an axis perpendicular to the rod passing through its middle point is _____ $\times 10^{-3}\ \mathrm{kg\ m^2}$.

Numerical value type: the answer is a number.

Answer: 176. · Key from source paper

Q98 JEE Main 2023 · 6 Apr · Shift 2 Numerical

A ring and a solid sphere rotating about an axis passing through their centres have same radii of gyration. The axis of rotation is perpendicular to plane of ring. The ratio of radius of ring to that of sphere is $\sqrt{\frac{2}{x}}$. The value of x is _____ .

Numerical value type: the answer is a number.

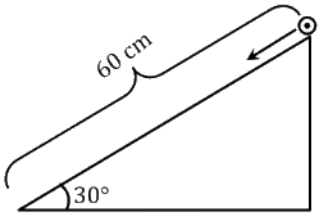
Answer: 5. · Key from source paper

Q99 JEE Main 2023 · 1 Feb · Shift 1 Numerical

A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60 cm. If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is _____ $\mathrm{m\ s^{-1}}$. (Given g = 10 $\mathrm{m\ s^{-2}}$)

(see the figure above)

Q22. A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60 cm. If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is _____ m s^{-1}. (Given $g = 10$ m s^{-2})



Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q100 JEE Main 2023 · 1 Feb · Shift 2 Numerical

Moment of inertia of a disc of mass M and radius 'R' about any of its diameter is $\frac{MR^2}{4}$. The moment of inertia of this disc about an axis normal to the disc and passing through a point on its edge will be, $\frac{x}{2}MR^2$. The value of x is _____.

Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q101 JEE Main 2023 · 31 Jan · Shift 1 Numerical

A solid sphere of mass 1 kg rolls without slipping on a plane surface. Its kinetic energy is 7×10^{-3} J. The speed of the centre of mass of the sphere is _____ cm s^{-1}.

Numerical value type: the answer is a number.

Answer: 10. · Key from source paper

Q102 JEE Main 2023 · 31 Jan · Shift 2 Numerical

Two discs of same mass and different radii are made of different materials such that their thicknesses are 1 cm and 0.5 cm respectively. The densities of materials are in the ratio 3 : 5. The moment of inertia of these discs respectively about their diameters will be in the ratio of $\frac{x}{6}$. The value of x is _____.

Numerical value type: the answer is a number.

Answer: 5. · Key from source paper

Q103 JEE Main 2023 · 30 Jan · Shift 1 Numerical

A thin uniform rod of length 2 m, cross sectional area A and density d is rotated about an axis passing through the centre and perpendicular to its length with angular velocity ω. If value of ω in terms of its rotational kinetic energy E is $\sqrt{\frac{\alpha E}{Ad}}$, then the value of α is _____.

Numerical value type: the answer is a number.

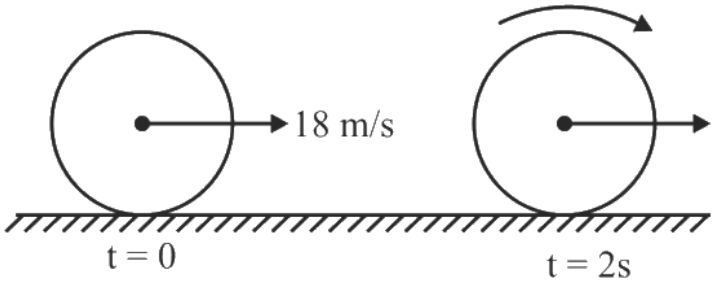
Answer: 3. · Key from source paper

Q104 JEE Main 2023 · 30 Jan · Shift 2 Numerical

A uniform disc of mass 0.5 kg and radius r is projected with velocity 18 m s^{-1} at t = 0 s on a rough horizontal surface. It starts off with a purely sliding motion at t = 0 s. After 2 s it acquires a purely rolling motion (see figure). The total kinetic energy of the disc after 2 s will be _____ J.
(given, coefficient of friction is 0.3 and g = 10 m s^{-2}).

(see the figure above)

Q8. A uniform disc of mass 0.5 kg and radius r is projected with velocity $18\ \mathrm{m\,s^{-1}}$ at $t = 0$ s on a rough horizontal surface. It starts off with a purely sliding motion at $t = 0$ s. After 2 s it acquires a purely rolling motion (see figure). The total kinetic energy of the disc after 2 s will be _____ J.
(given, coefficient of friction is 0.3 and $g = 10\ \mathrm{m\,s^{-2}}$).



Numerical value type: the answer is a number.

Answer: 54. · Key from source paper

Q105 JEE Main 2023 · 29 Jan · Shift 1 Numerical

A solid sphere of mass $2\ \mathrm{kg}$ is making pure rolling on a horizontal surface with kinetic energy $2240\ \mathrm{J}$. The velocity of centre of mass of the sphere will be _____ $\mathrm{m\,s^{-1}}$.

Numerical value type: the answer is a number.

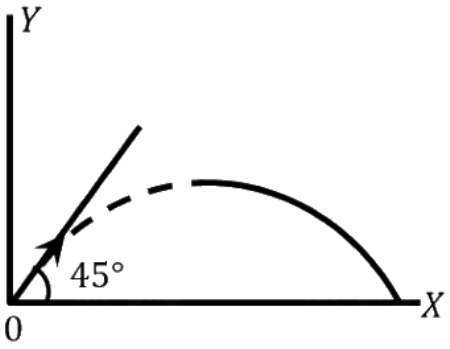
Answer: 40. · Key from source paper

Q106 JEE Main 2023 · 29 Jan · Shift 2 Numerical

A particle of mass 100 g is projected at time $t = 0$ with a speed $20\ \mathrm{m\,s^{-1}}$ at an angle 45° to the horizontal as given in the figure. The magnitude of the angular momentum of the particle about the starting point at time $t = 2$ s is found to be $\sqrt{K}\ \mathrm{kg\,m^2\,s^{-1}}$. The value of K is _____.
(Take $g = 10\ \mathrm{m\,s^{-2}}$)

(see the figure above)

Q5. A particle of mass 100 g is projected at time $t = 0$ with a speed 20 m s^{-1} at an angle 45° to the horizontal as given in the figure. The magnitude of the angular momentum of the particle about the starting point at time $t = 2$ s is found to be $\sqrt{K}$ kg m^2 s^{-1}. The value of K is _____.
(Take $g = 10$ m s^{-2})



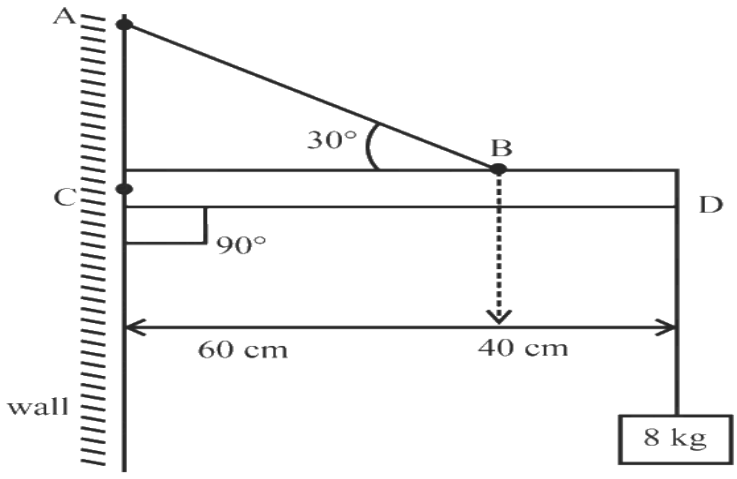
Numerical value type: the answer is a number.

Answer: 800. · Key from source paper

Q107 JEE Main 2023 · 25 Jan · Shift 1 MCQ

An object of mass 8 kg is hanging from one end of a uniform rod CD of mass 2 kg and length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is:
(Take $g = 10$ m s^{-2})
(see the figure above)

Q6. An object of mass 8 kg is hanging from one end of a uniform rod CD of mass 2 kg and length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is:
(Take $g = 10$ m s^{-2})



(1) 240 N
(2) 90 N
(3) 300 N
(4) 30 N

(A) 240 N
(B) 90 N
(C) 300 N
(D) 30 N

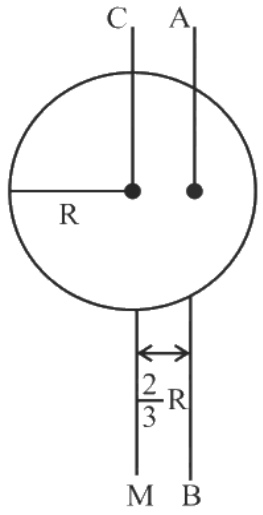
Answer: (C) 300 N · Key from source paper

Q108 JEE Main 2023 · 25 Jan · Shift 1 Numerical

I_{CM} is moment of inertia of a circular disc about an axis (CM) passing through its center and perpendicular to the plane of disc. I_{AB} is its moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance $\frac{2}{3}R$ from center, where R is the radius of the disc. The ratio of I_{AB} and I_{CM} is $x : 9$. The value of x is _____.

(see the figure above)

Q7. I_{CM} is moment of inertia of a circular disc about an axis (CM) passing through its center and perpendicular to the plane of disc. I_{AB} is its moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance $\frac{2}{3}R$ from center, where R is the radius of the disc. The ratio of I_{AB} and I_{CM} is $x : 9$. The value of x is _____.



Numerical value type: the answer is a number.

Answer: 17. · Key from source paper

Q109 JEE Main 2023 · 25 Jan · Shift 2 Numerical

If a solid sphere of mass 5 kg and a disc of mass 4 kg have the same radius, then the ratio of moment of inertia of the disc about a tangent in its plane to the moment of inertia of the sphere about its tangent will be $\frac{x}{7}$. The value of x is _____.

Numerical value type: the answer is a number.

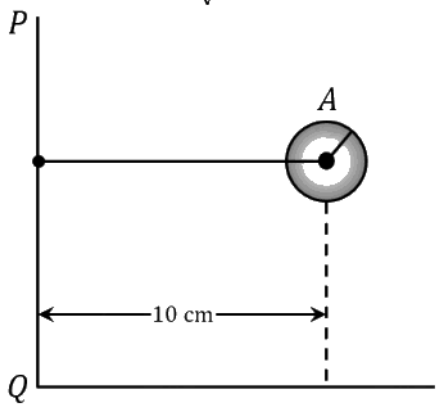
Answer: 5. · Key from source paper

Q110 JEE Main 2023 · 24 Jan · Shift 1 Numerical

Solid sphere A is rotating about an axis PQ. If the radius of the sphere is 5 cm, then its radius of gyration about PQ will be $\sqrt{x}$ cm. The value of x is _____.

(see the figure above)

Q23. Solid sphere A is rotating about an axis PQ. If the radius of the sphere is 5 cm, then its radius of gyration about PQ will be $\sqrt{x}$ cm. The value of x is _____.



Numerical value type: the answer is a number.

Answer: 110. · Key from source paper

Q111 JEE Main 2023 · 24 Jan · Shift 2 Numerical

A uniform solid cylinder with radius R and length L has moment of inertia I_1, about the axis of cylinder. A concentric solid cylinder of radius $R' = \frac{R}{2}$ and length $L' = \frac{L}{2}$ is carved out of the original cylinder. If I_2 is the moment of inertia of the carved out portion of the cylinder then $\frac{I_1}{I_2} =$ _____.
(Both I_1 and I_2 are about the axis of the cylinder)

Numerical value type: the answer is a number.

Answer: 32. · Key from source paper

Q112 JEE Main 2022 · 29 Jul · Shift 1 MCQ

Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The magnitude of position vector of centre of mass of this system will be similar to the magnitude of vector :

(A) $\hat{i} - 2\hat{j} + \hat{k}$
(B) $-3\hat{i} - 2\hat{j} + \hat{k}$
(C) $-2\hat{i} + 2\hat{k}$
(D) $-2\hat{i} - \hat{j} + 2\hat{k}$

Answer: (A) $\hat{i} - 2\hat{j} + \hat{k}$ · Key from source paper

Q113 JEE Main 2022 · 29 Jul · Shift 2 MCQ

The torque of a force $5\hat{i}+3\hat{j}-7\hat{k}$ about the origin is τ. If the force acts on a particle whose position vector is $2\hat{i}+2\hat{j}+\hat{k}$, then the value of τ will be

(A) $11\hat{i}+19\hat{j}-4\hat{k}$
(B) $-11\hat{i}+9\hat{j}-16\hat{k}$
(C) $-17\hat{i}+19\hat{j}-4\hat{k}$
(D) $17\hat{i}+9\hat{j}+16\hat{k}$

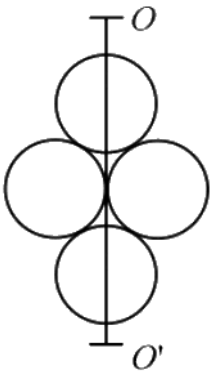
Answer: (C) $-17\hat{i}+19\hat{j}-4\hat{k}$ · Key from source paper

Q114 JEE Main 2022 · 28 Jul · Shift 1 Numerical

Four identical discs each of mass 'M' and diameter 'a' are arranged in a small plane as shown in figure. If the moment of inertia of the system about OO' is $\frac{x}{4}Ma^2$. Then, the value of x will be _____.

(see the figure above)

Q23. Four identical discs each of mass 'M' and diameter 'a' are arranged in a small plane as shown in figure. If the moment of inertia of the system about OO' is $\frac{x}{4}Ma^2$. Then, the value of x will be _____ .



Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q115 JEE Main 2022 · 28 Jul · Shift 2 Numerical

The distance of centre of mass from end A of a one dimensional rod (AB) having mass density $\rho = \rho_0\left(1-\frac{x^2}{L^2}\right)\ \mathrm{kg\,m^{-1}}$ and length L (in meter) is $\frac{3L}{\alpha}$ m. The value of α is _____ (where x is the distance form end A)

Numerical value type: the answer is a number.

Answer: 8. · Key from source paper

Q116 JEE Main 2022 · 27 Jul · Shift 1 Numerical

A pulley of radius 1.5 m is rotated about its axis by a force $F = (12t-3t^2)$ N applied tangentially (while t is measured in seconds). If moment of inertia of the pulley about its axis of rotation is 4.5

$\mathrm{kg\ m^2}$, the number of rotations made by the pulley before its direction of motion is reversed, will be $\frac{K}{\pi}$. The value of K is _____ .

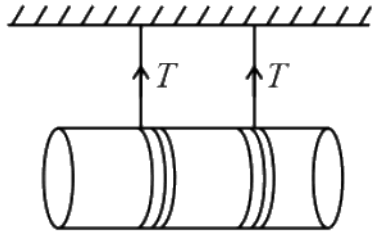
Numerical value type: the answer is a number.

Answer: 18. · Key from source paper

Q117 JEE Main 2022 · 27 Jul · Shift 2 Numerical

A solid cylinder length is suspended symmetrically through two massless strings, as shown in the figure. The distance from the initial rest position, the cylinder should be unbinding the strings to achieve a speed of $4\ \mathrm{m\ s^{-1}}$, is _____ cm.
(take $g = 10\ \mathrm{m\ s^{-2}}$)
(see the figure above)

Q22. A solid cylinder length is suspended symmetrically through two massless strings, as shown in the figure. The distance from the initial rest position, the cylinder should be unbinding the strings to achieve a speed of $4\ \mathrm{m\ s^{-1}}$, is _____cm.
(take $g = 10\ \mathrm{m\ s^{-2}}$)



Numerical value type: the answer is a number.

Answer: 120. · Key from source paper

Q118 JEE Main 2022 · 26 Jul · Shift 1 Numerical

A disc of mass 1 kg and radius R is free of rotate about a horizontal axis passing through its centre and perpendicular to the plane of disc. A body of same mass as that of disc is fixed at the highest point of the disc. Now the system is released, when the body comes to the lowest position, its angular speed will be $4\sqrt{\frac{x}{3R}}\ \mathrm{rad\ s^{-1}}$ where x = _____ .

Numerical value type: the answer is a number.

Answer: 5. · Key from source paper

Q119 JEE Main 2022 · 26 Jul · Shift 2 Numerical

The radius of gyration of a cylindrical rod about an axis of rotation perpendicular to its length and passing through the center will be _____ m. Given, the length of the rod is $10\sqrt{3}$ m.

Numerical value type: the answer is a number.

Answer: 5. · Key from source paper

Q120 JEE Main 2022 · 25 Jul · Shift 1 MCQ

A solid cylinder and a solid sphere, having same mass M and radius R, roll down the same inclined plane from top without slipping. They start from rest. The ratio of velocity of the solid cylinder to that of the solid sphere, with which they reach the ground, will be

(A) $\sqrt{\frac{5}{3}}$

(B) $\sqrt{\frac{4}{5}}$

(C) $\sqrt{\frac{3}{5}}$

(D) $\sqrt{\frac{14}{15}}$

Answer: (D) $\sqrt{\frac{14}{15}}$ · Key from source paper

Q121 JEE Main 2022 · 25 Jul · Shift 2 Numerical

Three identical spheres each of mass M are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 3 m each. Taking point of intersection of mutually perpendicular sides as origin, the magnitude of position vector of centre of mass of the system will be $\sqrt{x}$ m. The value of x is

Numerical value type: the answer is a number.

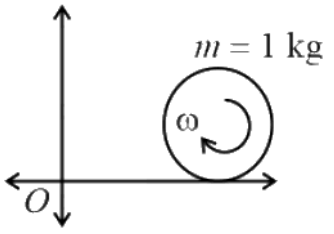
Answer: 2. · Key from source paper

Q122 JEE Main 2022 · 29 Jun · Shift 1 MCQ

A spherical shell of 1 kg mass and radius R is rolling with angular speed ω on horizontal plane (as shown in figure). The magnitude of angular momentum of the shell about the origin O is $\frac{a}{3}R^2\omega$. The value of a will be

(see the figure above)

Q7. A spherical shell of 1 kg mass and radius R is rolling with angular speed ω on horizontal plane (as shown in figure). The magnitude of angular momentum of the shell about the origin O is $\frac{a}{3}R^2\omega$. The value of a will be



(1) 2

(2) 3

(3) 5

(4) 4

(A) 2
(B) 3
(C) 5
(D) 4

Answer: (C) 5 · Key from source paper

Q123 JEE Main 2022 · 29 Jun · Shift 2 Numerical

The moment of inertia of a uniform thin rod about a perpendicular axis passing through one end is I_1. The same rod is bent into a ring and its moment of inertia about a diameter is I_2. If $\frac{I_1}{I_2}$ is $\frac{x\pi^2}{3}$, then the value of x will be _____.

Numerical value type: the answer is a number.

Answer: 8. · Key from source paper

Q124 JEE Main 2022 · 28 Jun · Shift 1 MCQ

Match List-I with List-II

List-I
(A) Moment of inertia of solid sphere of radius R about any tangent.
(B) Moment of inertia of hollow sphere of radius (R) about any tangent.
(C) Moment of inertia of circular ring of radius (R) about its diameter.
(D) Moment of inertia of circular disc of radius (R) about any diameter.

List-II
(I) $\frac{5}{3}MR^2$
(II) $\frac{7}{5}MR^2$
(III) $\frac{1}{4}MR^2$
(IV) $\frac{1}{2}MR^2$

(A) A – II, B – I, C – IV, D – III
(B) A – I, B – II, C – IV, D – III
(C) A – II, B – I, C – III, D – IV
(D) A – I, B – II, C – III, D – IV

Answer: (A) A – II, B – I, C – IV, D – III · Key from source paper

Q125 JEE Main 2022 · 28 Jun · Shift 1 Numerical

The position vector of 1 kg object is $\vec{r} = \left(3\hat{i} - \hat{j}\right)$ m and its velocity $\vec{v} = \left(3\hat{j} + \hat{k}\right)$ $\mathrm{m\,s^{-1}}$. The magnitude of its angular momentum is $\sqrt{x}$ N m s, where x is

Numerical value type: the answer is a number.

Answer: 91. · Key from source paper

Q126 JEE Main 2022 · 28 Jun · Shift 2 MCQ

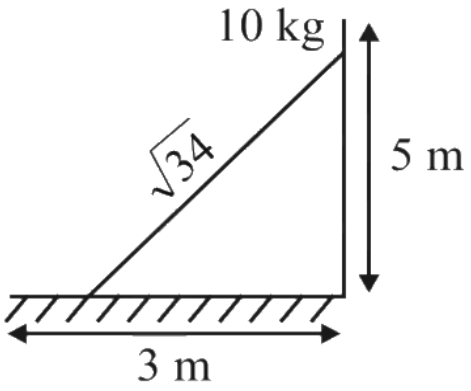
A $\sqrt{34}$ m long ladder weighing 10 kg leans on a frictionless wall. Its feet rest on the floor 3 m away from the wall as shown in the figure. If F_f and F_w are the reaction forces of the floor and the wall, then ratio of $\frac{F_w}{F_f}$ will be :

(Use $g = 10\ \text{m s}^{-2}$.)

(see the figure above)

Q5. A $\sqrt{34}$ m long ladder weighing 10 kg leans on a frictionless wall. Its feet rest on the floor 3 m away from the wall as shown in the figure. If F_f and F_w are the reaction forces of the floor and the wall, then ratio of $\frac{F_w}{F_f}$ will be :

(Use $g = 10\ \text{m s}^{-2}$.)



(1) $\frac{6}{\sqrt{110}}$ (2) $\frac{3}{\sqrt{113}}$

(3) $\frac{3}{\sqrt{109}}$ (4) $\frac{2}{\sqrt{109}}$

(A) $\frac{6}{\sqrt{110}}$

(B) $\frac{3}{\sqrt{113}}$

(C) $\frac{3}{\sqrt{109}}$

(D) $\frac{2}{\sqrt{109}}$

Answer: (C) $\frac{3}{\sqrt{109}}$ · Key from source paper

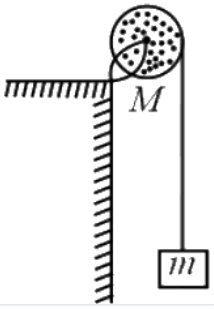
Q127 JEE Main 2022 · 28 Jun · Shift 2 Numerical

A uniform disc with mass $M = 4$ kg and radius $R = 10$ cm is mounted on a fixed horizontal axle as shown in figure. A block with mass $m = 2$ kg hangs from a massless cord that is wrapped around the rim of the disc. During the fall of the block, the cord does not slip and there is no friction at the axle. The tension in the cord is _____ N.

(Take $g = 10\ \text{ms}^{-2}$)

(see the figure above)

Q22. A uniform disc with mass $M = 4$ kg and radius $R = 10$ cm is mounted on a fixed horizontal axle as shown in figure. A block with mass $m = 2$ kg hangs from a massless cord that is wrapped around the rim of the disc. During the fall of the block, the cord does not slip and there is no friction at the axle. The tension in the cord is _____ N.
(Take $g = 10\ \text{ms}^{-2}$)



Numerical value type: the answer is a number.

Answer: 10. · Key from source paper

Q128 JEE Main 2022 · 27 Jun · Shift 1 MCQ

Two blocks of masses 10 kg and 30 kg are placed on the same straight line with coordinates $(0, 0)$ cm and $(x, 0)$ cm respectively. The block of 10 kg is moved on the same line through a distance of 6 cm towards the other block. The distance through which the block of 30 kg must be moved to keep the position of centre of mass of the system unchanged is

(A) 4 cm towards the 10 kg block
(B) 2 cm away from the 10 kg block
(C) 2 cm towards the 10 kg block
(D) 4 cm away from the 10 kg block

Answer: (C) 2 cm towards the 10 kg block · Key from source paper

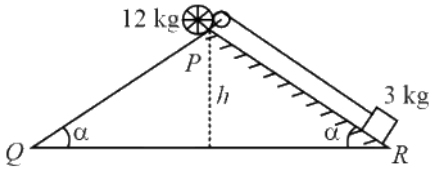
Q129 JEE Main 2022 · 27 Jun · Shift 2 Numerical

A rolling wheel of 12 kg is on an inclined plane at position P and connected to a mass of 3 kg through a string of fixed length and pulley as shown in figure.
Consider PR as friction free surface.
The velocity of centre of mass of the wheel when it reaches at the bottom Q of the inclined plane PQ will be $\frac{1}{2}\sqrt{xgh}\ \text{m s}^{-1}$. The value of x (rounded off to the nearest integer) is _____ .
(see the figure above)

Q22. A rolling wheel of 12 kg is on an inclined plane at position P and connected to a mass of 3 kg through a string of fixed length and pulley as shown in figure.

Consider PR as friction free surface.

The velocity of centre of mass of the wheel when it reaches at the bottom Q of the inclined plane PQ will be $\frac{1}{2}\sqrt{xgh}$ m s^{-1}. The value of x (rounded off to the nearest integer) is _____.



Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q130 JEE Main 2022 · 26 Jun · Shift 1 MCQ

A thin circular ring of mass M and radius R is rotating with a constant angular velocity 2 rad s^{-1} in a horizontal plane about an axis vertical to its plane and passing through the center of the ring. If two objects each of mass m be attached gently to the opposite ends of a diameter of ring, the ring will then rotate with an angular velocity (in rad s^{-1}).

(A) $\frac{M}{(M+m)}$
(B) $\frac{(M+2m)}{2M}$
(C) $\frac{2M}{(M+2m)}$
(D) $\frac{2(M+2m)}{M}$

Answer: (C) $\frac{2M}{(M+2m)}$ · Key from source paper

Q131 JEE Main 2022 · 26 Jun · Shift 2 MCQ

A solid spherical ball is rolling on a frictionless horizontal plane surface about its axis of symmetry. The ratio of rotational kinetic energy of the ball to its total kinetic energy is

(A) $\frac{1}{5}$
(B) $\frac{2}{5}$
(C) $\frac{2}{7}$
(D) $\frac{7}{10}$

Answer: (C) $\frac{2}{7}$ · Key from source paper

Q132 JEE Main 2022 · 25 Jun · Shift 1 MCQ

If force $\vec{F} = 3\hat{i} + 4\hat{j} - 2\hat{k}$ acts on a particle having position vector $2\hat{i} + \hat{j} + 2\hat{k}$ then, the torque about the origin will be:

(A) $-10\hat{i}+10\hat{j}+5\hat{k}$
(B) $3\hat{i}+4\hat{j}-2\hat{k}$
(C) $10\hat{i}+5\hat{j}-10\hat{k}$
(D) $10\hat{i}+\hat{j}-5\hat{k}$

Answer: (A) $-10\hat{i}+10\hat{j}+5\hat{k}$ · Key from source paper

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Q133 JEE Main 2022 · 25 Jun · Shift 2 Numerical

Moment of Inertia (M.I.) of four bodies having same mass M and radius $2R$ are as follows
$I_1 =$ M.I. of solid sphere about its diameter
$I_2 =$ M.I. of solid cylinder about its axis
$I_3 =$ M.I. of solid circular disc about its diameter
$I_4 =$ M.I. of thin circular ring about its diameter
If $2\left(I_2+I_3\right)+I_4 = xI_1$ then the value of x will be _____ .

Numerical value type: the answer is a number.

Answer: 5. · Key from source paper

Q134 JEE Main 2022 · 24 Jun · Shift 1 Numerical

A metre scale is balanced on a knife edge at its centre. When two coins, each of mass $10\ \mathrm{g}$ are put one on the top of the other at the $10.0\ \mathrm{cm}$ mark the scale is found to be balanced at $40.0\ \mathrm{cm}$ mark. The mass of the metre scale is found to be $x \times 10^{-2}\ \mathrm{kg}$. The value of x is _____ .

Numerical value type: the answer is a number.

Answer: 6. · Key from source paper

Q135 JEE Main 2022 · 24 Jun · Shift 2 MCQ

A fly wheel is accelerated uniformly from rest and rotates through $5\ \mathrm{rad}$ in the first second. The angle rotated by the fly wheel in the next second, will be :

(A) $7.5\ \mathrm{rad}$
(B) $15\ \mathrm{rad}$
(C) $20\ \mathrm{rad}$
(D) $30\ \mathrm{rad}$

Answer: (B) $15\ \mathrm{rad}$ · Key from source paper

Q136 JEE Main 2021 · 1 Sep · Shift 2 Numerical

A 2 kg steel rod of length 0.6 m is clamped on a table vertically at its lower end and is free to rotate in the vertical plane. The upper end is pushed so that the rod falls under gravity. Ignoring the friction due to clamping at its lower end, the speed of the free end of the rod when it passes through its lowest position is _____ m s^{-1}.
(Take $g = 10$ m s^{-2})

Numerical value type: the answer is a number.

Answer: 6. · Key from source paper

Q137 JEE Main 2021 · 31 Aug · Shift 1 MCQ

Angular momentum of a single particle moving with constant speed along circular path :

(A) remains same in magnitude but changes in the direction
(B) remains same in magnitude and direction
(C) is zero
(D) changes in magnitude but remains same in the direction

Answer: (B) remains same in magnitude and direction · Key from source paper

Q138 JEE Main 2021 · 31 Aug · Shift 2 MCQ

A system consists of two identical spheres each of mass 1.5 kg and radius 50 cm at the ends of a light rod. The distance between the centres of the two spheres is 5 m. What will be the moment of inertia of the system about an axis perpendicular to the rod passing through its midpoint?

(A) 1.905×10^5 kg m^2
(B) 18.75 kg m^2
(C) 19.05 kg m^2
(D) 1.875×10^5 kg m^2

Answer: (C) 19.05 kg m^2 · Key from source paper

Q139 JEE Main 2021 · 27 Aug · Shift 1 MCQ

Moment of inertia of a square plate of side l about the axis passing through one of the corner and perpendicular to the plane of square plate is given by:

(A) $\frac{Ml^2}{6}$
(B) $\frac{2}{3}Ml^2$
(C) Ml^2
(D) $\frac{Ml^2}{12}$

Answer: (B) $\frac{2}{3}Ml^2$ · Key from source paper

Q140 JEE Main 2021 · 27 Aug · Shift 2 MCQ

Two discs have moments of intertia I_1 and I_2 about their respective axes perpendicular to the plane and passing through the centre. They are rotating with angular speeds, ω_1 and ω_2 respectively and are brought into contact face to face with their axes of rotation coaxial. The loss in kinetic energy of the system in the process is given by:

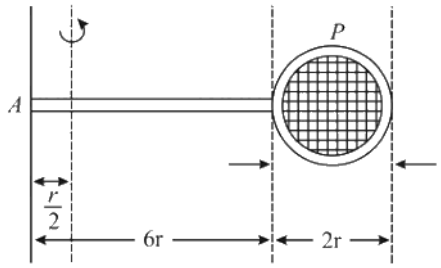
(A) $\frac{I_1 I_2}{(I_1+I_2)}(\omega_1-\omega_2)^2$
(B) $\frac{(\omega_1-\omega_2)^2}{2(I_1+I_2)}$
(C) $\frac{I_1 I_2}{2(I_1+I_2)}(\omega_1-\omega_2)^2$
(D) $\frac{(I_1-I_2)^2\omega_1\omega_2}{2(I_1+I_2)}$

Answer: (C) $\frac{I_1 I_2}{2(I_1+I_2)}(\omega_1-\omega_2)^2$ · Key from source paper

Q141 JEE Main 2021 · 26 Aug · Shift 1 Numerical

Consider a badminton racket with length scales as shown in the figure.
(see the figure above)
If the mass of the linear and circular portions of the badminton racket are same (M) and the mass of the threads are negligible, the moment of inertia of the racket about an axis perpendicular to the handle and in the plane of the ring at, $\frac{r}{2}$ distance from the end A of the handle will be _____Mr^2.

Q23. Consider a badminton racket with length scales as shown in the figure.



If the mass of the linear and circular portions of the badminton racket are same (M) and the mass of the threads are negligible, the moment of inertia of the racket about an axis perpendicular to the handle and in the plane of the ring at, $\frac{r}{2}$ distance from the end A of the handle will be _____Mr^2.

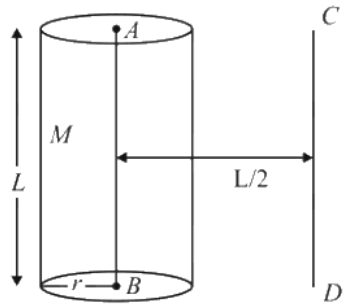
Numerical value type: the answer is a number.

Answer: 52. · Key from source paper

Q142 JEE Main 2021 · 26 Aug · Shift 2 MCQ

The solid cylinder of length 80 cm and mass M has a radius of 20 cm. Calculate the density of the material used if the moment of inertia of the cylinder about an axis CD parallel to AB as shown in figure is 2.7 kg m^2.
(see the figure above)

Q6. The solid cylinder of length 80 cm and mass M has a radius of 20 cm. Calculate the density of the material used if the moment of inertia of the cylinder about an axis CD parallel to AB as shown in figure is $2.7\ \text{kg m}^2$.



(1) $1.49 \times 10^2\ \text{kg m}^{-3}$
(2) $7.5 \times 10^1\ \text{kg m}^{-3}$
(3) $14.9\ \text{kg m}^{-3}$
(4) $7.5 \times 10^2\ \text{kg m}^{-3}$

(A) $1.49 \times 10^2\ \text{kg m}^{-3}$
(B) $7.5 \times 10^1\ \text{kg m}^{-3}$
(C) $14.9\ \text{kg m}^{-3}$
(D) $7.5 \times 10^2\ \text{kg m}^{-3}$

Answer: (A) $1.49 \times 10^2\ \text{kg m}^{-3}$ · Key from source paper

Q143 JEE Main 2021 · 27 Jul · Shift 1 MCQ

List-I: (a) MI of the rod (length L, Mass M, about an axis $\perp$ to the rod passing through the midpoint) (b) MI of the rod (length L, Mass $2M$, about an axis $\perp$ to the rod passing through one of its end) (c) MI of the rod (length $2L$, Mass M, about an axis $\perp$ to the rod passing through its midpoint) (d) MI of the rod (Length $2L$, Mass $2M$, about an axis $\perp$ to the rod passing through one of its end)
List-II: (i) $\frac{8ML^2}{3}$ (ii) $\frac{ML^2}{3}$ (iii) $\frac{ML^2}{12}$ (iv) $\frac{2ML^2}{3}$
Choose the correct answer from the options given below:

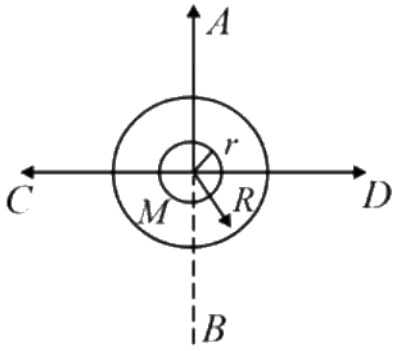
(A) (a) – (ii), (b) – (iii), (c) – (i), (d) – (iv)
(B) (a) – (ii), (b) – (i), (c) – (iii), (d) – (iv)
(C) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)
(D) (a) – (iii), (b) – (iv), (c) – (i), (d) – (ii)

Answer: (C) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i) · Key from source paper

Q144 JEE Main 2021 · 27 Jul · Shift 1 MCQ

The figure shows two solid discs with radius R and r respectively. If mass per unit area is the same for both, what is the ratio of MI of bigger disc around axis AB (Which is $\perp$ to the plane of the disc and passing through its centre) of MI of smaller disc around one of its diameters lying on its plane? Given M is the mass of the larger disc.
(MI stands for a moment of inertia)
(see the figure above)

Q5. The figure shows two solid discs with radius R and r respectively. If mass per unit area is the same for both, what is the ratio of MI of bigger disc around axis AB (Which is $\perp$ to the plane of the disc and passing through its centre) of MI of smaller disc around one of its diameters lying on its plane? Given M is the mass of the larger disc.
(MI stands for a moment of inertia)



(1) $R^2 : r^2$
(2) $2r^4 : R^4$
(3) $2R^2 : r^2$
(4) $2R^4 : r^4$

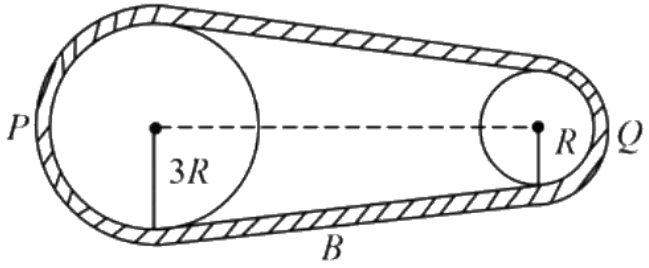
(A) $R^2 : r^2$
(B) $2r^4 : R^4$
(C) $2R^2 : r^2$
(D) $2R^4 : r^4$

Answer: (D) $2R^4 : r^4$ · Key from source paper

Q145 JEE Main 2021 · 27 Jul · Shift 2 Numerical

In the given figure, two wheels P and Q are connected by a belt B. The radius of P is three times that of Q. In the case of the same rotational kinetic energy, the ratio of rotational inertias $\left(\frac{I_1}{I_2}\right)$ will be $x : 1$. The value of x will be _____.
(see the figure above)

Q24. In the given figure, two wheels P and Q are connected by a belt B. The radius of P is three times that of Q. In the case of the same rotational kinetic energy, the ratio of rotational inertias $\left(\frac{I_1}{I_2}\right)$ will be $x : 1$. The value of x will be _____.



Numerical value type: the answer is a number.

Answer: 9. · Key from source paper

Q146 JEE Main 2021 · 25 Jul · Shift 1 MCQ

Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Moment of inertia of a circular disc of mass M and radius R about X, Y axes (passing through its plane) and Z-axis which were perpendicular to its plane were found to be I_x, I_y and I_z, respectively. The respective radii of gyration about all the three axes will be the same.
Reason R: A rigid body making rotational motion has fixed mass and shape. In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both A and R are correct but R is not the correct explanation of A.
(B) A is not correct but R is correct.
(C) A is correct but R is not correct.
(D) Both A and R are correct and R is the correct explanation of A.

Answer: (B) A is not correct but R is correct. · Key from source paper

Q147 JEE Main 2021 · 25 Jul · Shift 1 Numerical

A particle of mass m is moving in time t on a trajectory given by,
$\vec{r} = 10\alpha t^2\hat{i} + 5\beta t - 5\hat{j}$
where α and β are dimensional constants.
The angular momentum of the particle becomes the same as it was for $t = 0$ at time $t =$ _____ seconds.

Numerical value type: the answer is a number.

Answer: 10. · Key from source paper

Q148 JEE Main 2021 · 25 Jul · Shift 2 Numerical

A solid disc of radius $20\ \text{cm}$ and mass $10\ \text{kg}$ is rotating with an angular velocity of $600\ \text{rpm}$, about an axis normal to its circular plane and passing through its centre of mass. The retarding torque required to bring the disc at rest in $10\ \text{s}$ is _____ $\pi \times 10^{-1}\ \text{N m}$

Numerical value type: the answer is a number.

Answer: 4. · Key from source paper

Q149 JEE Main 2021 · 22 Jul · Shift 1 MCQ

Consider a situation in which a ring, a solid cylinder and a solid sphere roll down on the same inclined plane without slipping. Assume that they start rolling from rest and having identical diameter. The correct statement for this situation is

(A) The sphere has the greatest and the ring has the least velocity of the centre of mass at the bottom of the inclined plane.

(B) The ring has the greatest and the cylinder has the least velocity of the centre of mass at the bottom of the inclined plane.

(C) All of them will have same velocity.

(D) The cylinder has the greatest and the sphere has the least velocity of the centre of mass at the bottom of the inclined plane.

Answer: (A) The sphere has the greatest and the ring has the least velocity of the centre of mass at the bottom of the inclined plane. · Key from source paper

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Q150 JEE Main 2021 · 22 Jul · Shift 1 Numerical

The position of the centre of mass of a uniform semi-circular wire of radius R placed in $x-y$ plane with its centre at the origin and the line joining its ends as $x-$axis is given by, $\left(0, \frac{xR}{\pi}\right)$. Then, the value of $|x|$ is _____.

Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q151 JEE Main 2021 · 22 Jul · Shift 1 Numerical

The centre of a wheel rolling on a plane surface moves with a speed v_0. A particle on the rim of the wheel at the same level as the centre will be moving at a speed $\sqrt{x}v_0$. Then the value of x is _____.

Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q152 JEE Main 2021 · 20 Jul · Shift 1 Numerical

A rod of mass M and length L is lying on a horizontal frictionless surface. A particle of mass m travelling along the surface hits at one end of the rod with a velocity u in a direction perpendicular to the rod. The collision is completely elastic. After collision, particle comes to rest. The ratio of masses $\left(\frac{m}{M}\right)$ is $\frac{1}{x}$. The value of x will be

Numerical value type: the answer is a number.

Answer: 4. · Key from source paper

Q153 JEE Main 2021 · 20 Jul · Shift 1 Numerical

A circular disc reaches from top to bottom of an inclined plane of length L. When it slips down the plane, it takes time t_1. When it rolls down the plane, it takes time t_2. The value of $\frac{t_2}{t_1}$ is $\sqrt{\frac{3}{x}}$. The value of x will be

Numerical value type: the answer is a number.

Answer: 2. · Key from source paper

Q154 JEE Main 2021 · 20 Jul · Shift 2 MCQ

A body rolls down an inclined plane without slipping. The kinetic energy of rotation is 50% of its translational kinetic energy. The body is:

(A) solid sphere
(B) solid cylinder
(C) hollow cylinder
(D) ring

Answer: (B) solid cylinder · Key from source paper

Q155 JEE Main 2021 · 20 Jul · Shift 2 Numerical

Two bodies, a ring and a solid cylinder of same material are rolling down without slipping on an inclined plane. The radii of the bodies are same. The ratio of velocity of the centre of mass at the bottom of the inclined plane of the ring to that of the cylinder is $\frac{\sqrt{x}}{2}$. Then, the value of x is

Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q156 JEE Main 2021 · 20 Jul · Shift 2 Numerical

A body rotating with an angular speed of $600\ \mathrm{rpm}$ is uniformly accelerated to $1800\ \mathrm{rpm}$ in $10\ \mathrm{sec}$. The number of rotations made in the process is

Numerical value type: the answer is a number.

Answer: 200. · Key from source paper

Q157 JEE Main 2021 · 18 Mar · Shift 1 MCQ

A thin circular ring of mass M and radius r is rotating about its axis with an angular speed ω. Two particles having mass m each are now attached at diametrically opposite points. The angular speed of the ring will become:

(A) $\omega\frac{M}{M+m}$
(B) $\omega\frac{M+2m}{M}$
(C) $\omega\frac{M}{M+2m}$
(D) $\omega\frac{M-2m}{M+2m}$

Answer: (C) $\omega\frac{M}{M+2m}$ · Key from source paper

Q158 JEE Main 2021 · 18 Mar · Shift 2 MCQ

Consider a uniform wire of mass M and length L. It is bent into a semicircle. Its moment of inertia about a line perpendicular to the plane of the wire passing through the centre is :

(A) $\frac{1}{4}\frac{ML^2}{\pi^2}$
(B) $\frac{2}{5}\frac{ML^2}{\pi^2}$
(C) $\frac{ML^2}{\pi^2}$
(D) $\frac{1}{2}\frac{ML^2}{\pi^2}$

Answer: (C) $\frac{ML^2}{\pi^2}$ · Key from source paper

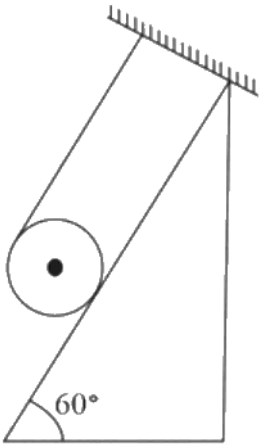
Q159 JEE Main 2021 · 18 Mar · Shift 2 MCQ

A solid cylinder of mass m is wrapped with an inextensible light string and, is placed on a rough inclined plane as shown in the figure. The frictional force acting between the cylinder and the inclined plane is:

(see the figure above)

[The coefficient of static friction, μ_s, is 0.4]

Q6. A solid cylinder of mass m is wrapped with an inextensible light string and, is placed on a rough inclined plane as shown in the figure. The frictional force acting between the cylinder and the inclined plane is:



[The coefficient of static friction, μ_s, is 0.4]

(1) $\frac{7}{2}mg$
(2) $5mg$
(3) $\frac{mg}{5}$
(4) 0

(A) $\frac{7}{2}mg$
(B) $5mg$
(C) $\frac{mg}{5}$
(D) 0

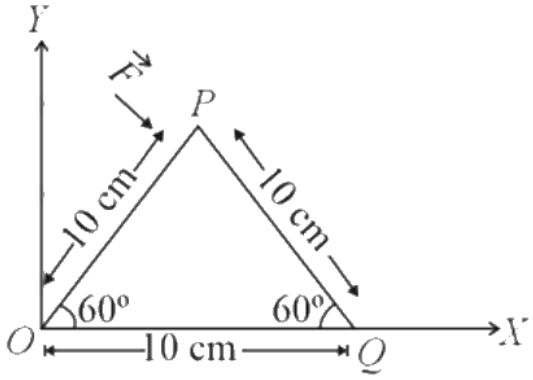
Answer: (C) $\frac{mg}{5}$ · Key from source paper

Q160 JEE Main 2021 · 17 Mar · Shift 1 MCQ

A triangular plate is shown. A force $\vec{F} = 4\hat{i} - 3\hat{j}$ is applied at point P. The torque at point P with respect to point O and Q are:

(see the figure above)

Q4. A triangular plate is shown. A force $\vec{F} = 4\hat{i} - 3\hat{j}$ is applied at point P. The torque at point P with respect to point O and Q are:



(1) $-15 - 20\sqrt{3}, 15 - 20\sqrt{3}$
(2) $15 + 20\sqrt{3}, 15 - 20\sqrt{3}$
(3) $15 - 20\sqrt{3}, 15 + 20\sqrt{3}$
(4) $-15 + 20\sqrt{3}, 15 + 20\sqrt{3}$

(A) $-15 - 20\sqrt{3}, 15 - 20\sqrt{3}$
(B) $15 + 20\sqrt{3}, 15 - 20\sqrt{3}$
(C) $15 - 20\sqrt{3}, 15 + 20\sqrt{3}$
(D) $-15 + 20\sqrt{3}, 15 + 20\sqrt{3}$

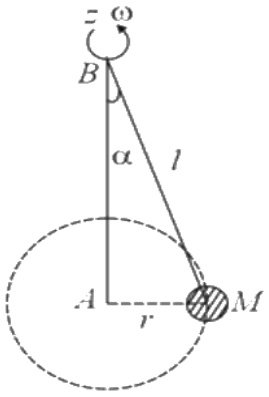
Answer: (A) $-15 - 20\sqrt{3}, 15 - 20\sqrt{3}$ · Key from source paper

Q161 JEE Main 2021 · 17 Mar · Shift 1 MCQ

A mass M hangs on a massless rod of length l which rotates at a constant angular frequency. The mass M moves with steady speed in a circular path of constant radius. Assume that the system is in steady circular motion with constant angular velocity ω. The angular momentum of M about point A is L_A which lies in the positive z direction and the angular momentum of M about B is L_B. The correct statement for this system is:

(see the figure above)

Q5. A mass M hangs on a massless rod of length l which rotates at a constant angular frequency. The mass M moves with steady speed in a circular path of constant radius. Assume that the system is in steady circular motion with constant angular velocity ω. The angular momentum of M about point A is L_A which lies in the positive z direction and the angular momentum of M about B is L_B. The correct statement for this system is:



(1) L_A and L_B are both constant in magnitude and direction

(2) L_B is constant in direction with varying magnitude

(3) L_B is constant, both in magnitude and direction

(4) L_A is constant, both in magnitude and direction

(A) L_A and L_B are both constant in magnitude and direction

(B) L_B is constant in direction with varying magnitude

(C) L_B is constant, both in magnitude and direction

(D) L_A is constant, both in magnitude and direction

Answer: (D) L_A is constant, both in magnitude and direction · Key from source paper

Q162 JEE Main 2021 · 17 Mar · Shift 1 Numerical

The angular speed of truck wheel is increased from 900rpm to 2460rpm in 26 seconds. The number of revolutions by the truck engine during this time is _____.
(Assuming the acceleration to be uniform).

Numerical value type: the answer is a number.

Answer: 728. · Key from source paper

Q163 JEE Main 2021 · 17 Mar · Shift 1 Numerical

The following bodies,
(1) a ring
(2) a disc
(3) a solid cylinder
(4) a solid sphere,
of same mass m and radius R are allowed to roll down without slipping simultaneously from the top of the inclined plane. The body which will reach first at the bottom of the inclined plane is
[Mark the body as per their respective numbering given in the question]
(see the figure above)

Q23. The following bodies,

(1) a ring

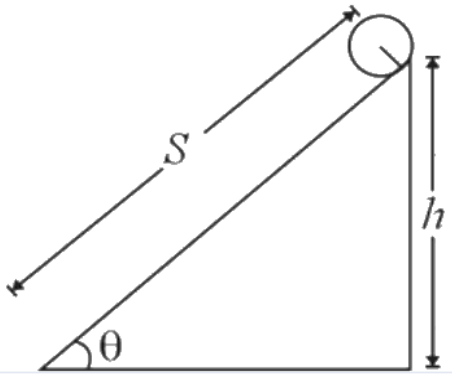
(2) a disc

(3) a solid cylinder

(4) a solid sphere,

of same mass m and radius R are allowed to roll down without slipping simultaneously from the top of the inclined plane. The body which will reach first at the bottom of the inclined plane is

[Mark the body as per their respective numbering given in the question]



Numerical value type: the answer is a number.

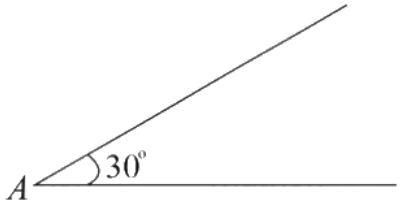
Answer: 4. · Key from source paper

Q164 JEE Main 2021 · 17 Mar · Shift 2 MCQ

A sphere of mass $2\ \text{kg}$ and radius $0.5\ \text{m}$ is rolling with an initial speed of $1\ \text{m s}^{-1}$ goes up an inclined plane which makes an angle of 30° with the horizontal plane, without slipping. How low will the sphere take to return to the starting point A ?

(see the figure above)

Q4. A sphere of mass $2\ \text{kg}$ and radius $0.5\ \text{m}$ is rolling with an initial speed of $1\ \text{m s}^{-1}$ goes up an inclined plane which makes an angle of 30° with the horizontal plane, without slipping. How low will the sphere take to return to the starting point A?



(1) $0.60\ \text{s}$ (2) $0.52\ \text{s}$

(3) $0.56\ \text{s}$ (4) $0.80\ \text{s}$

(A) $0.60\ \text{s}$

(B) $0.52\ \text{s}$

(C) $0.56\ \text{s}$

(D) $0.80\ \text{s}$

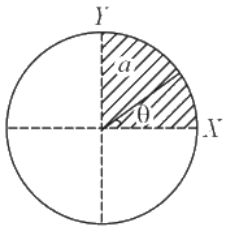
Answer: (C) $0.56\ \text{s}$ · Key from source paper

Q165 JEE Main 2021 · 17 Mar · Shift 2 Numerical

The disc of mass M with uniform surface mass density σ is shown in the figure. The center of mass of the quarter disc (the shaded area) is at the position $\left(\frac{xa}{3\pi}, \frac{xa}{3\pi}\right)$ where x is _____. (Round off to the Nearest Integer) [a is an area as shown in the figure]

(see the figure above)

Q23. The disc of mass M with uniform surface mass density σ is shown in the figure. The center of mass of the quarter disc (the shaded area) is at the position $\left(\frac{xa}{3\pi}, \frac{xa}{3\pi}\right)$ where x is _____ . (Round off to the Nearest Integer) [a is an area as shown in the figure]



Numerical value type: the answer is a number.

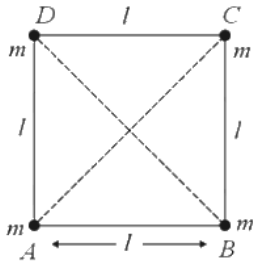
Answer: 4. · Key from source paper

Q166 JEE Main 2021 · 16 Mar · Shift 1 MCQ

Four equal masses, m each are placed at the corners of a square of length (l) as shown in the figure. The moment of inertia of the system about an axis passing through A and parallel to DB would be :

(see the figure above)

Q5. Four equal masses, m each are placed at the corners of a square of length (l) as shown in the figure. The moment of inertia of the system about an axis passing through A and parallel to DB would be :



(1) ml^2
(2) $2\ ml^2$
(3) $3\ ml^2$
(4) $\sqrt{3}\ ml^2$

(A) ml^2
(B) $2ml^2$
(C) $3ml^2$
(D) $\sqrt{3}ml^2$

Answer: (C) $3ml^2$ · Key from source paper

Q167 JEE Main 2021 · 16 Mar · Shift 1 Numerical

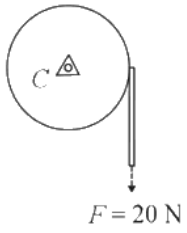
Consider a 20 kg uniform circular disk of radius $0.2\ \mathrm{m}$. It is pin supported at its center and is at rest initially. The disk is acted upon by a constant force $F = 20\ \mathrm{N}$ through a massless string wrapped around its periphery as shown in the figure.

(see the figure above)

Suppose the disk makes n number of revolutions to attain an angular speed of $50\mathrm{rads}^{-1}$. The value of n, to the nearest integer, is _____.

[Given : In one complete revolution, the disk rotates by $6.28\ \mathrm{rad}$]

Q23. Consider a $20\ \mathrm{kg}$ uniform circular disk of radius $0.2\ \mathrm{m}$. It is pin supported at its center and is at rest initially. The disk is acted upon by a constant force $F = 20\ \mathrm{N}$ through a massless string wrapped around its periphery as shown in the figure.



Suppose the disk makes n number of revolutions to attain an angular speed of $50\ \mathrm{rad\ s}^{-1}$. The value of n, to the nearest integer, is _____ .

[Given : In one complete revolution, the disk rotates by $6.28\ \mathrm{rad}$]

Numerical value type: the answer is a number.

Answer: 20. · Key from source paper

Q168 JEE Main 2021 · 16 Mar · Shift 2 Numerical

A force $\vec{F} = 4\hat{i} + 3\hat{j} + 4\hat{k}$ is applied on an intersection point of $x = 2$ plane and x-axis. The magnitude of torque of this force about a point $(2, 3, 4)$ is _____. (Round off to the Nearest Integer)

Numerical value type: the answer is a number.

Answer: 20. · Key from source paper

Q169 JEE Main 2021 · 16 Mar · Shift 2 Numerical

A solid disc of radius a and mass m rolls down without slipping on an inclined plane making an angle θ with the horizontal. The acceleration of the disc will be $\frac{2}{b}g\sin\theta$, where b is _____. (Round off to the Nearest Integer)

(g = acceleration due to gravity)

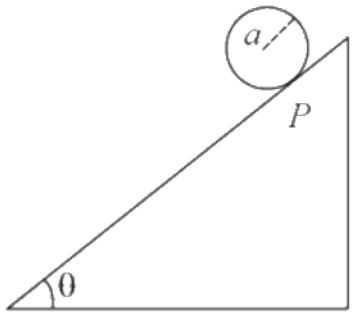
(θ = angle as shown in figure)

(see the figure above)

Q24. A solid disc of radius a and mass m rolls down without slipping on an inclined plane making an angle θ with the horizontal. The acceleration of the disc will be $\frac{2}{b}g\sin\theta$, where b is _____. (Round off to the Nearest Integer)

(g = acceleration due to gravity)

(θ = angle as shown in figure)



Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q170 JEE Main 2021 · 26 Feb · Shift 1 MCQ

Four identical solid spheres each of mass m and radius a are placed with their centres on the four corners of a square of side b. The moment of inertia of the system about one side of square where the axis of rotation is parallel to the plane of the square is :

(A) $\frac{8}{5}ma^2 + mb^2$

(B) $\frac{4}{5}ma^2 + 2mb^2$

(C) $\frac{8}{5}ma^2 + 2mb^2$

(D) $\frac{4}{5}ma^2$

Answer: (C) $\frac{8}{5}ma^2 + 2mb^2$ · Key from source paper

Q171 JEE Main 2021 · 26 Feb · Shift 2 MCQ

A cord is wound round the circumference of wheel of radius r, The axis of the wheel is horizontal and the moment of inertia about it is I. A weight mg is attached to the cord at the end. The weight falls from rest. After falling through a distance h, the square of angular velocity of wheel will be

(A) $\frac{2mgh}{I+mr^2}$

(B) $\frac{2mgh}{I+2mr^2}$

(C) $2gh$

(D) $\frac{2gh}{I+mr^2}$

Answer: (A) $\frac{2mgh}{I+mr^2}$ · Key from source paper

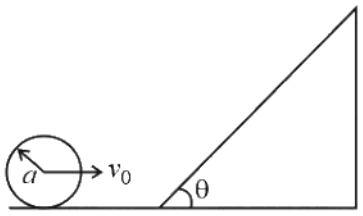
Q172 JEE Main 2021 · 25 Feb · Shift 2 MCQ

A sphere of radius a and mass m rolls along a horizontal plane with constant speed v_0. It encounters an inclined plane at angle θ and climbs upward. Assuming that it rolls without slipping, how far up the

sphere will travel?

(see the figure above)

Q3. A sphere of radius a and mass m rolls along a horizontal plane with constant speed v_0. It encounters an inclined plane at angle θ and climbs upward. Assuming that it rolls without slipping, how far up the sphere will travel?



(1) $\frac{2}{5}\frac{v_0^2}{g\sin\theta}$ (2) $\frac{7v_0^2}{10\,g\sin\theta}$

(3) $\frac{v_0^2}{5g\sin\theta}$ (4) $\frac{v_0^2}{2g\sin\theta}$

(A) $\frac{2}{5}\frac{v_0^2}{g\sin\theta}$

(B) $\frac{7v_0^2}{10\,g\sin\theta}$

(C) $\frac{v_0^2}{5g\sin\theta}$

(D) $\frac{v_0^2}{2g\sin\theta}$

Answer: (B) $\frac{7v_0^2}{10\,g\sin\theta}$ · Key from source paper

Q173 JEE Main 2021 · 24 Feb · Shift 1 MCQ

Moment of inertia M.I. of four bodies, having same mass and radius, are reported as;

I_1 = M.I. of thin circular ring about its diameter,

I_2 = M.I. of circular disc about an axis perpendicular to disc and going through the centre,

I_3 = M.I. of solid cylinder about its axis and

I_4 = M.I. of solid sphere about its diameter.

Then:

(A) $I_1 + I_2 = I_3 + \frac{5}{2}I_4$.

(B) $I_1 + I_3 < I_2 + I_4$

(C) $I_1 = I_2 = I_3 > I_4$

(D) $I_1 = I_2 = I_3 < I_4$

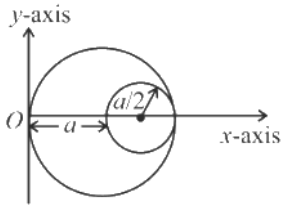
Answer: (C) $I_1 = I_2 = I_3 > I_4$ · Key from source paper

Q174 JEE Main 2021 · 24 Feb · Shift 2 MCQ

A circular hole of radius $\left(\frac{a}{2}\right)$ is cut out of a circular disc of radius a as shown in figure. The centroid of the remaining circular portion with respect to point O will be:

(see the figure above)

Q3. A circular hole of radius $\left(\frac{a}{2}\right)$ is cut out of a circular disc of radius a as shown in figure. The centroid of the remaining circular portion with respect to point O will be:



(1) $\frac{2}{3}a$
(2) $\frac{5}{6}a$
(3) $\frac{1}{6}a$
(4) $\frac{10}{11}a$

(A) $\frac{2}{3}a$
(B) $\frac{5}{6}a$
(C) $\frac{1}{6}a$
(D) $\frac{10}{11}a$

Answer: (B) $\frac{5}{6}a$ · Key from source paper

Q175 JEE Main 2021 · 24 Feb · Shift 2 Numerical

A uniform thin bar of mass $6\ \text{kg}$ and length 2.4 meter is bent to make an equilateral hexagon. The moment of inertia about an axis passing through the centre of mass and perpendicular to the plane of hexagon is _____ $\times 10^{-1}\ \text{kg m}^2$.

Numerical value type: the answer is a number.

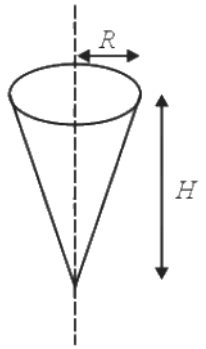
Answer: 8. · Key from source paper

Q176 JEE Main 2020 · 6 Sep · Shift 1 MCQ

Shown in the figure is a hollow ice-cream cone (it is open at top). If its mass is M, radius of its top is R and height, H, then its moment of inertia about its axis is

(see the figure above)

Q4. Shown in the figure is a hollow ice-cream cone (it is open at top). If its mass is M, radius of its top is R and height, H, then its moment of inertia about its axis is



(1) $\frac{MR^2}{2}$
(2) $\frac{M(R^2+H^2)}{4}$
(3) $\frac{MH^2}{3}$
(4) $\frac{MR^2}{3}$

(A) $\frac{MR^2}{2}$
(B) $\frac{M(R^2+H^2)}{4}$
(C) $\frac{MH^2}{3}$
(D) $\frac{MR^2}{3}$

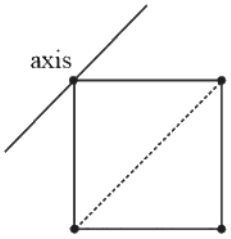
Answer: (A) $\frac{MR^2}{2}$ · Key from source paper

Q177 JEE Main 2020 · 6 Sep · Shift 1 MCQ

Four point masses, each of mass m, are fixed at the corners of a square of side l. The square is rotating with angular frequency ω, about an axis passing through one of the corners of the square and parallel to tis diagonal, as shown in the figure. The angular momentum of the square about the axis is

(see the figure above)

Q5. Four point masses, each of mass m, are fixed at the corners of a square of side l. The square is rotating with angular frequency ω, about an axis passing through one of the corners of the square and parallel to tis diagonal, as shown in the figure. The angular momentum of the square about the axis is



(1) $m\ell^2\omega$ (2) $4m\ell^2\omega$
(3) $3m\ell^2\omega$ (4) $2m\ell^2\omega$

(A) $m\ell^2\omega$
(B) $4m\ell^2\omega$
(C) $3m\ell^2\omega$
(D) $2m\ell^2\omega$

Answer: (C) $3m\ell^2\omega$ · Key from source paper

Q178 JEE Main 2020 · 6 Sep · Shift 2 MCQ

The linear mass density of a thin rod AB of length L varies from A to B as $\lambda(x) = \lambda_0\left(1+\frac{x}{L}\right)$, where x is the distance from A. If M is the mass of the rod then its moment of inertia about an axis passing through A and perpendicular to the rod :

(A) $\frac{5}{12}ML^2$
(B) $\frac{7}{18}ML^2$
(C) $\frac{2}{5}ML^2$
(D) $\frac{3}{7}ML^2$

Answer: (B) $\frac{7}{18}ML^2$ · Key from source paper

Q179 JEE Main 2020 · 6 Sep · Shift 2 Numerical

The centre of mass of a solid hemisphere of radius 8 cm is x cm from the centre of the flat surface. Then value of x is

Numerical value type: the answer is a number.

Answer: 3. · Key from source paper

Q180 JEE Main 2020 · 5 Sep · Shift 1 MCQ

A wheel is rotating freely with an angular speed ω on a shaft. The moment of inertia of the wheel is I and the moment of inertia of the shaft is negligible. Another wheel of moment of inertia $3I$ initially at rest is suddenly coupled to the same shaft. The resultant fractional loss in the kinetic energy of the system is:

(A) $\frac{5}{6}$
(B) $\frac{1}{4}$
(C) 0
(D) $\frac{3}{4}$

Answer: (D) $\frac{3}{4}$ · Key from source paper

Q181 JEE Main 2020 · 5 Sep · Shift 1 Numerical

A force $\vec{F} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$ N acts at a point $\left(4\hat{i} + 3\hat{j} - \hat{k}\right)$ m. Then the magnitude of torque about the point $\left(\hat{i} + 2\hat{j} + \hat{k}\right)$ m will be $\sqrt{x}$ N – m.The value of x is.....

Numerical value type: the answer is a number.

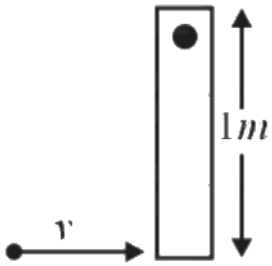
Answer: 195. · Key from source paper

Q182 JEE Main 2020 · 5 Sep · Shift 2 Numerical

A thin rod of mass 0. 9 kg and length 1 m is suspended, at rest, from one end so that it can freely oscillate in the vertical plane. A particle of move (sic) 0. 1 kg moving in a straight line with velocity 80 m s^{-1} hits the rod at its bottom most point and sticks to it (see figure). The angular speed (in rad s^{-1}) of the rod immediately after the collision will be _____

(see the figure above)

Q22. A thin rod of mass 0.9 kg and length 1 m is suspended, at rest, from one end so that it can freely oscillate in the vertical plane. A particle of move 0.1 kg moving in a straight line with velocity 80 m s^{-1} hits the rod at its bottom most point and sticks to it (see figure). The angular speed (in rad s^{-1}) of the rod immediately after the collision will be .....



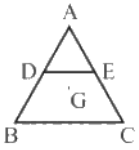
Numerical value type: the answer is a number.

Answer: 20. · Key from source paper

Q183 JEE Main 2020 · 4 Sep · Shift 1 Numerical

ABC is a plane lamina of the shape of an equilateral triangle. D, E are mid-points of AB, AC and G is the centroid of the lamina. Moment of inertia of the lamina about an axis passing through G and perpendicular to the plane ABC is I_0. If part ADE is removed, the moment of inertia of the remaining part about the same axis is $\frac{NI_0}{16}$ where N is an integer. Value of N is:
(see the figure above)

Q21. ABC is a plane lamina of the shape of an equilateral triangle. D, E are mid-points of AB, AC and G is the centroid of the lamina. Moment of inertia of the lamina about an axis passing through G and perpendicular to the plane ABC is I_0. If part ADE is removed, the moment of inertia of the remaining part about the same axis is $\frac{NI_0}{16}$ where N is an integer. Value of N is:



Numerical value type: the answer is a number.

Answer: 11. · Key from source paper

Q184 JEE Main 2020 · 4 Sep · Shift 1 Numerical

A circular disc of mass M and radius R is rotating about its axis with angular speed ω_1. If another stationary disc having radius $\frac{R}{2}$ and same mass M is dropped co-axially on to the rotating disc. Gradually both discs attain constant angular speed ω_2. The energy lost in the process is p% of the initial energy. Value of p is _____

Numerical value type: the answer is a number.

Answer: 20. · Key from source paper

Q185 JEE Main 2020 · 4 Sep · Shift 2 MCQ

Consider two uniform discs of the same thickness and different radii $R_1 = R$ and $R_2 = \alpha R$ made of the same material. If the ratio of their moments of inertia I_1 and I_2, respectively, about their axes is $I_1 : I_2 = 1 : 16$ then the value of α is :

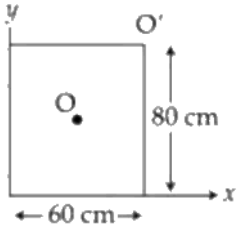
(A) $2\sqrt{2}$
(B) $\sqrt{2}$
(C) 2
(D) 4

Answer: (C) 2 · Key from source paper

Q186 JEE Main 2020 · 4 Sep · Shift 2 MCQ

see figure

Q6.



For a uniform rectangular sheet shown in the figure, the ratio of moments of inertia about the axes perpendicular to the sheet and passing through O (the centre of mass) and O' (corner point) is:

(1) 2/3 (2) 1/4
(3) 1/8 (4) 1/2

(A) 2/3
(B) 1/4
(C) 1/8
(D) 1/2

Answer: (B) 1/4 · Key from source paper

Q187 JEE Main 2020 · 3 Sep · Shift 1 MCQ

Moment of inertia of a cylinder of mass m, length L and radius R about an axis passing through its centre and perpendicular to the axis of the cylinder is $I = M\left(\frac{R^2}{4} + \frac{L^2}{12}\right)$. If such a cylinder is to be made for a given mass of a material, the ratio $\frac{L}{R}$ for it to have minimum possible I is:

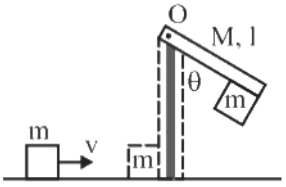
(A) $\frac{2}{3}$
(B) $\frac{3}{2}$
(C) $\sqrt{\frac{3}{2}}$
(D) $\sqrt{\frac{2}{3}}$

Answer: (C) $\sqrt{\frac{3}{2}}$ · Key from source paper

Q188 JEE Main 2020 · 3 Sep · Shift 1 MCQ

A block of mass $m = 1\ \text{kg}$ slides with velocity $v = 6\ \text{m s}^{-1}$ on a frictionless horizontal surface and collides with a uniform vertical rod and sticks to it as shown. The rod is pivoted about O and swings as a result of the collision making angle θ before momentarily coming to rest. if the rod has mass $M = 2\ \text{kg}$, and length $\ell = 1\ \text{m}$, the value of θ is approximately $(\text{take } g = 10\ \text{m s}^{-2})$
(see the figure above)

Q2. A block of mass $\text{m} = 1\ \text{kg}$ slides with velocity $\text{v} = 6\ \text{m s}^{-1}$ on a frictionless horizontal surface and collides with a uniform vertical rod and sticks to it as shown. The rod is pivoted about O and swings as a result of the collision making angle θ before momentarily coming to rest. if the rod has mass $M = 2\ \text{kg}$, and length $\ell = 1\ \text{m}$, the value of θ is approximately $(\text{take g} = 10\ \text{m s}^{-2})$



(1) 63° (2) 55°
(3) 69° (4) 49°

(A) 63°
(B) 55°
(C) 69°
(D) 49°

Answer: (A) 63° · Key from source paper

Q189 JEE Main 2020 · 3 Sep · Shift 1 Numerical

A person of $80\ \text{kg}$ mass is standing on the rim of a circular platform of mass $200\ \text{kg}$ rotating about its axis at 5 revolutions per minute (rpm). The person now starts moving towards the centre of the platform. What will be the rotational speed (in rpm) of the platform when the person reaches its centre....

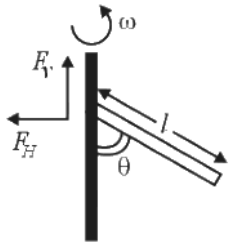
Numerical value type: the answer is a number.

Answer: 9. · Key from source paper

Q190 JEE Main 2020 · 3 Sep · Shift 2 MCQ

see figure

Q5.



A uniform rod of length ' ℓ' is pivoted at one of its ends on a vertical shaft of negligible radius. When the shaft rotates at angular speed ω the rod makes an angle $\theta$with it (see figure). To find θ equate the rate of change of angular momentum (direction going into the paper) $\frac{m\ell^2}{12}\omega^2 \sin\theta$ about the centre of mass (CM) to the torque provided by the horizontal and vertical forces $F_H$and F_v about the CM. The value of θ is then such that:

(1) $\cos\theta = \frac{2g}{3\ell\omega^2}$ (2) $\cos\theta = \frac{g}{2\ell\omega^2}$

(3) $cos\theta = \frac{g}{\ell\omega^2}$ (4) $\cos\theta = \frac{3g}{2\ell\omega^2}$

(A) $\cos\theta = \frac{2g}{3\ell\omega^2}$

(B) $\cos\theta = \frac{g}{2\ell\omega^2}$

(C) $\cos\theta = \frac{g}{\ell\omega^2}$

(D) $\cos\theta = \frac{3g}{2\ell\omega^2}$

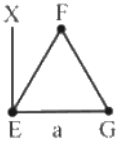
Answer: (D) $\cos\theta = \frac{3g}{2\ell\omega^2}$ · Key from source paper

Q191 JEE Main 2020 · 3 Sep · Shift 2 Numerical

An massless equilateral triangle EFG of side 'a' (As shown in figure) has three particles of mass m situated at its vertices. The moment of inertia of the system about the line EX perpendicular to EG in the plane of EFG is $\frac{N}{20}ma^2$ where N is an integer. The value of N is _____ .

(see the figure above)

Q22. An massless equilateral triangle EFG of side 'a' (As shown in figure) has three particles of mass m situated at its vertices. The moment of inertia of the system about the line EX perpendicular to EG in the plane of EFG is $\frac{N}{20}ma^2$ where N is an integer. The value of N is _____ .



Numerical value type: the answer is a number.

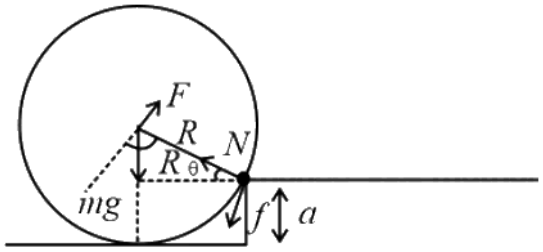
Answer: 25. · Key from source paper

Q192 JEE Main 2020 · 2 Sep · Shift 1 MCQ

A uniform cylinder of mass M and radius R is to be pulled over a step of height a ($a < R$) by applying a force F at its centre 'O' perpendicular to the plane through the axes of the cylinder on the edge of

the step (see figure). The minimum value of F required is :
(see the figure above)

Q4. A uniform cylinder of mass M and radius R is to be pulled over a step of height a ($a < R$) by applying a force F at its centre 'O' perpendicular to the plane through the axes of the cylinder on the edge of the step (see figure). The minimum value of F required is :



(1) $Mg\sqrt{1-\left(\frac{R-a}{R}\right)^2}$
(2) $Mg\sqrt{\left(\frac{R}{R-a}\right)^2-1}$
(3) $Mg\frac{a}{R}$
(4) $Mg\sqrt{1-\frac{a^2}{R^2}}$

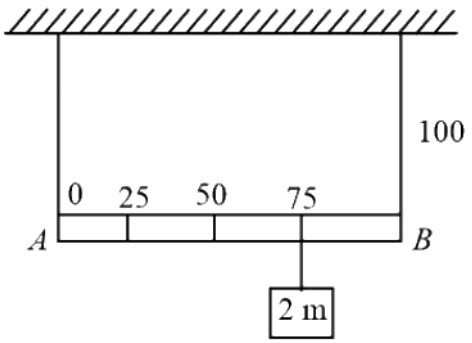
(A) $Mg\sqrt{1-\left(\frac{R-a}{R}\right)^2}$
(B) $Mg\sqrt{\left(\frac{R}{R-a}\right)^2-1}$
(C) $Mg\frac{a}{R}$
(D) $Mg\sqrt{1-\frac{a^2}{R^2}}$

Answer: (A) $Mg\sqrt{1-\left(\frac{R-a}{R}\right)^2}$ · Key from source paper

Q193 JEE Main 2020 · 2 Sep · Shift 1 MCQ

Shown in the figure is rigid and uniform one meter long rod AB held in horizontal position by two strings tied to its ends and attached to the ceiling. The rod is off mass 'm' and has another weight of mass 2 m hung at a distance of 75 cm from A. The tension in the string at A is:
(see the figure above)

Q7. Shown in the figure is rigid and uniform one meter long rod AB held in horizontal position by two strings tied to its ends and attached to the ceiling. The rod is off mass 'm' and has another weight of mass 2 m hung at a distance of 75 cm from A. The tension in the string at A is:



(1) $0.5\ mg$
(2) $2\ mg$
(3) $0.75\ mg$
(4) $1\ mg$

(A) $0.5\ mg$
(B) $2\ mg$
(C) $0.75\ mg$
(D) $1\ mg$

Answer: (D) $1\ mg$ · Key from source paper

Q194 JEE Main 2020 · 2 Sep · Shift 2 MCQ

Two uniform circular discs are rotating independently in the same direction around their common axis passing through their centres. The moment of inertia and angular velocity of the first disc are $0.1\ \text{kg} - \text{m}^2$ and $10\ \text{rad s}^{-1}$ respectively while those for the second one are $0.2\ \text{kg} - \text{m}^2$ and $5\ \text{rad s}^{-1}$ respectively. At some instant they get stuck together and start rotating as a single system about their common axis with some angular speed. The kinetic energy of the combined system is :

(A) $\frac{10}{3}\text{J}$
(B) $\frac{20}{3}\text{J}$
(C) $\frac{5}{3}\text{J}$
(D) $\frac{2}{3}\text{J}$

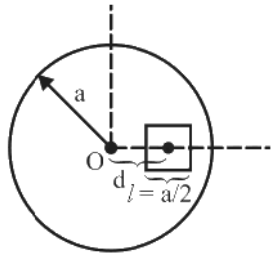
Answer: (B) $\frac{20}{3}\text{J}$ · Key from source paper

Q195 JEE Main 2020 · 2 Sep · Shift 2 Numerical

A square shaped hole of side $l = \frac{a}{2}$ is carved out at a distance $d = \frac{a}{2}$ from the centre 'O' of a uniform circular disk of radius a. If the distance of the centre of mass of the remaining portion from O is $-\frac{a}{x}$, value of X (to the nearest integer) is :

(see the figure above)

Q21. A square shaped hole of side $l = \frac{a}{2}$ is carved out at a distance $d = \frac{a}{2}$ from the centre 'O' of a uniform circular disk of radius a. If the distance of the centre of mass of the remaining portion from O is $-\frac{a}{x}$, value of X (to the nearest integer) is :



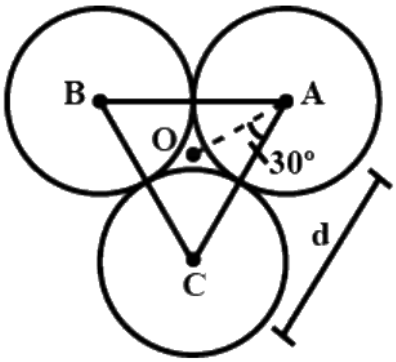
Numerical value type: the answer is a number.

Answer: 23. · Key from source paper

Q196 JEE Main 2020 · 9 Jan · Shift 1 MCQ

see figure

Q4.



Three solid spheres each of mass m and diameter d are stuck together such that the lines connecting the centres form an equilateral triangle of side of length d . The ratio $\frac{I_0}{I_A}$ of moment of inertia I_0 of the system about an axis passing the centroid and about center of any of the spheres I_A and perpendicular to the plane of the triangle is:

(1) $\frac{13}{23}$
(2) $\frac{15}{13}$
(3) $\frac{23}{13}$
(4) $\frac{13}{15}$

(A) $\frac{13}{23}$
(B) $\frac{15}{13}$
(C) $\frac{23}{13}$
(D) $\frac{13}{15}$

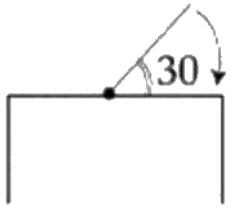
Answer: (A) $\frac{13}{23}$ · Key from source paper

Q197 JEE Main 2020 · 9 Jan · Shift 1 Numerical

One end of a straight uniform $1m$ long bar is pivoted on horizontal table. It is released from rest when it makes an angle 30° from the horizontal (see figure). Its angular speed when it hits the table is given as $\sqrt{n}\ rad\ s^{-1}$, where n is an integer. The value of n is _____.

(see the figure above)

Q22. One end of a straight uniform $1m$ long bar is pivoted on horizontal table. It is released from rest when it makes an angle 30° from the horizontal (see figure). Its angular speed when it hits the table is given as $\sqrt{n}\ rad\ s^{-1}$, where n is an integer. The value of n is _____



Numerical value type: the answer is a number.

Answer: 15. · Key from source paper

Q198 JEE Main 2020 · 9 Jan · Shift 2 MCQ

A rod of length l has non-uniform linear mass density given by $\rho(x) = a + b\left(\frac{x}{l}\right)^2$, where a and b are constants and $0 \le x \le l$ The value of x for the centre of mass of the rod is at:

(A) $\frac{3}{2}\left(\frac{a+b}{2a+b}\right)L$
(B) $\frac{3}{4}\left(\frac{2a+b}{3a+b}\right)L$
(C) $\frac{4}{3}\left(\frac{a+b}{2a+3b}\right)L$
(D) $\frac{3}{2}\left(\frac{2a+b}{3a+b}\right)L$

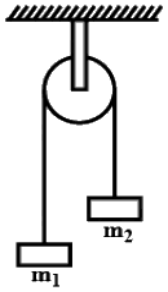
Answer: (B) $\frac{3}{4}\left(\frac{2a+b}{3a+b}\right)L$ · Key from source paper

Q199 JEE Main 2020 · 9 Jan · Shift 2 MCQ

A uniformly thick wheel with moment of inertia I and radius R is free to rotate about its centre of mass (see fig). A massless string is wrapped over its rim and two blocks of masses m_1 and $m_2(m_1 > m_2)$ are attached to the ends of the string. The system Is released from rest. The angular speed of the wheel when m_1 descends by a distance h is:

(see the figure above)

Q6. A uniformly thick wheel with moment of inertia I and radius R is free to rotate about its centre of mass (see fig). A massless string is wrapped over its rim and two blocks of masses m_1 and $m_2(m_1 > m_2)$ are attached to the ends of the string. The system Is released from rest. The angular speed of the wheel when m_1 descends by a distance h is:



(1) $\left[\frac{2(m_1-m_2)gh}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}$
(2) $\left[\frac{2(m_1+m_2)gh}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}$
(3) $\left[\frac{(m_1-m_2)}{(m_1+m_2)R^2+1}\right]^{\frac{1}{2}}gh$
(4) $\left[\frac{m_1+m_2}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}gh$

(A) $\left[\frac{2(m_1-m_2)gh}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}$
(B) $\left[\frac{2(m_1+m_2)gh}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}$
(C) $\left[\frac{(m_1-m_2)}{(m_1+m_2)R^2+1}\right]^{\frac{1}{2}}gh$
(D) $\left[\frac{m_1+m_2}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}gh$

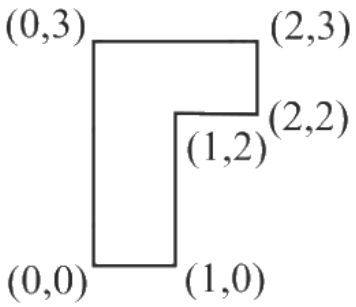
Answer: (A) $\left[\frac{2(m_1-m_2)gh}{(m_1+m_2)R^2+I}\right]^{\frac{1}{2}}$ · Key from source paper

Q200 JEE Main 2020 · 8 Jan · Shift 1 MCQ

The coordinates of the centre of mass of a uniform flag-shaped lamina (thin flat plate) of mass 4 kg. (The coordinates of the same are shown in the figure) are:

(see the figure above)

Q3. The coordinates of the centre of mass of a uniform flag-shaped lamina (thin flat plate) of mass 4 kg. (The coordinates of the same are shown in the figure) are:



(1) $(1.25\ \text{m}, 1.50\ \text{m})$
(2) $(0.75\ \text{m}, 1.75\ \text{m})$
(3) $(0.75\ \text{m}, 0.75\ \text{m})$
(4) $(1\ \text{m}, 1.75\ \text{m})$

(A) $(1.25\ \text{m}, 1.50\ \text{m})$
(B) $(0.75\ \text{m}, 1.75\ \text{m})$
(C) $(0.75\ \text{m}, 0.75\ \text{m})$
(D) $(1\ \text{m}, 1.75\ \text{m})$

Answer: (B) $(0.75\ \text{m}, 1.75\ \text{m})$ · Key from source paper

Q201 JEE Main 2020 · 8 Jan · Shift 1 MCQ

Consider a uniform rod of mass $M = 4m$ and length l pivoted about its centre. A mass m moving with velocity v making angle $\theta = \frac{\pi}{4}$ to the rod's long axis collides with one end of the rod and sticks to it. The angular speed of the rod-mass system just after the collision is:

(A) $\frac{3}{7\sqrt{2}}\frac{v}{l}$
(B) $\frac{3}{7}\frac{v}{l}$
(C) $\frac{3\sqrt{2}}{7}\frac{v}{l}$
(D) $\frac{4}{7}\frac{v}{l}$

Answer: (C) $\frac{3\sqrt{2}}{7}\frac{v}{l}$ · Key from source paper

Q202 JEE Main 2020 · 8 Jan · Shift 2 MCQ

As shown in figure. When a spherical cavity (centred at O) of radius 1 is cut out of a uniform sphere of radius R (centred at C), the centre of mass of remaining (shaded part of sphere is at G, i.e., on the surface of the cavity. R can be determined by the equation:

(see the figure above)

Q4. As shown in figure. When a spherical cavity (centred at O) of radius 1 is cut out of a uniform sphere of radius R (centred at C), the centre of mass of remaining (shaded part of sphere is at G, i.e., on the surface of the cavity. R can be determined by the equation:



(1) $(R^2+R+1)(2-R)=1$
(2) $(R^2-R-1)(2-R)=1$
(3) $(R^2-R+1)(2-R)=1$
(4) $(R^2+R-1)(2-R)=1$

(A) $(R^2+R+1)(2-R)=1$
(B) $(R^2-R-1)(2-R)=1$
(C) $(R^2-R+1)(2-R)=1$
(D) $(R^2+R-1)(2-R)=1$

Answer: (A) $(R^2+R+1)(2-R)=1$ · Key from source paper

Q203 JEE Main 2020 · 8 Jan · Shift 2 MCQ

A uniform sphere of mass $500\ \text{g}$ rolls without slipping on a plane horizontal surface with its centre moving at a speed of $5.00\ \text{cm s}^{-1}$. Its kinetic energy is:

(A) $8.75\times10^{-4}\ \text{J}$
(B) $8.75\times10^{-3}\ \text{J}$
(C) $6.25\times10^{-4}\ \text{J}$
(D) $1.13\times10^{-3}\ \text{J}$

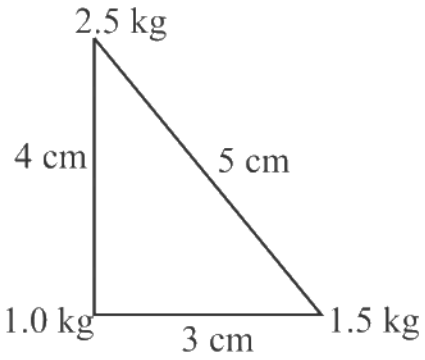
Answer: (A) $8.75\times10^{-4}\ \text{J}$ · Key from source paper

Q204 JEE Main 2020 · 7 Jan · Shift 1 MCQ

Three point particles of masses $1.0\ \text{kg}$, $1.5\ \text{kg}$ and $2.5\ \text{kg}$ are placed at three corners of a right angle triangle of sides $4.0\ \text{cm}$, $3.0\ \text{cm}$ and $5.0\ \text{cm}$ as shown in the figure. The centre of mass of the system is at a point:

(see the figure above)

Q2. Three point particles of masses 1.0 kg, 1.5 kg and 2.5 kg are placed at three corners of a right angle triangle of sides 4.0 cm, 3.0 cm and 5.0 cm as shown in the figure. The centre of mass of the system is at a point:



(1) 0.6 cm right and 2.0 cm above 1 kg mass.
(2) 1.5 cm right and 1.2 cm above 1 kg mass.
(3) 2.0 cm right and 0.9 cm above 1 kg mass.
(4) 0.9 cm right and 2.0 cm above 1 kg mass.

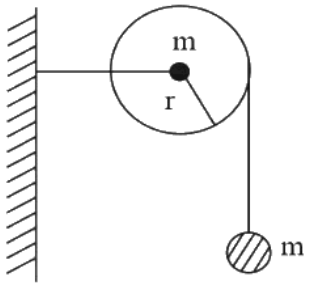
(A) 0.6 cm right and 2.0 cm above 1 kg mass.
(B) 1.5 cm right and 1.2 cm above 1 kg mass.
(C) 2.0 cm right and 0.9 cm above 1 kg mass.
(D) 0.9 cm right and 2.0 cm above 1 kg mass.

Answer: (D) 0.9 cm **right and** 2.0 cm **above** 1 kg **mass.** · Key from source paper

Q205 JEE Main 2020 · 7 Jan · Shift 1 MCQ

see figure

Q3.



As shown in the figure, a bob of mass m is tied to a massless string whose other end portion is wound on a fly wheel (disc) of radius r and mass m. When released from rest the bob starts falling vertically. When it has covered a distance of h, the angular speed of the wheel will be:

(1) $\frac{1}{r}\sqrt{\frac{4gh}{3}}$
(2) $r\sqrt{\frac{3}{2gh}}$
(3) $\frac{1}{r}\sqrt{\frac{2gh}{3}}$
(4) $r\sqrt{\frac{3}{4gh}}$

(A) $\frac{1}{r}\sqrt{\frac{4gh}{3}}$
(B) $r\sqrt{\frac{3}{2gh}}$
(C) $\frac{1}{r}\sqrt{\frac{2gh}{3}}$
(D) $r\sqrt{\frac{3}{4gh}}$

Answer: (A) $\frac{1}{r}\sqrt{\frac{4gh}{3}}$ · Key from source paper

Q206 JEE Main 2020 · 7 Jan · Shift 1 MCQ

The radius of gyration of a uniform rod of length l, about an axis passing through a point $\frac{l}{4}$ away from the centre of the rod, and perpendicular to it, is:

(A) $\frac{1}{4}l$
(B) $\frac{1}{8}l$
(C) $\sqrt{\frac{7}{48}}l$
(D) $\sqrt{\frac{3}{8}}l$

Answer: (C) $\sqrt{\frac{7}{48}}l$ · Key from source paper

Q207 JEE Main 2020 · 7 Jan · Shift 2 MCQ

Mass per unit area of a circular disc of radius a depends on the distance r from its centre as $\sigma(r) = A + Br$. The moment of inertia of the disc about the axis, perpendicular to the plane and passing through its centre is:

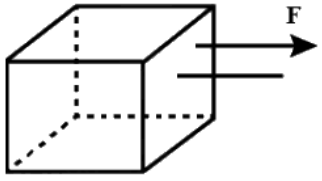
(A) $2\pi a^4\left(\frac{A}{4}+\frac{aB}{5}\right)$
(B) $2\pi a^4\left(\frac{aA}{4}+\frac{B}{5}\right)$
(C) $\pi a^4\left(\frac{A}{4}+\frac{aB}{5}\right)$
(D) $2\pi a^4\left(\frac{A}{4}+\frac{B}{5}\right)$

Answer: (A) $2\pi a^4\left(\frac{A}{4}+\frac{aB}{5}\right)$ · Key from source paper

Q208 JEE Main 2020 · 7 Jan · Shift 2 Numerical

see figure

Q22.



Consider a uniform cubical box of side a on a rough floor that is to be moved by applying minimum possible force F at a point b above its centre of mass (see figure). If the coefficient of friction is $\mu = 0.4$, the maximum possible value of $100 \times \frac{b}{a}$ for a box not to topple before moving is _____

Numerical value type: the answer is a number.

Answer: 50. · Key from source paper

Q209 JEE Main 2019 · 12 Apr · Shift 1 MCQ

A person of mass M is sitting on a swing of length L and swinging with and an angular amplitude θ_0 . If the person stands up when the swing passes through its lowest point, the work done by him, assuming that his centre of mass moves by a distance l $l << L$, is close to:

(A) $Mgl\left(1-\theta_0^2\right)$

(B) $Mgl\left(1+\frac{\theta_0^2}{2}\right)$

(C) Mgl

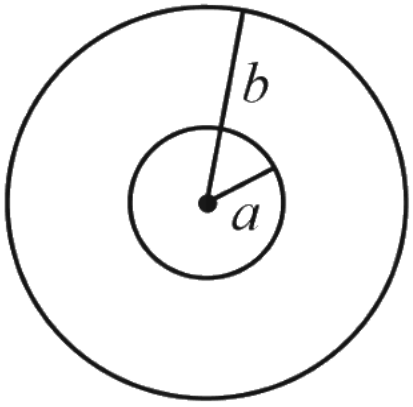
(D) $Mgl\left(1+\theta_0^2\right)$

Answer: (D) $Mgl\left(1+\theta_0^2\right)$ · Key from source paper

Q210 JEE Main 2019 · 12 Apr · Shift 1 MCQ

A circular disc of radius b has a hole of radius a at its centre(see figure). If the mass per unit area of the disc varies as $\frac{\sigma_0}{r}$ then, the radius of gyration of the disc about its axis passing through the center is *(see the figure above)*

Q7. A circular disc of radius b has a hole of radius a at its centre(see figure). If the mass per unit area of the disc varies as $\frac{\sigma_0}{r}$ then, the radius of gyration of the disc about its axis passing through the center is



(1) $\frac{a+b}{3}$

(2) $\sqrt{\frac{a^2+b^2+ab}{3}}$

(3) $\frac{a+b}{2}$

(4) $\sqrt{\frac{a^2+b^2+ab}{2}}$

(A) $\frac{a+b}{3}$

(B) $\sqrt{\frac{a^2+b^2+ab}{3}}$

(C) $\frac{a+b}{2}$

(D) $\sqrt{\frac{a^2+b^2+ab}{2}}$

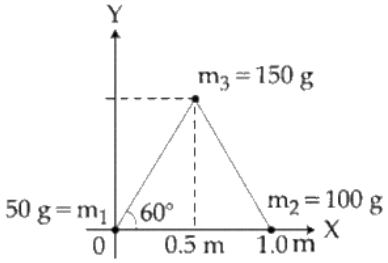
Answer: (B) $\sqrt{\frac{a^2+b^2+ab}{3}}$ · Key from source paper

Q211 JEE Main 2019 · 12 Apr · Shift 2 MCQ

Three particles of masses 50 g, 100 g and 150 g are placed at the vertices of an equilateral triangle of side 1 m (as shown in the figure). The (x, y) coordinates of the centre of mass will be:

(see the figure above)

Q5. Three particles of masses 50 g, 100 g and 150 g are placed at the vertices of an equilateral triangle of side 1 m (as shown in the figure). The (x, y) coordinates of the centre of mass will be:



(1) $\left(\frac{7}{12}\text{ m}, \frac{\sqrt{3}}{4}\text{ m}\right)$
(2) $\left(\frac{7}{12}\text{ m}, \frac{\sqrt{3}}{8}\text{ m}\right)$
(3) $\left(\frac{\sqrt{3}}{4}\text{ m}, \frac{5}{12}\text{ m}\right)$
(4) $\left(\frac{\sqrt{3}}{8}\text{ m}, \frac{7}{12}\text{ m}\right)$

(A) $\left(\frac{7}{12}\text{ m}, \frac{\sqrt{3}}{4}\text{ m}\right)$
(B) $\left(\frac{7}{12}\text{ m}, \frac{\sqrt{3}}{8}\text{ m}\right)$
(C) $\left(\frac{\sqrt{3}}{4}\text{ m}, \frac{5}{12}\text{ m}\right)$
(D) $\left(\frac{\sqrt{3}}{8}\text{ m}, \frac{7}{12}\text{ m}\right)$

Answer: (A) $\left(\frac{7}{12}\text{ m}, \frac{\sqrt{3}}{4}\text{ m}\right)$ · Key from source paper

Q212 JEE Main 2019 · 10 Apr · Shift 1 MCQ

A particle of mass m is moving along a trajectory given by

$x = x_0 + a\ \cos\omega_1 t$

$y = y_0 + b\ \sin\omega_2 t$

The torque, acting on the particle about the origin, at t = 0 is:

(A) $+my_0a\omega_1^2\hat{k}$
(B) $-m\left(x_0b\omega_2^2 - y_0a\omega_1^2\right)\hat{k}$
(C) Zero
(D) $m\left(-x_0b + y_0a\right)\omega_1^2\hat{k}$

Answer: (A) $+my_0a\omega_1^2\hat{k}$ · Key from source paper

Q213 JEE Main 2019 · 10 Apr · Shift 1 MCQ

A thin disc of mass M and radius R has mass per unit area $\sigma(r) = kr^2$ where r is the distance from its centre. Its moment inertia about an axis going through its centre of mass and perpendicular to its plane is:

(A) $\frac{MR^2}{3}$
(B) $\frac{MR^2}{2}$
(C) $\frac{MR^2}{6}$
(D) $\frac{2MR^2}{3}$

Answer: (D) $\frac{2MR^2}{3}$ · Key from source paper

Q214 JEE Main 2019 · 10 Apr · Shift 1 MCQ

Two coaxial discs, having moments of inertia I_1 and $\frac{I_1}{2}$, are rotating with respective angular velocities ω_1 and $\frac{\omega_1}{2}$, about their common axis. They are brought in contact with each other and thereafter they rotate with a common angular velocity. If E_f and E_i are the final and initial total energies, then $(E_f - E_i)$ is:

(A) $\frac{I_1\omega_1^2}{6}$
(B) $\frac{3}{8}I_1\omega_1^2$
(C) $-\frac{I_1\omega_1^2}{12}$
(D) $-\frac{I_1\omega_1^2}{24}$

Answer: (D) $-\frac{I_1\omega_1^2}{24}$ · Key from source paper

Q215 JEE Main 2019 · 10 Apr · Shift 2 MCQ

A solid sphere of mass M and radius R is divided into two unequal parts. The first part has a mass of $\frac{7M}{8}$ and is converted into uniform disc of radius $2R$. The second part is converted into a uniform solid sphere. Let I_1 be the moment of inertia of the disc about its axis and I_2 be the moment of inertia of the new sphere about its axis. The ratio I_1/I_2 is given by:

(A) 140
(B) 185
(C) 65
(D) 285

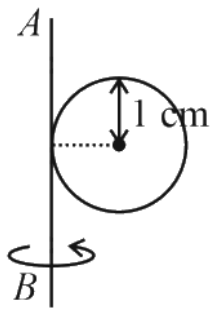
Answer: (A) 140 · Key from source paper

Q216 JEE Main 2019 · 10 Apr · Shift 2 MCQ

A metal coin of mass $5\ \text{g}$ and radius $1\ \text{cm}$ is fixed to a thin stick AB of negligible mass as shown in the figure. The system is initially at rest. The constant torque, that will make the system rotate about AB at 25 rotations per second in $5\ \text{s}$, is close to:

(see the figure above)

Q6. A metal coin of mass 5 g and radius 1 cm is fixed to a thin stick AB of negligible mass as shown in the figure. The system is initially at rest. The constant torque, that will make the system rotate about AB at 25 rotations per second in 5 s , is close to:



(1) 1.6×10^{-5} N m
(2) 2.0×10^{-5} N m
(3) 7.9×10^{-6} N m
(4) 4.0×10^{-6} N m

(A) $1.6 \times 10^{-5}\ \mathrm{N\,m}$
(B) $2.0 \times 10^{-5}\ \mathrm{N\,m}$
(C) $7.9 \times 10^{-6}\ \mathrm{N\,m}$
(D) $4.0 \times 10^{-6}\ \mathrm{N\,m}$

Answer: (B) $2.0 \times 10^{-5}\ \mathrm{N\,m}$ · Key from source paper

Q217 JEE Main 2019 · 10 Apr · Shift 2 MCQ

The time dependence of the position of a particle of mass $m = 2$ is given by $\vec{r}\,t = 2t\,\hat{i} - 3t^2\hat{j}$. Its angular momentum, with respect to the origin, at time $t = 2$ is:

(A) $36\,\hat{k}$
(B) $48\,\hat{i} + \hat{j}$
(C) $-48\,\hat{k}$
(D) $-34\,\hat{k} - \hat{i}$

Answer: (C) $-48\,\hat{k}$ · Key from source paper

Q218 JEE Main 2019 · 9 Apr · Shift 1 MCQ

A stationary horizontal disc is free to rotate about its axis. When a torque is applied on it, its kinetic energy as a function of θ, where θ is the angle by which it has rotated, is given as $k\theta^2$. If its moment of inertia is I then the angular acceleration of the disc is:

(A) $\frac{2k}{I}\theta$
(B) $\frac{k}{2I}\theta$
(C) $\frac{k}{4I}\theta$
(D) $\frac{k}{I}\theta$

Answer: (A) $\frac{2k}{I}\theta$ · Key from source paper

Q219 JEE Main 2019 · 9 Apr · Shift 1 MCQ

The following bodies are made to roll up (without slipping) the same inclined plane from a horizontal plane: (i) a ring of radius R, (ii) a solid cylinder of radius $\frac{R}{2}$ and (iii) a solid sphere of radius $\frac{R}{4}$. If, in each case, the speed of the center of mass at the bottom of the incline is same, the ratio of the maximum heights they climb is:

(A) 2 : 3 : 4
(B) 20 : 15 : 14
(C) 4 : 3 : 2
(D) 14 : 15 : 20

Answer: (B) 20 : 15 : 14 · Key from source paper

Q220 JEE Main 2019 · 9 Apr · Shift 2 MCQ

A thin smooth rod of length L and mass M is rotating freely with angular speed ω_0 about an axis perpendicular to the rod and passing through center. Two beads of mass m and negligible size are at the center of the rod initially. The beads of mass m and negligible size are at the center of the rod initially. The beads are free to slide along the rod. The angular speed of the system, when the beads reach the opposite ends of the rod, will be:

(A) $\frac{M\omega_0}{M+3m}$
(B) $\frac{M\omega_0}{M+2m}$
(C) $\frac{M\omega_0}{M+6m}$
(D) $\frac{M\omega_0}{M+m}$

Answer: (C) $\frac{M\omega_0}{M+6m}$ · Key from source paper

Q221 JEE Main 2019 · 9 Apr · Shift 2 MCQ

Moment of inertia of a body about a given axis is 1.5 $\mathrm{kg\ m^2}$. Initially the body is at rest. In order to produce a rotational kinetic energy of 1200 J, the angular acceleration of 20 $\mathrm{rad/s^2}$ must be applied about the axis for a duration of:

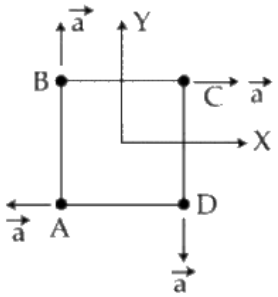
(A) 3 s
(B) 2 s
(C) 2.5 s
(D) 5 s

Answer: (B) 2 s · Key from source paper

Q222 JEE Main 2019 · 8 Apr · Shift 1 MCQ

Four particles A, B, C and D with masses $m_A = m$, $m_B = 2m$, $m_C = 3m$ and $m_D = 4m$ are at the corners of a square. They have accelerations of equal magnitude with directions as shown. The acceleration of the centre of mass of the particles is:
(see the figure above)

Q5. Four particles A, B, C and D with masses $m_A = m, m_B = 2m, m_C = 3m$ and $m_D = 4m$ are at the corners of a square. They have accelerations of equal magnitude with directions as shown. The acceleration of the centre of mass of the particles is:



(1) $\frac{a}{5}\hat{i} + \hat{j}$ (2) $\frac{a}{5}\hat{i} - \hat{j}$ (3) $a\hat{i} + \hat{j}$ (4) Zero

(A) $\frac{a}{5}\hat{i} + \hat{j}$
(B) $\frac{a}{5}\hat{i} - \hat{j}$
(C) $a\hat{i} + \hat{j}$
(D) Zero

Answer: (B) $\frac{a}{5}\hat{i} - \hat{j}$ · Key from source paper

Q223 JEE Main 2019 · 8 Apr · Shift 1 MCQ

A thin circular plate of mass M and radius R has its density varying as $\rho(r) = \rho_0 r$ with ρ_0 as constant and r is the distance from its centre. The moment of Inertia of the circular plate about an axis perpendicular to the plate and passing through its edge is $I = aMR^2$. The value of the coefficient a is:

(A) $\frac{3}{5}$
(B) $\frac{1}{2}$
(C) $\frac{8}{5}$
(D) $\frac{3}{2}$

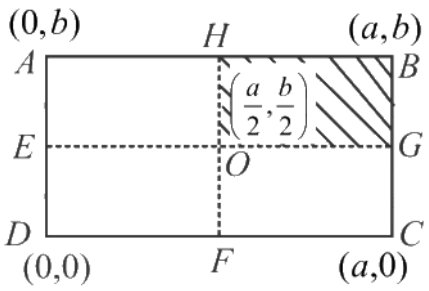
Answer: (C) $\frac{8}{5}$ · Key from source paper

Q224 JEE Main 2019 · 8 Apr · Shift 2 MCQ

A uniform rectangular thin sheet $ABCD$ of mass M has length a and breadth b, as shown in the figure. If the shaded portion $HBGO$ is cut-off, the coordinates of the centre of mass of the remaining portion will be:

(see the figure above)

Q5. A uniform rectangular thin sheet $ABCD$ of mass M has length a and breadth b, as shown in the figure. If the shaded portion $HBGO$ is cut-off, the coordinates of the centre of mass of the remaining portion will be:



(1) $\frac{5a}{12}, \frac{5b}{12}$
(2) $\frac{5a}{3}, \frac{5b}{3}$
(3) $\frac{2a}{3}, \frac{2b}{3}$
(4) $\frac{3a}{4}, \frac{3b}{4}$

(A) $\frac{5a}{12}, \frac{5b}{12}$
(B) $\frac{5a}{3}, \frac{5b}{3}$
(C) $\frac{2a}{3}, \frac{2b}{3}$
(D) $\frac{3a}{4}, \frac{3b}{4}$

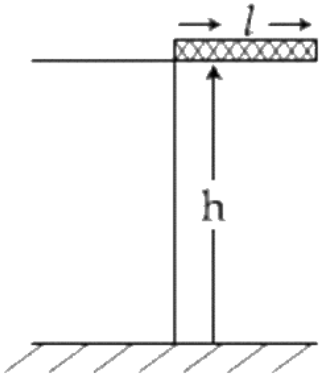
Answer: (A) $\frac{5a}{12}, \frac{5b}{12}$ · Key from source paper

Q225 JEE Main 2019 · 8 Apr · Shift 2 MCQ

A rectangular solid box of length 0.3 m is held horizontally, with one of its sides on the edge of a platform of height 5 m . When released, it slips off the table in a very short time τ = 0.01 s , remaining essentially horizontal. The angle by which it would rotate when it hits the ground will be (in radians) close to:

(see the figure above)

Q7. A rectangular solid box of length 0.3 m is held horizontally, with one of its sides on the edge of a platform of height 5 m . When released, it slips off the table in a very short time $\tau = 0.01$ s , remaining essentially horizontal. The angle by which it would rotate when it hits the ground will be (in radians) close to:



(1) 0.5
(2) 0.3
(3) 0.02
(4) 0.28

(A) 0.5
(B) 0.3
(C) 0.02
(D) 0.28

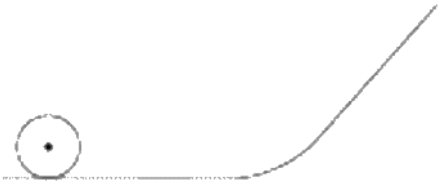
Answer: (A) 0.5 · Key from source paper

Q226 JEE Main 2019 · 8 Apr · Shift 2 MCQ

A solid sphere and solid cylinder of identical radii approach an incline with the same linear velocity (see figure). Both roll without slipping all throughout. The two climb maximum heights h_{sph} and h_{cyl} on the inline. The ratio $\frac{h_{sph}}{h_{cyl}}$ is given by:

(see the figure above)

Q8. A solid sphere and solid cylinder of identical radii approach an incline with the same linear velocity (see figure). Both roll without slipping all throughout. The two climb maximum heights h_{sph} and h_{cyl} on the inline. The ratio $\frac{h_{sph}}{h_{cyl}}$ is given by:



(1) $\frac{2}{\sqrt{5}}$
(2) $\frac{4}{5}$
(3) $\frac{14}{15}$
(4) 1

(A) $\frac{2}{\sqrt{5}}$
(B) $\frac{4}{5}$
(C) $\frac{14}{15}$
(D) 1

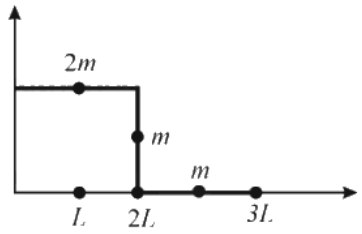
Answer: (C) $\frac{14}{15}$ · Key from source paper

Q227 JEE Main 2019 · 12 Jan · Shift 1 MCQ

The position vector of the center of mass $\overrightarrow{r}_{cm}$ of an asymmetric uniform bar of negligible area of cross-section as shown in figure is:

(see the figure above)

Q4. The position vector of the center of mass $\vec{r}_{cm}$ of an asymmetric uniform bar of negligible area of cross-section as shown in figure is:



(1) $\vec{r}_{cm} = \frac{13}{8}L\hat{x} + \frac{5}{8}L\hat{y}$
(2) $\vec{r}_{cm} = \frac{5}{8}L\hat{x} + \frac{13}{8}L\hat{y}$
(3) $\vec{r}_{cm} = \frac{3}{8}L\hat{x} + \frac{11}{8}L\hat{y}$
(4) $\vec{r}_{cm} = \frac{11}{8}L\hat{x} + \frac{3}{8}L\hat{y}$

(A) $\overrightarrow{r}_{cm} = \frac{13}{8}L\hat{x} + \frac{5}{8}L\hat{y}$
(B) $\overrightarrow{r}_{cm} = \frac{5}{8}L\hat{x} + \frac{13}{8}L\hat{y}$
(C) $\overrightarrow{r}_{cm} = \frac{3}{8}L\hat{x} + \frac{11}{8}L\hat{y}$
(D) $\overrightarrow{r}_{cm} = \frac{11}{8}L\hat{x} + \frac{3}{8}L\hat{y}$

Answer: (A) $\overrightarrow{r}_{cm} = \frac{13}{8}L\hat{x} + \frac{5}{8}L\hat{y}$ · Key from source paper

Q228 JEE Main 2019 · 12 Jan · Shift 1 MCQ

Let the moment of inertia of a hollow cylinder of length 30 cm (inner radius 10 cm and outer radius 20 cm), about its axis be I . The radius of a thin cylinder of the same mass such that its moment of inertia about its axis is also I, is:

(A) 16 cm
(B) 14 cm
(C) 12 cm
(D) 18 cm

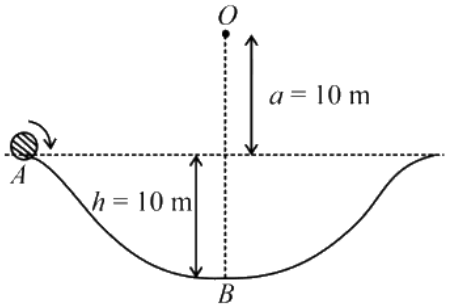
Answer: (A) 16 cm · Key from source paper

Q229 JEE Main 2019 · 12 Jan · Shift 2 MCQ

A particle of mass 20 g is released with an initial velocity 5 m s^{-1} along the curve from the point A, as shown in the figure. The point A is at height h from point B. The particle slides along the frictionless surface. When the particle reaches point B, its angular momentum about O will be: (Take $g = 10$ m s^{-2})

(see the figure above)

Q5. A particle of mass 20 g is released with an initial velocity 5 m s^{-1} along the curve from the point A, as shown in the figure. The point A is at height h from point B. The particle slides along the frictionless surface. When the particle reaches point B, its angular momentum about O will be: (Take $g = 10$ m s^{-2})



(1) 3 kg m^2 s^{-1}
(2) 2 kg m^2 s^{-1}
(3) 6 kg m^2 s^{-1}
(4) 8 kg m^2 s^{-1}

(A) 3 kg m^2 s^{-1}
(B) 2 kg m^2 s^{-1}
(C) 6 kg m^2 s^{-1}
(D) 8 kg m^2 s^{-1}

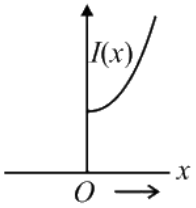
Answer: (C) 6 kg m^2 s^{-1} · Key from source paper

Q230 JEE Main 2019 · 12 Jan · Shift 2 MCQ

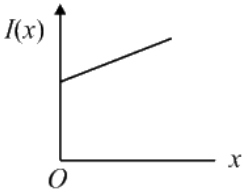
The moment of inertial of a solid sphere, about an axis parallel to its diameter and at a distance of x from it, is '$I(x)$'. Which one of the graphs represents the variation of $I(x)$ with x correctly?

Q8. The moment of inertial of a solid sphere, about an axis parallel to its diameter and at a distance of x from it, is $I(x)'$. Which one of the graphs represents the variation of $I(x)$ with x correctly?

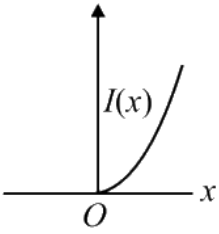
(1)



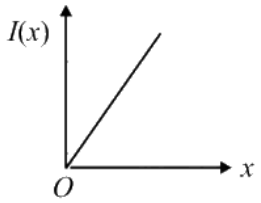
(2)



(3)



(4)



(A) *see figure*
(B) *see figure*
(C) *see figure*
(D) *see figure*

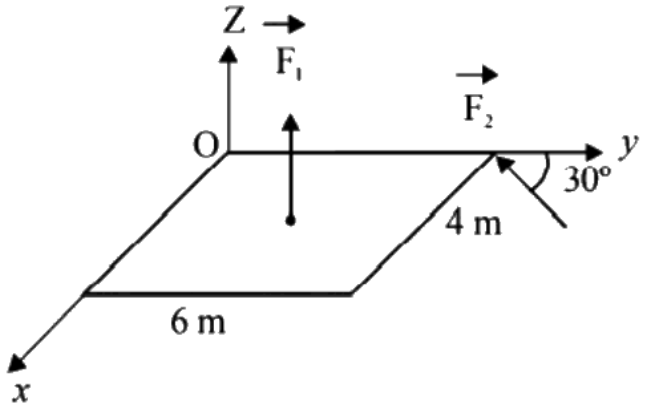
Answer: (A) · Key from source paper

Q231 JEE Main 2019 · 11 Jan · Shift 1 MCQ

A slab is subjected to two forces $\vec{F}_1$ and $\vec{F}_2$ of same magnitude F as shown in the figure. Force $\vec{F}_2$ is in XY-plane while force F_1 acts along z -axis at the point $(2\hat{i}+3\hat{j})$. The moment of these forces about point O will be:

(see the figure above)

Q5. A slab is subjected to two forces $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ of same magnitude F as shown in the figure. Force $\overrightarrow{F_2}$ is in XY-plane while force F_1 acts along z -axis at the point $(2\vec{i}+3\vec{j})$. The moment of these forces about point O will be:



(1) $(3\hat{i}-2\hat{j}+3\hat{k})$ F
(2) $(3\hat{i}-2\hat{j}-3\hat{k})$F
(3) $(3\hat{i}+2\hat{j}-3\hat{k})$F
(4) $(3\hat{i}+2\hat{j}+3\hat{k})$F

(A) $(3\hat{i}-2\hat{j}+3\hat{k})$ F
(B) $(3\hat{i}-2\hat{j}-3\hat{k})$F
(C) $(3\hat{i}+2\hat{j}-3\hat{k})$F
(D) $(3\hat{i}+2\hat{j}+3\hat{k})$F

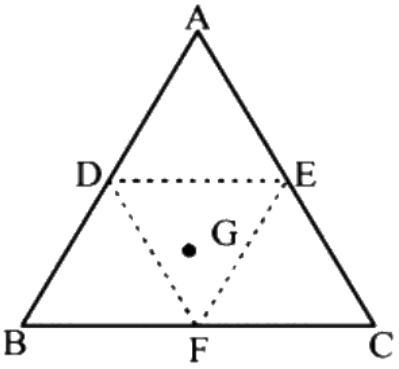
Answer: (A) $(3\hat{i}-2\hat{j}+3\hat{k})$ F · Key from source paper

Q232 JEE Main 2019 · 11 Jan · Shift 1 MCQ

An equilateral triangle ABC is cut from a thin solid sheet of wood. (See figure) D, E and F are the mid-points of its sides as shown and G is the centre of the triangle. The moment of inertia of the triangle about an axis passing through G and perpendicular to the plane of the triangle is I_0. If the smaller triangle DEF is removed from ABC, the moment of inertia of the remaining figure about the same axis is I. Then

(see the figure above)

Q6. An equilateral triangle ABC is cut from a thin solid sheet of wood. (See figure) D, E and F are the mid-points of its sides as shown and G is the centre of the triangle. The moment of inertia of the triangle about an axis passing through G and perpendicular to the plane of the triangle is I_0. If the smaller triangle DEF is removed from ABC, the moment of inertia of the remaining figure about the same axis is I. Then



(1) $I = \frac{15}{16}I_0$
(2) $I = \frac{3}{4}I_0$
(3) $I = \frac{9}{16}I_0$
(4) $I = \frac{I_0}{4}$

(A) $I = \frac{15}{16}I_0$
(B) $I = \frac{3}{4}I_0$
(C) $I = \frac{9}{16}I_0$
(D) $I = \frac{I_0}{4}$

Answer: (A) $I = \frac{15}{16}I_0$ · Key from source paper

Q233 JEE Main 2019 · 11 Jan · Shift 2 MCQ

The magnitude of torque on a particle of mass 1 kg is 2.5 Nm about the origin. If the force acting on it is 1 N, and the distance of the particle from the origin is 5 m, the angle between the force and the position vector is (in radians):

(A) $\frac{\pi}{6}$
(B) $\frac{\pi}{3}$
(C) $\frac{\pi}{8}$
(D) $\frac{\pi}{4}$

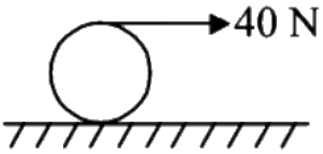
Answer: (A) $\frac{\pi}{6}$ · Key from source paper

Q234 JEE Main 2019 · 11 Jan · Shift 2 MCQ

a string is wound around a hollow cylinder of mass 5 kg and radius 0.5 m. If the string is now pulled with a horizontal force of 40 N, and the cylinder is rolling without slipping on a horizontal surface (see figure), then the angular acceleration of the cylinder will be (Neglect the mass and thickness of the string)

(see the figure above)

Q5. a string is wound around a hollow cylinder of mass 5 kg and radius 0.5 m. If the string is now pulled with a horizontal force of 40 N, and the cylinder is rolling without slipping on a horizontal surface (see figure), then the angular acceleration of the cylinder will be (Neglect the mass and thickness of the string)



(1) 20rad/s^2 (2) 16rad/s^2
(3) 12rad/s^2 (4) 10rad/s^2

(A) 20rad/s^2
(B) 16rad/s^2
(C) 12rad/s^2
(D) 10rad/s^2

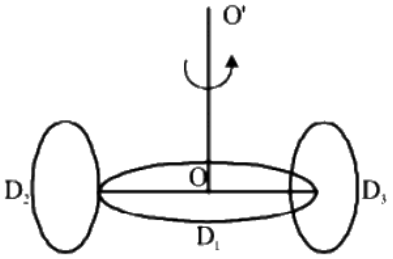
Answer: (B) 16rad/s^2 · Key from source paper

Q235 JEE Main 2019 · 11 Jan · Shift 2 MCQ

A circular disc D_1 of mass M and radius R has two identical discs D_2 and D_3 of the same mass M and radius R attached rigidly at its opposite ends (see figure). The moment of inertia of the system about the axis OO', passing through the centre of D_1, as shown in the figure, will be

(see the figure above)

Q6. A circular disc D_1 of mass M and radius R has two identical discs D_2 and D_3 of the same mass M and radius R attached rigidly at its opposite ends (see figure). The moment of inertia of the system about the axis OO', passing through the centre of D_1, as shown in the figure, will be



(1) MR^2
(2) $3MR^2$
(3) $\frac{4}{5}MR^2$
(4) $\frac{2}{3}MR^2$

(A) MR^2
(B) $3MR^2$
(C) $\frac{4}{5}MR^2$
(D) $\frac{2}{3}MR^2$

Answer: (B) $3MR^2$ · Key from source paper

Q236 JEE Main 2019 · 10 Jan · Shift 1 MCQ

To mop-clean a floor, a cleaning machine presses a circular mop of radius R vertically down with a total force F and rotates it with a constant angular speed about its axis. If the force F is distributed uniformly over the mop and if coefficient of friction between the mop and the floor is μ, the torque, applied by the machine on the mop is:

(A) $2\,\mu FR/3$
(B) $\mu FR/3$
(C) $\mu FR/6$
(D) $\mu FR/2$

Answer: (A) $2\,\mu FR/3$ · Key from source paper

Q237 JEE Main 2019 · 10 Jan · Shift 1 MCQ

A homogeneous solid cylindrical roller of radius R and mass M is pulled on a cricket pitch by a horizontal force. Assuming rolling without slipping, angular acceleration of the cylinder is:

(A) $\frac{F}{3\,mR}$
(B) $\frac{3F}{2\,m\,R}$
(C) $\frac{2F}{3\,m\,R}$
(D) $\frac{F}{2\,m\,R}$

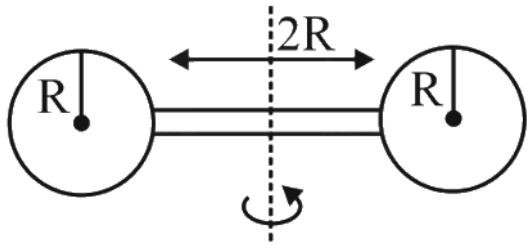
Answer: (C) $\frac{2F}{3\,m\,R}$ · Key from source paper

Q238 JEE Main 2019 · 10 Jan · Shift 2 MCQ

Two identical spherical balls of mass M and radius R each are stuck on two ends of a rod of length $2R$ and mass M(see figure). The moment of inertia of the system about the axis passing perpendicularly through the centre of the rod is

(see the figure above)

Q6. Two identical spherical balls of mass M and radius R each are stuck on two ends of a rod of length $2R$ and mass M(see figure). The moment of inertia of the system about the axis passing perpendicularly through the centre of the rod is



(1) $\frac{209}{15}MR^2$.
(2) $\frac{152}{15}MR^2$.
(3) $\frac{137}{15}MR^2$.
(4) $\frac{17}{5}MR^2$.

(A) $\frac{209}{15}MR^2$.
(B) $\frac{152}{15}MR^2$.
(C) $\frac{137}{15}MR^2$.
(D) $\frac{17}{5}MR^2$.

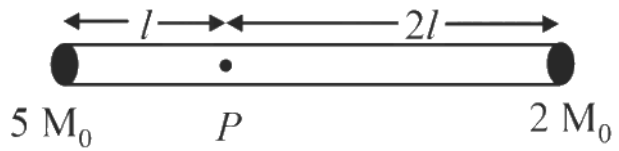
Answer: (C) $\frac{137}{15}MR^2$. · Key from source paper

Q239 JEE Main 2019 · 10 Jan · Shift 2 MCQ

A rigid massless rod of length $3l$ has two masses attached at each end as shown in the figure. The rod is pivoted at point P on the horizontal axis. When released from the initial horizontal position, its instantaneous angular acceleration will be

(see the figure above)

Q7. A rigid massless rod of length $3l$ has two masses attached at each end as shown in the figure. The rod is pivoted at point P on the horizontal axis. When released from the initial horizontal position, its instantaneous angular acceleration will be



(1) $\frac{g}{2l}$
(2) $\frac{7g}{3l}$
(3) $\frac{g}{3l}$
(4) $\frac{g}{13l}$

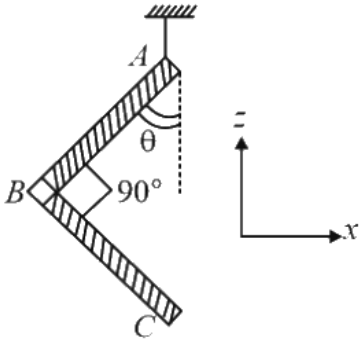
(A) $\frac{g}{2l}$
(B) $\frac{7g}{3l}$
(C) $\frac{g}{3l}$
(D) $\frac{g}{13l}$

Answer: (D) $\frac{g}{13l}$ · Key from source paper

Q240 JEE Main 2019 · 9 Jan · Shift 1 MCQ

An L -shaped object, made of thin rods of uniform mass density, is suspended with a string as shown in figure. If $AB = BC$, and the angle made by AB with downward vertical is θ, then:
(see the figure above)

Q7. An L -shaped object, made of thin rods of uniform mass density, is suspended with a string as shown in figure. If $AB = BC$, and the angle made by AB with downward vertical is θ, then:



(1) $\tan\theta = \frac{2}{\sqrt{3}}$
(2) $\tan\theta = \frac{1}{3}$
(3) $\tan\theta = \frac{1}{2}$
(4) $\tan\theta = \frac{1}{2\sqrt{3}}$

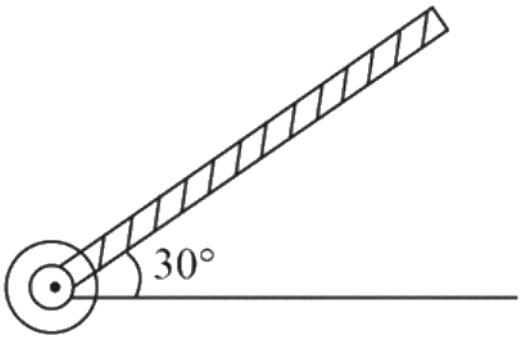
(A) $\tan\theta = \frac{2}{\sqrt{3}}$
(B) $\tan\theta = \frac{1}{3}$
(C) $\tan\theta = \frac{1}{2}$
(D) $\tan\theta = \frac{1}{2\sqrt{3}}$

Answer: (B) $\tan\theta = \frac{1}{3}$ · Key from source paper

Q241 JEE Main 2019 · 9 Jan · Shift 2 MCQ

A rod of length $50\ cm$ is pivoted at one end. It is raised such that it makes an angle of 30° from the horizontal as shown and released from rest. Its angular speed when it passes through the horizontal (in $rad\ s^{-1}$) will be $(g = 10\ ms^{-2})$
(see the figure above)

Q6. A rod of length 50 cm is pivoted at one end. It is raised such that it makes an angle of 30° from the horizontal as shown and released from rest. Its angular speed when it passes through the horizontal (in $rad\, s^{-1}$) will be $(g = 10\, ms^{-2})$



(1) $\frac{\sqrt{20}}{3}$
(2) $\sqrt{30}$
(3) $\sqrt{\frac{30}{2}}$
(4) $\frac{\sqrt{30}}{2}$

(A) $\frac{\sqrt{20}}{3}$
(B) $\sqrt{30}$
(C) $\sqrt{\frac{30}{2}}$
(D) $\frac{\sqrt{30}}{2}$

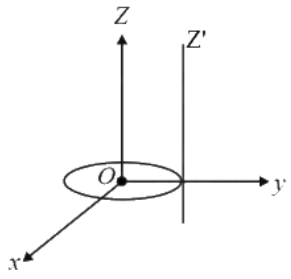
Answer: (B) $\sqrt{30}$ · Key from source paper

Q242 JEE Main 2018 · 16 Apr · Online MCQ

A thin circular disk is in the xy plane as shown in the figure. The ratio of its moment of inertia about z and z' axes will be:

(see the figure above)

Q5. A thin circular disk is in the xy plane as shown in the figure. The ratio of its moment of inertia about z and $z\prime$ axes will be:



(1) 1 : 4
(2) 1 : 5
(3) 1 : 3
(4) 1 : 2

(A) $1:4$

(B) $1:5$

(C) $1:3$

(D) $1:2$

Answer: (C) $1:3$ · Key from source paper

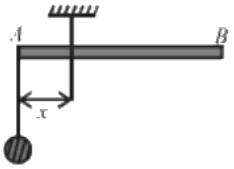
Q243 JEE Main 2018 · 15 Apr · Shift 1 MCQ

A uniform rod AB is suspended from a point X, at a variable distance from x from A, as shown. To make the rod horizontal, a mass m is suspended from its end A. A set of (m, x) values is recorded. The appropriate

(see the figure above)

variable that give a straight line, when plotted, are:

Q5. A uniform rod AB is suspended from a point X, at a variable distance from x from A, as shown. To make the rod horizontal, a mass m is suspended from its end A. A set of (m, x) values is recorded. The appropriate



variable that give a straight line, when plotted, are:

(1) $m, \frac{1}{x}$ (2) $m, \frac{1}{x^2}$

(3) m, x (4) m, x^2

(A) $m, \frac{1}{x}$

(B) $m, \frac{1}{x^2}$

(C) m, x

(D) m, x^2

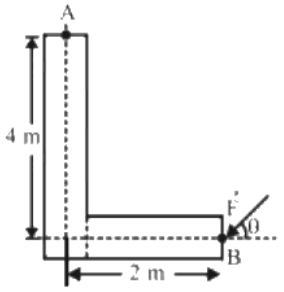
Answer: (A) $m, \frac{1}{x}$ · Key from source paper

Q244 JEE Main 2018 · 15 Apr · Shift 1 MCQ

A force of $40\ \mathrm{N}$ acts on a point B at the end of an L-shaped object, as shown in the figure. The angle θ that will produce maximum moment of the force about point A is given by:

(see the figure above)

Q6. A force of 40 N acts on a point B at the end of an L-shaped object, as shown in the figure. The angle θ that will



produce maximum moment of the force about point A is given by:

(1) $\tan\theta = \frac{1}{4}$ (2) $\tan\theta = 2$

(3) $\tan\theta = \frac{1}{2}$ (4) $\tan\theta = 4$

(A) $\tan\theta = \frac{1}{4}$

(B) $\tan\theta = 2$

(C) $\tan\theta = \frac{1}{2}$

(D) $\tan\theta = 4$

Answer: (C) $\tan\theta = \frac{1}{2}$ · Key from source paper

Q245 JEE Main 2018 · 15 Apr · Shift 2 MCQ

A thin rod MN, free to rotate in the vertical plane about the fixed end N, is held horizontal. When the end M is released the speed of this end, when the rod makes an angle α with the horizontal, will be proportional to: (see figure)

(see the figure above)

Q7. A thin rod MN, free to rotate in the vertical plane about the fixed end N, is held horizontal. When the end M is released the speed of this end, when the rod makes an angle α with the horizontal, will be proportional to: (see

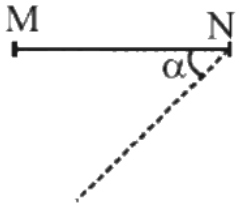


figure)

(1) $\sqrt{\cos\alpha}$ (2) $\cos\alpha$

(3) $\sin\alpha$ (4) $\sqrt{\sin\alpha}$

(A) $\sqrt{\cos\alpha}$

(B) $\cos\alpha$

(C) $\sin\alpha$

(D) $\sqrt{\sin\alpha}$

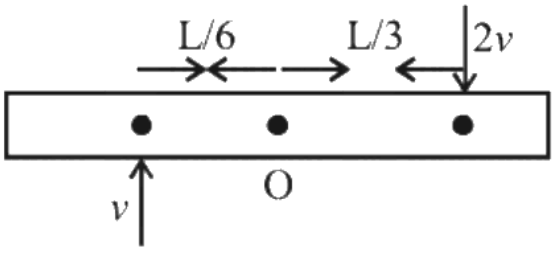
Answer: (D) $\sqrt{\sin\alpha}$ · Checked by our team

Q246 JEE Main 2018 · 15 Apr · Shift 2 MCQ

A thin uniform bar of length L and mass $8\ \mathrm{m}$ lies on a smooth horizontal table. Two point masses m and $2\ \mathrm{m}$ moving in the same horizontal plane from opposite sides of the bar with speeds $2v$ and v respectively. The masses stick to the bar after collision at a distance $\frac{L}{3}$ and $\frac{L}{6}$ respectively from the centre of the bar. If the bar starts rotating about its center of mass as a result of collision, the angular speed of the bar will be:

(see the figure above)

Q8. A thin uniform bar of length L and mass $8\ \mathrm{m}$ lies on a smooth horizontal table. Two point masses m and $2\ \mathrm{m}$ moving in the same horizontal plane from opposite sides of the bar with speeds $2\mathrm{v}$ and v respectively. The masses stick to the bar after collision at a distance $\frac{\mathrm{L}}{3}$ and $\frac{\mathrm{L}}{6}$ respectively from the centre of the bar. If the bar starts rotating about its center of mass as a result of collision, the angular speed of the bar will be:



(1) $\frac{\mathrm{v}}{6\,\mathrm{L}}$ (2) $\frac{6\mathrm{v}}{5\,\mathrm{L}}$
(3) $\frac{3\mathrm{v}}{5\,\mathrm{L}}$ (4) $\frac{\mathrm{v}}{5\,\mathrm{L}}$

(A) $\frac{v}{6\,\mathrm{L}}$
(B) $\frac{6v}{5\,\mathrm{L}}$
(C) $\frac{3v}{5\,\mathrm{L}}$
(D) $\frac{v}{5\,\mathrm{L}}$

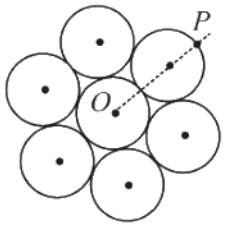
Answer: (B) $\frac{6v}{5\,\mathrm{L}}$ · Checked by our team

Q247 JEE Main 2018 · 8 Apr · Offline MCQ

Seven identical circular planar disks, each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is:

(see the figure above)

Q8. Seven identical circular planar disks, each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is:



(1) $\frac{181}{2}MR^2$
(2) $\frac{19}{2}MR^2$
(3) $\frac{55}{2}MR^2$
(4) $\frac{73}{2}MR^2$

(A) $\frac{181}{2}MR^2$
(B) $\frac{19}{2}MR^2$
(C) $\frac{55}{2}MR^2$
(D) $\frac{73}{2}MR^2$

Answer: (A) $\frac{181}{2}MR^2$ · Key from source paper

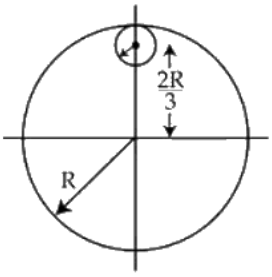
Q248

JEE Main 2018 · 8 Apr · Offline · MCQ

From a uniform circular disc of radius R and mass 9 M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is:

(see the figure above)

Q9. From a uniform circular disc of radius R and mass 9 M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is:



(1) $\frac{37}{9}MR^2$
(2) $4MR^2$
(3) $\frac{40}{9}MR^2$
(4) $10MR^2$

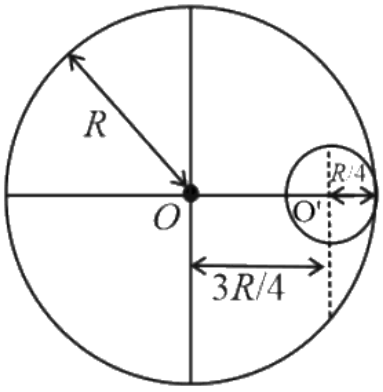
(A) $\frac{37}{9}MR^2$
(B) $4MR^2$
(C) $\frac{40}{9}MR^2$
(D) $10MR^2$

Answer: (B) $4MR^2$ · Key from source paper

Q249 JEE Main 2017 · 9 Apr · Online MCQ

A circular hole of radius $\frac{R}{4}$ is made in a thin uniform disc having mass and radius R, as shown in figure. The moment of inertia of the remaining portion of the disc about an axis passing through the point O and perpendicular to the plane of the disc is-
(see the figure above)

Q6. A circular hole of radius $\frac{R}{4}$ is made in a thin uniform disc having mass and radius R, as shown in figure. The moment of inertia of the remaining portion of the disc about an axis passing through the point O and perpendicular to the plane of the disc is-



(1) $\frac{219MR^2}{256}$
(2) $\frac{237MR^2}{512}$
(3) $\frac{197MR^2}{256}$
(4) $\frac{19MR^2}{512}$

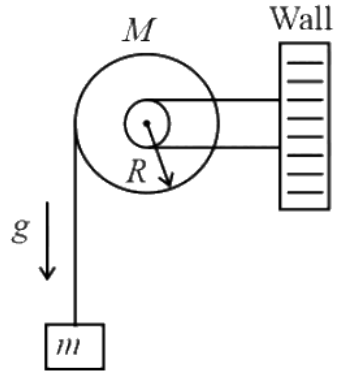
(A) $\frac{219MR^2}{256}$
(B) $\frac{237MR^2}{512}$
(C) $\frac{197MR^2}{256}$
(D) $\frac{19MR^2}{512}$

Answer: (B) $\frac{237MR^2}{512}$ · Key from source paper

Q250 JEE Main 2017 · 8 Apr · Online MCQ

A uniform disc of radius R and mass M is free to rotate only about its axis. A string is wrapped over its rim and a body of mass m is tied to the free end of the string as shown in the figure. The body is released from rest. Then the acceleration of the body is:
(see the figure above)

Q4. A uniform disc of radius R and mass M is free to rotate only about its axis. A string is wrapped over its rim and a body of mass m is tied to the free end of the string as shown in the figure. The body is released from rest. Then the acceleration of the body is:



(1) $\frac{2\,Mg}{2m+M}$
(2) $\frac{2\,Mg}{2M+m}$
(3) $\frac{2\,mg}{2M+m}$
(4) $\frac{2\,mg}{2m+M}$

A $\frac{2Mg}{2m+M}$
B $\frac{2Mg}{2M+m}$
C $\frac{2mg}{2M+m}$
D $\frac{2mg}{2m+M}$

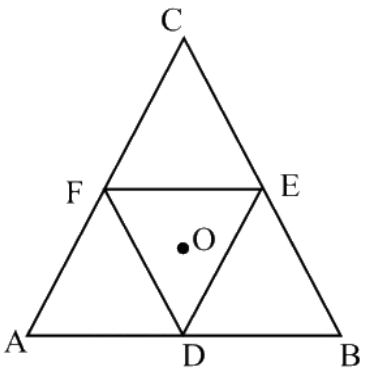
Answer: (D) $\frac{2mg}{2m+M}$ · Key from source paper

Q251 JEE Main 2017 · 8 Apr · Online MCQ

Moment of inertia of an equilateral triangular lamina ABC, about the axis passing through its centre O and perpendicular to its plane is I_0 as shown in the figure. A cavity DEF is cut out from the lamina, where D, E, F are mid points of the sides. Moment of inertia of the remaining part of lamina about the same axis is:

(see the figure above)

Q5. Moment of inertia of an equilateral triangular lamina ABC, about the axis passing through its centre O and perpendicular to its plane is I_0 as shown in the figure. A cavity DEF is cut out from the lamina, where D, E, F are the mid points of the sides. Moment of inertia of the remaining part of lamina about the same axis is:



(1) $\frac{7}{8}I_0$
(2) $\frac{15}{16}I_0$
(3) $\frac{3}{4}I_0$
(4) $\frac{31I_0}{32}$

(A) $\frac{7}{8}I_0$
(B) $\frac{15}{16}I_0$
(C) $\frac{3}{4}I_0$
(D) $\frac{31I_0}{32}$

Answer: (B) $\frac{15}{16}I_0$ · Key from source paper

Q252 JEE Main 2017 · 8 Apr · Online MCQ

In a physical balance working on the principle of moments, when 5 mg weight is placed on the left pan, the beam becomes horizontal. Both the empty pans of the balance are of equal mass. Which of the following statements is correct?

(A) Every object that is weighed using this balance appears lighter than its actual weight
(B) Left arm is shorter than the right arm
(C) Both the arms are of same length
(D) Left arm is longer than the right arm

Answer: (B) Left arm is shorter than the right arm · Key from source paper

Q253 JEE Main 2017 · 2 Apr · Offline MCQ

The moment of inertia of a uniform cylinder of length l and radius R about its perpendicular bisector is I. What is the ratio l/R such that the moment of inertia is minimum?

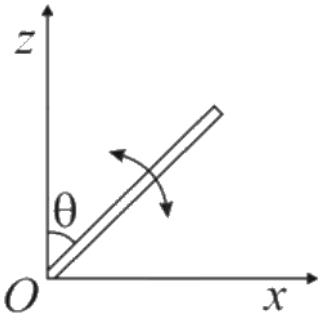
(A) $\frac{3}{\sqrt{2}}$
(B) $\sqrt{\frac{3}{2}}$
(C) $\frac{\sqrt{3}}{2}$
(D) 1

Answer: (B) $\sqrt{\frac{3}{2}}$ · Key from source paper

Q254 JEE Main 2017 · 2 Apr · Offline MCQ

A slender uniform rod of mass M and length l is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the pivot and then released. The angular acceleration of the rod when it makes an angle θ with the vertical is:
(see the figure above)

Q6. A slender uniform rod of mass M and length l is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the pivot and then released. The angular acceleration of the rod when it makes an angle θ with the vertical is:



(1) $\frac{2g}{3l}\cos\theta$
(2) $\frac{3g}{2l}\sin\theta$
(3) $\frac{2g}{3l}\sin\theta$
(4) $\frac{3g}{2l}\cos\theta$

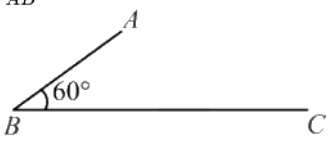
(A) $\frac{2g}{3l}\cos\theta$
(B) $\frac{3g}{2l}\sin\theta$
(C) $\frac{2g}{3l}\sin\theta$
(D) $\frac{3g}{2l}\cos\theta$

Answer: (B) $\frac{3g}{2l}\sin\theta$ · Key from source paper

Q255 JEE Main 2016 · 10 Apr · Online MCQ

In the figure shown ABC is a uniform wire. If the center of mass of the wire lies vertically below point A, then $\frac{BC}{AB}$ is close to
(see the figure above)

Q7. In the figure shown ABC is a uniform wire. If the center of mass of the wire lies vertically below point A, then $\frac{BC}{AB}$ is close to



(1) 1.85
(2) 1.5
(3) 1.37
(4) 3

(A) 1.85
(B) 1.5
(C) 1.37
(D) 3

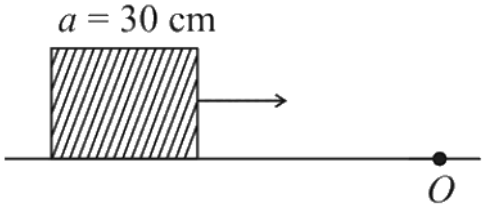
Answer: (C) 1.37 · Key from source paper

Q256 JEE Main 2016 · 9 Apr · Online MCQ

A cubical block of side 30 cm is moving with velocity $2\ \mathrm{m\,s^{-1}}$ on a smooth horizontal surface. The surface has a bump at a point O as shown in the figure. The angular velocity (in rad/s) of the block immediately after it hits the bump, is :

(see the figure above)

Q5. A cubical block of side 30 cm is moving with velocity $2\ \mathrm{m\,s^{-1}}$ on a smooth horizontal surface. The surface has a bump at a point O as shown in the figure. The angular velocity (in rad/s) of the block immediately after it hits the bump, is :



(1) 13.3
(2) 5.0
(3) 9.4
(4) 6.7

(A) 13.3
(B) 5.0
(C) 9.4
(D) 6.7

Answer: (B) 5.0 · Key from source paper

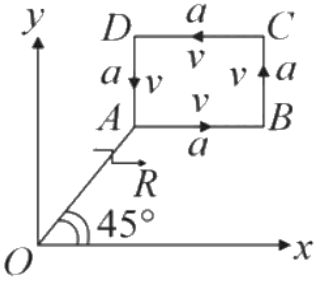
Q257 JEE Main 2016 · 3 Apr · Offline MCQ

A particle of mass m is moving along the side of a square of side 'a', with a uniform speed v in the x-y plane as shown in the figure:

(see the figure above)

Which of the following statements is false for the angular momentum $\vec{L}$ about the origin?

Q4. A particle of mass m is moving along the side of a square of side 'a', with a uniform speed υ in the x-y plane as shown in the figure:



Which of the following statements is false for the angular momentum $\vec{L}$ about the origin?

(1) $\vec{L} = m\upsilon\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from B to C.

(2) $\vec{L} = \frac{m\upsilon}{\sqrt{2}}R\hat{k}$ when the particle is moving from D to A.

(3) $\vec{L} = -\frac{m\upsilon}{\sqrt{2}}R\hat{k}$ when the particle is moving from A to B.

(4) $\vec{L} = m\upsilon\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from C to D.

(A) $\vec{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from B to C.

(B) $\vec{L} = \frac{mv}{\sqrt{2}}R\hat{k}$ when the particle is moving from D to A.

(C) $\vec{L} = -\frac{mv}{\sqrt{2}}R\hat{k}$ when the particle is moving from A to B.

(D) $\vec{L} = mv\left[\frac{R}{\sqrt{2}} + a\right]\hat{k}$ when the particle is moving from C to D.

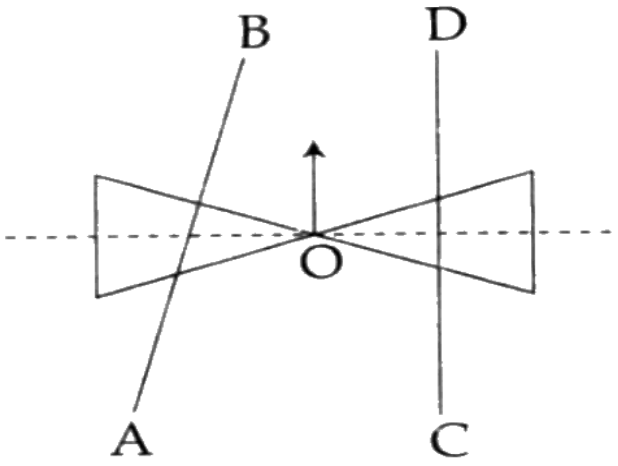
Answer: (B) $\vec{L} = \frac{mv}{\sqrt{2}}R\hat{k}$ **when the particle is moving from D to A.** · Key from source paper

Q258 JEE Main 2016 · 3 Apr · Offline MCQ

A roller is made by joining together two cones at their vertices O. It is kept on two rails AB and CD which are placed asymmetrically (see figure), with its axis perpendicular to CD and its centre O at the centre of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its centre O moving parallel to CD in the direction shown. As it moves, the roller will tend to:

(see the figure above)

Q5. A roller is made by joining together two cones at their vertices O. It is kept on two rails AB and CD which are placed asymmetrically (see figure), with its axis perpendicular to CD and its centre O at the centre of line joining AB and CD (see figure). It is given a light push so that it starts rolling with its centre O moving parallel to CD in the direction shown. As it moves, the roller will tend to:



(1) go straight.
(2) turn left and right alternately.
(3) turn left.
(4) turn right.

(A) go straight.
(B) turn left and right alternately.
(C) turn left.
(D) turn right.

Answer: (C) turn left. · Key from source paper

Q259 JEE Main 2015 · 11 Apr · Online MCQ

A uniform thin rod AB of length L has linear mass density $\mu(x) = a + \frac{bx}{L}$, where x is measured from A. If the CM of the rod lies at a distance of $\left(\frac{7}{12}L\right)$ from A, then a and b are related as:

(A) $2a = b$
(B) $a = 2b$
(C) $a = b$
(D) $3a = 2b$

Answer: (A) $2a = b$ · Key from source paper

Q260 JEE Main 2015 · 11 Apr · Online MCQ

A particle of mass 2 kg is on a smooth horizontal table and moves in a circular path of radius 0.6 m. The height of the table from the ground is 0.8 m. If the angular speed of the particle is 12 rad s^{-1}, the magnitude of its angular momentum about a point on the ground right under the center of the circle is:

(A) $14.4\ \mathrm{kg\ m^2\ s^{-1}}$
(B) $11.52\ \mathrm{kg\ m^2\ s^{-1}}$
(C) $20.16\ \mathrm{kg\ m^2\ s^{-1}}$
(D) $8.64\ \mathrm{kg\ m^2\ s^{-1}}$

Answer: (A) $14.4\ \mathrm{kg\ m^2\ s^{-1}}$ · Key from source paper

Q261 JEE Main 2015 · 10 Apr · Online MCQ

Consider a thin uniform square sheet made of a rigid material. If its side is a, mass m and moment of inertia I about one of its diagonals, then:

(A) $I = \frac{ma^2}{24}$
(B) $\frac{ma^2}{24} < I < \frac{ma^2}{12}$
(C) $I > \frac{ma^2}{12}$
(D) $I = \frac{ma^2}{12}$

Answer: (D) $I = \frac{ma^2}{12}$ · Key from source paper

Q262 JEE Main 2015 · 10 Apr · Online MCQ

A uniform solid cylindrical roller of mass m is being pulled on a horizontal surface with force F parallel to the surface and applied at its centre. If the acceleration of the cylinder is a and it is rolling without slipping then the value of F is:

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

Answer: (A) $\frac{3}{2}\,ma$ · Key from source paper

Q263 JEE Main 2015 · 4 Apr · Offline MCQ

Distance of the centre of mass of a solid uniform cone from its vertex is z_0. If the radius of its base is R and its height is h then z_0 is equal to:

(A) $\frac{3h^2}{8R}$
(B) $\frac{h^2}{4R}$
(C) $\frac{3h}{4}$
(D) $\frac{5h}{8}$

Answer: (C) $\frac{3h}{4}$ · Key from source paper

Q264 JEE Main 2015 · 4 Apr · Offline MCQ

From a solid sphere of mass M and radius R, a cube of the maximum possible volume is cut. Moment of inertia of cube about an axis passing through its centre and perpendicular to one of its faces is:

(A) $\frac{4MR^2}{3\sqrt{3}\pi}$
(B) $\frac{MR^2}{32\sqrt{2}\pi}$
(C) $\frac{MR^2}{16\sqrt{2}\pi}$
(D) $\frac{4MR^2}{9\sqrt{3}\pi}$

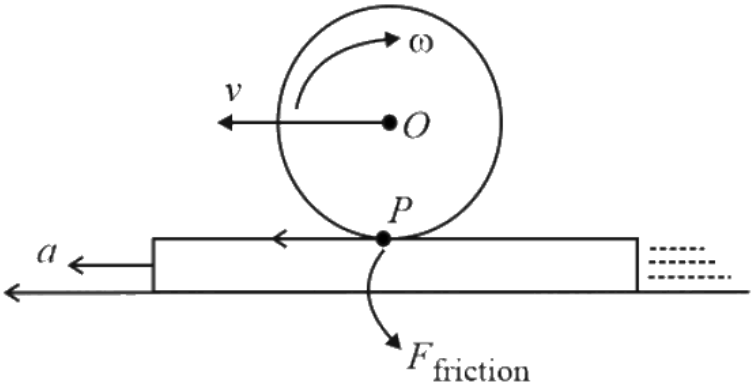
Answer: (D) $\frac{4MR^2}{9\sqrt{3}\pi}$ · Key from source paper

Q265 JEE Main 2014 · 19 Apr · Online MCQ

Consider a cylinder of mass M resting on a rough horizontal rug that is pulled out from under it with acceleration 'a' perpendicular to the axis of the cylinder. What is $F_{friction}$ at point P ? It is assumed that the cylinder does not slip.

(see the figure above)

Q4. Consider a cylinder of mass M resting on a rough horizontal rug that is pulled out from under it with acceleration 'a' perpendicular to the axis of the cylinder. What is $F_{friction}$ at point P ? It is assumed that the cylinder does not slip.



(1) Ma
(2) $\frac{Ma}{2}$
(3) $\frac{Ma}{3}$
(4) Mg

(A) Ma
(B) $\frac{Ma}{2}$
(C) $\frac{Ma}{3}$
(D) Mg

Answer: (C) $\frac{Ma}{3}$ · Key from source paper

Q266 JEE Main 2014 · 19 Apr · Online MCQ

A ball of mass 160 g is thrown up at an angle of 60° to the horizontal at a speed of $10\ \mathrm{m\,s^{-1}}$. The angular momentum of the ball at the highest point of the trajectory with respect to the point from which the ball is thrown is nearly $(g = 10\ \mathrm{m\,s^{-2}})$

(A) $1.73\ \mathrm{kg\,m^2\,s^{-1}}$

(B) $3.46\ \mathrm{kg\,m^2\,s^{-1}}$

(C) $3.0\ \mathrm{kg\,m^2\,s^{-1}}$

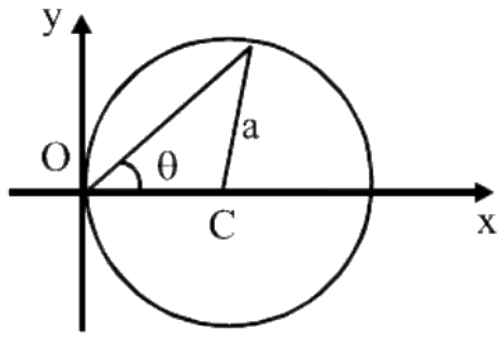
(D) $6.0\ \mathrm{kg\,m^2\,s^{-1}}$

Answer: (C) $3.0\ \mathrm{kg\,m^2\,s^{-1}}$ · Key from source paper

Q267 JEE Main 2014 · 12 Apr · Online MCQ

A particle is moving in a circular path of radius a, with a constant velocity v as shown in the figure. The centre of circle is marked by ' C '. The angular momentum from the origin O can be written as:
(see the figure above)

Q6. A particle is moving in a circular path of radius a, with a constant velocity v as shown in the figure. The centre of circle is marked by ' C '. The angular momentum from the origin O can be written as:



(1) va $(1 + \cos 2\theta)$

(2) va $(1 + \cos\theta)$

(3) va $\cos 2\theta$

(4) va

(A) $\mathrm{va}\,(1 + \cos 2\theta)$

(B) $\mathrm{va}\,(1 + \cos\theta)$

(C) $\mathrm{va}\cos 2\theta$

(D) va

Answer: (A) $\mathrm{va}\,(1 + \cos 2\theta)$ · Key from source paper

Q268 JEE Main 2014 · 11 Apr · Online MCQ

A thin bar of length L has a mass per unit length λ, that increases linearly with distance from one end. If its total mass is M and its mass per unit length at the lighter end is λ_0, then the distance of the centre of mass from the lighter end is:

(A) $\frac{L}{2} - \frac{\lambda_0 L^2}{4M}$
(B) $\frac{L}{3} + \frac{\lambda_0 L^2}{8M}$
(C) $\frac{L}{3} + \frac{\lambda_0 L^2}{4M}$
(D) $\frac{2L}{3} - \frac{\lambda_0 L^2}{6M}$

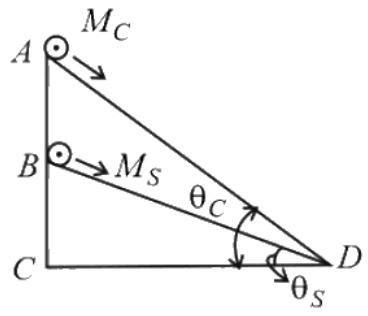
Answer: (D) $\frac{2L}{3} - \frac{\lambda_0 L^2}{6M}$ · Checked by our team

Q269 JEE Main 2014 · 9 Apr · Online MCQ

A cylinder of mass M_c and sphere of mass M_s are placed at points A and B of two inclines, respectively. (See figure). If they roll on the incline without slipping such that their accelerations are the same, then the ratio $\frac{\sin\theta_c}{\sin\theta_s}$ is :

(see the figure above)

Q5. A cylinder of mass M_c and sphere of mass M_s are placed at points A and B of two inclines, respectively. (See figure). If they roll on the incline without slipping such that their accelerations are the same, then the ratio $\frac{\sin\theta_c}{\sin\theta_s}$ is :



(1) $\frac{8}{7}$
(2) $\sqrt{\frac{8}{7}}$
(3) $\sqrt{\frac{15}{14}}$
(4) $\frac{15}{14}$

(A) $\frac{8}{7}$
(B) $\sqrt{\frac{8}{7}}$
(C) $\sqrt{\frac{15}{14}}$
(D) $\frac{15}{14}$

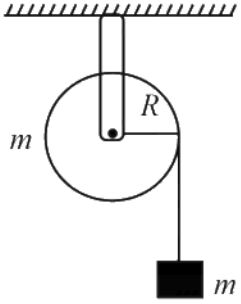
Answer: (D) $\frac{15}{14}$ · Key from source paper

Q270 JEE Main 2014 · 6 Apr · Offline MCQ

A mass m is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what acceleration will the mass fall on release?

(see the figure above)

Q5. A mass m is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what acceleration will the mass fall on release?



(1) $\frac{2g}{3}$ (2) $\frac{g}{2}$
(3) $\frac{5g}{6}$ (4) g

(A) $\frac{2g}{3}$
(B) $\frac{g}{2}$
(C) $\frac{5g}{6}$
(D) g

Answer: (B) $\frac{g}{2}$ · Key from source paper

Q271 JEE Main 2014 · 6 Apr · Offline MCQ

A bob of mass m attached to an inextensible string of length l is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the vertical. About the point of suspension :

(A) Angular momentum is conserved
(B) Angular momentum changes in magnitude but not in direction
(C) Angular momentum changes in direction but not in magnitude
(D) Angular momentum changes both in direction and magnitude

Answer: (C) Angular momentum changes in direction but not in magnitude · Key from source paper

Q272 JEE Main 2013 · 25 Apr · Online MCQ

A ring of mass M and radius R is rotating about its axis with angular velocity ω. Two identical bodies each of mass m are now gently attached at the two ends of a diameter of the ring. Because of this, the kinetic energy loss will be :

(A) $\frac{m(M+2m)}{M}\omega^2R^2$
(B) $\frac{Mm}{(M+m)}\omega^2R^2$
(C) $\frac{Mm}{(M+2m)}\omega^2R^2$
(D) $\frac{(M+m)M}{(M+2m)}\omega^2R^2$

Answer: (C) $\frac{Mm}{(M+2m)}\omega^2R^2$ · Key from source paper

Q273 JEE Main 2013 · 23 Apr · Online MCQ

A boy of mass 20 kg is standing on a 80 kg free to move long cart. There is negligible friction between cart and ground. Initially, the boy is standing 25 m from a wall. If he walks 10 m on the cart towards the wall, then the final distance of the boy from the wall will be

(A) 15 m
(B) 12.5 m
(C) 15.5 m
(D) 17 m

Answer: (D) 17 m · Key from source paper

Q274 JEE Main 2013 · 23 Apr · Online MCQ

A projectile of mass M is fired so that the horizontal range is 4 km. At the highest point the projectile explodes in two parts of masses $M/4$ and $3M/4$ respectively and the heavier part starts falling down vertically with zero initial speed. The horizontal range (distance from point of firing) of the lighter part is :

(A) 16 km
(B) 1 km
(C) 10 km
(D) 2 km

Answer: (C) 10 km · Key from source paper

Q275 JEE Main 2013 · 23 Apr · Online MCQ

A particle of mass 2 kg is moving such that at time t, its position, in meter, is given by $\vec{r}(t) = 5\hat{i} - 2t^2\hat{j}$. The angular momentum of the particle at $t = 2s$ about the origin in $\mathrm{kgm^{-2}\,s^{-1}}$ is :

(A) $-80\hat{k}$
(B) $(10\hat{i} - 16\hat{j})$
(C) $-40\hat{k}$
(D) $40\hat{k}$

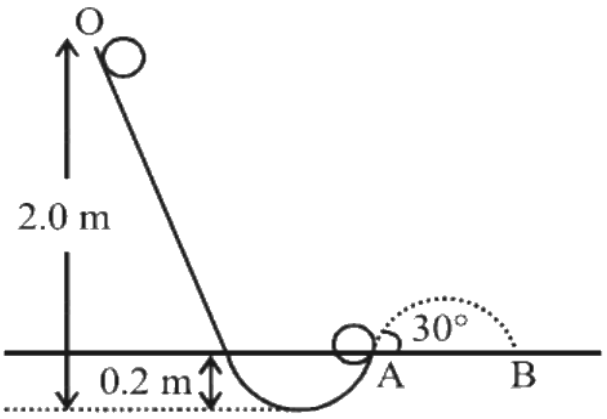
Answer: (A) $-80\hat{k}$ · Key from source paper

Q276 JEE Main 2013 · 22 Apr · Online MCQ

A tennis ball (treated as hollow spherical shell) starting from O rolls down a hill. At point A the ball becomes air borne leaving at an angle of 30° with the horizontal. The ball strikes the ground at B. What is the value of the distance AB ? (Moment of inertia of a spherical shell of mass m and radius R about its diameter $= \frac{2}{3}mR^2$)

(see the figure above)

Q5. A tennis ball (treated as hollow spherical shell) starting from O rolls down a hill. At point A the ball becomes air borne leaving at an angle of 30° with the horizontal. The ball strikes the ground at B. What is the value of the distance AB ? (Moment of inertia of a spherical shell of mass m and radius R about its diameter $= \frac{2}{3}mR^2$)



(1) 1.87 m
(2) 2.08 m
(3) 1.57 m
(4) 1.77 m

(A) 1.87 m
(B) 2.08 m
(C) 1.57 m
(D) 1.77 m

Answer: (B) 2.08 m · Key from source paper

Q277 JEE Main 2013 · 9 Apr · Online MCQ

A bullet of mass 10 g and speed 500 m/s is fired into a door and gets embedded exactly at the centre of the door. The door is 1.0 m wide and weighs 12 kg. It is hinged at one end and rotates about a vertical axis practically without friction. The angular speed of the door just after the bullet embeds into it will be :

(A) 6.25rad/sec
(B) 0.625rad/sec
(C) 3.35rad/sec
(D) 0.335rad/sec

Answer: (B) 0.625rad/sec · Key from source paper

Q278 JEE Main 2013 · 7 Apr · Offline MCQ

A hoop of radius r and mass m rotating with an angular velocity ω_0 is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases to slip?

(A) $\frac{r\omega_0}{2}$
(B) $r\omega_0$
(C) $\frac{r\omega_0}{4}$
(D) $\frac{r\omega_0}{3}$

Answer: (A) $\frac{r\omega_0}{2}$ · Key from source paper

Q279 AIEEE 2012 · 26 May · Online MCQ

A stone of mass m, tied to the end of a string, is whirled around in a circle on a horizontal frictionless table. The length of the string is reduced gradually keeping the angular momentum of the stone about the centre of the circle constant. Then, the tension in the string is given by $T = Ar^n$, where A is a constant, r is the instantaneous radius of the circle. The value of n is equal to

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

Answer: (D) -3 · Key from source paper

Q280 AIEEE 2012 · 26 May · Online MCQ

A thick-walled hollow sphere has outside radius R_0. It rolls down an incline without slipping and its speed at the bottom is v_0. Now the incline is waxed, so that it is practically frictionless and the sphere is observed to slide down (without any rolling). Its speed at the bottom is observed to be $5v_0/4$. The radius of gyration of the hollow sphere about an axis through its centre is

(A) $3R_0/2$
(B) $3R_0/4$
(C) $9R_0/16$
(D) $3R_0$

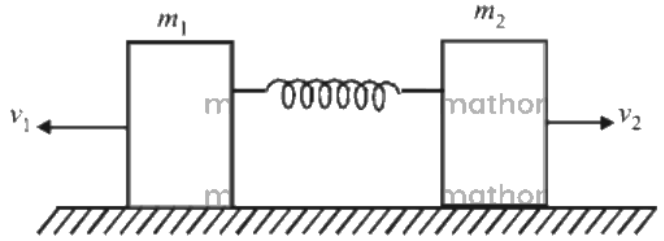
Answer: (B) $3R_0/4$ · Key from source paper

Q281 AIEEE 2012 · 12 May · Online MCQ

A spring is compressed between two blocks of masses m_1 and m_2 placed on a horizontal frictionless surface as shown in the figure. When the blocks are released, they have initial velocity of v_1 and v_2 as shown. The blocks travel distances x_1 and x_2 respectively before coming to rest. The ratio $\left(\frac{x_1}{x_2}\right)$ is

(see the figure above)

Q6. A spring is compressed between two blocks of masses m_1 and m_2 placed on a horizontal frictionless surface as shown in the figure. When the blocks are released, they have initial velocity of v_1 and v_2 as shown. The blocks travel distances x_1 and x_2 respectively before coming to rest. The ratio $\left(\frac{x_1}{x_2}\right)$ is



(1) $\frac{m_2}{m_1}$
(2) $\frac{m_1}{m_2}$
(3) $\sqrt{\frac{m_2}{m_1}}$
(4) $\sqrt{\frac{m_1}{m_2}}$

(A) $\frac{m_2}{m_1}$
(B) $\frac{m_1}{m_2}$
(C) $\sqrt{\frac{m_2}{m_1}}$
(D) $\sqrt{\frac{m_1}{m_2}}$

Answer: (A) $\frac{m_2}{m_1}$ · Key from source paper

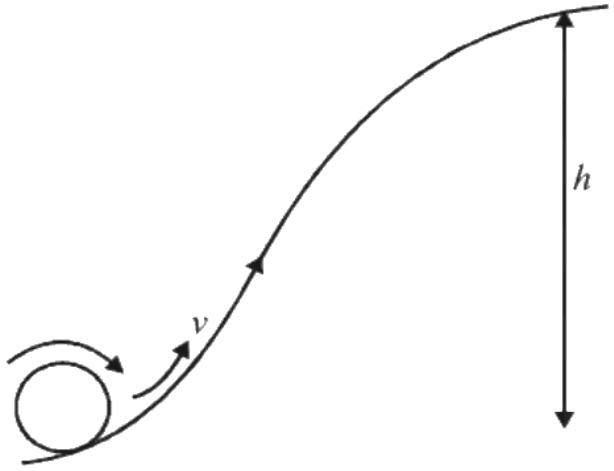
Q282

AIEEE 2012 · 12 May · Online · MCQ

A solid sphere is rolling on a surface as shown in figure, with a translational velocity $v\ \mathrm{m\,s^{-1}}$. If it is to climb the inclined surface continuing to roll without slipping, then minimum velocity for this to happen is

(see the figure above)

Q7. A solid sphere is rolling on a surface as shown in figure, with a translational velocity $v\ \mathrm{m\,s^{-1}}$. If it is to climb the inclined surface continuing to roll without slipping, then minimum velocity for this to happen is



(1) $\sqrt{2gh}$
(2) $\sqrt{\frac{7}{5}gh}$
(3) $\sqrt{\frac{7}{2}gh}$
(4) $\sqrt{\frac{10}{7}gh}$

(A) $\sqrt{2gh}$
(B) $\sqrt{\frac{7}{5}gh}$
(C) $\sqrt{\frac{7}{2}gh}$
(D) $\sqrt{\frac{10}{7}gh}$

Answer: (D) $\sqrt{\frac{10}{7}gh}$ · Key from source paper

Q283 AIEEE 2012 · 12 May · Online MCQ

This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: When moment of inertia I of a body rotating about an axis with angular speed ω increases, its angular momentum L is unchanged but the kinetic energy K increases if there is no torque applied on it. Statement 2: $L = I\omega$, kinetic energy of rotation $= \frac{1}{2}I\omega^2$

(A) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.
(B) Statement 1 is false, Statement 2 is true.
(C) Statement 1 is true, Statement 2 is true, Statement 2 is correct explanation of the Statement 1.
(D) Statement 1 is true, Statement 2 is false.

Answer: (B) Statement 1 is false, Statement 2 is true. · Key from source paper

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Q284 AIEEE 2012 · 7 May · Online MCQ

A circular hole of diameter R is cut from a disc of mass M and radius R; the circumference of the cut passes through the centre of the disc. The moment of inertia of the remaining portion of the disc about an axis perpendicular to the disc and passing through its centre is

(A) $\left(\frac{15}{32}\right)MR^2$
(B) $\left(\frac{1}{8}\right)MR^2$
(C) $\left(\frac{3}{8}\right)MR^2$
(D) $\left(\frac{13}{32}\right)MR^2$

Answer: (D) $\left(\frac{13}{32}\right)MR^2$ · Key from source paper

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Q285 AIEEE 2012 · 7 May · Online MCQ

A solid sphere having mass m and radius r rolls down an inclined plane. Then its kinetic energy is

(A) $\frac{5}{7}$ rotational and $\frac{2}{7}$ translational
(B) $\frac{2}{7}$ rotational and $\frac{5}{7}$ translational
(C) $\frac{2}{5}$ rotational and $\frac{3}{5}$ translational
(D) $\frac{1}{2}$ rotational and $\frac{1}{2}$ translational

Answer: (B) $\frac{2}{7}$ rotational and $\frac{5}{7}$ translational · Key from source paper

Q286 AIEEE 2011 MCQ

A mass m hangs with the help of a string wrapped around a pulley on a frictionless bearing. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is

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

Answer: (B) $\frac{2}{3}g$ · Key from source paper

Q287 AIEEE 2011 MCQ

A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of the disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc:

(A) continuously decreases
(B) continuously increases
(C) first increases and then decreases
(D) remains unchanged

Answer: (C) first increases and then decreases · Key from source paper

Q288 AIEEE 2011 MCQ

A pulley of radius $2\ \mathrm{m}$ is rotated about its axis by a force $F = (20t - 5t^2)$ Newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation is $10\ \mathrm{kg\,m^2}$, the number of rotations made by the pulley before its direction of motion is reversed, is :

(A) more than 3 but less than 6
(B) more than 6 but less than 9
(C) more than 9
(D) less than 3

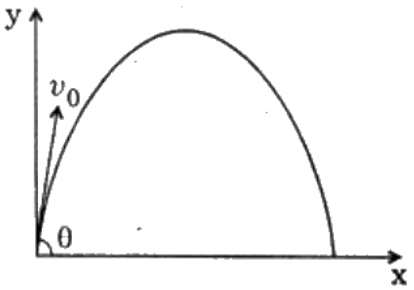
Answer: (A) more than 3 but less than 6 · Key from source paper

Q289 AIEEE 2010 MCQ

A small particle of mass m is projected at an angle θ with the x-axis with an initial velocity v_0 in the $x-y$ plane as shown in the figure. At a time $t < \frac{v_0 \sin\theta}{g}$, the angular momentum of the particle is where $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x, y and z-axis respectively.

(see the figure above)

Q3. A small particle of mass m is projected at an angle θ with the x-axis with an initial velocity v_0 in the $x-y$ plane as shown in the figure. At a time $t < \frac{v_0 \sin\theta}{g}$, the angular momentum of the particle is where $\hat{i}, \hat{j}$ and $\hat{k}$ are



unit vectors along x, y and z-axis respectively.

(1) $-mgv_0 t^2 \cos\theta\hat{j}$

(2) $mgv_0 t \cos\theta\hat{k}$

(3) $-\frac{1}{2}mgv_0t^2\cos\theta\hat{k}$

(4) $\frac{1}{2}mgv_0t^2\cos\theta\hat{i}$

(A) $-mgv_0t^2\cos\theta\,\hat{j}$

(B) $mgv_0t\cos\theta\,\hat{k}$

(C) $-\frac{1}{2}mgv_0t^2\cos\theta\,\hat{k}$

(D) $\frac{1}{2}mgv_0t^2\cos\theta\,\hat{i}$

Answer: (C) $-\frac{1}{2}mgv_0t^2\cos\theta\,\hat{k}$ · Key from source paper

Q290 AIEEE 2009 MCQ

A thin uniform rod of length ℓ and mass m is swinging freely about a horizontal axis passing through its end. Its maximum angular speed is ω. Its centre of mass rises to a maximum height of

(A) $\frac{1}{3}\frac{\ell^2\omega^2}{g}$

(B) $\frac{1}{6}\frac{\ell\omega}{g}$

(C) $\frac{1}{2}\frac{\ell^2\omega^2}{g}$

(D) $\frac{1}{6}\frac{\ell^2\omega^2}{g}$

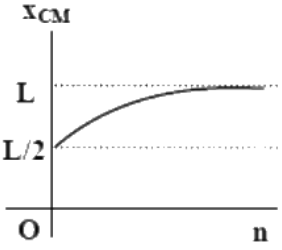
Answer: (D) $\frac{1}{6}\frac{\ell^2\omega^2}{g}$ · Key from source paper

Q291 AIEEE 2008 MCQ

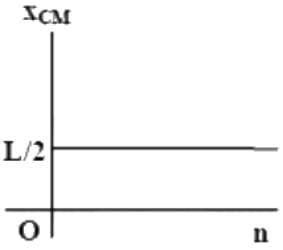
A thin rod of length ' L ' is lying along the x-axis with its ends at $x = 0$ and $x = L$. Its linear density (mass/length) varies with x ask $\left(\frac{x}{L}\right)^n$, where n can be zero or any positive number. If the position x_{CM} of the centre of mass of the rod is plotted against ' n ', which of the following graphs best approximates the dependence of x_{CM} on n ?

Q4. A thin rod of length ' L ' is lying along the x-axis with its ends at $x = 0$ and $x = L$. Its linear density (mass/length) varies with x ask $\left(\frac{x}{L}\right)^n$, where n can be zero or any positive number. If the position x_{CM} of the centre of mass of the rod is plotted against ' n ', which of the following graphs best approximates the dependence of x_{CM} on n ?

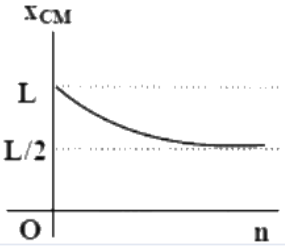
(1)



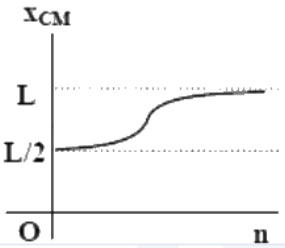
(2)



(3)



(4)



(A) *see figure*

(B) *see figure*

(C) *see figure*

(D) *see figure*

Answer: (A) · Key from source paper

Q292 AIEEE 2008 MCQ

Consider a uniform square plate of side ' a ' and mass ' m '. The moment of inertia of this plate about an axis perpendicular to its plane and passing through one of its corners is

(A) $\frac{5}{6}ma^2$

(B) $\frac{1}{12}ma^2$

(C) $\frac{7}{12}ma^2$

(D) $\frac{2}{3}ma^2$

Answer: (D) $\frac{2}{3}ma^2$ · Key from source paper

Q293 AIEEE 2007 MCQ

A circular disc of radius R is removed from a bigger circular disc of radius 2R such that the circumferences of the discs coincide. The centre of mass of the new disc is α/R from the centre of the bigger disc. The value of α is

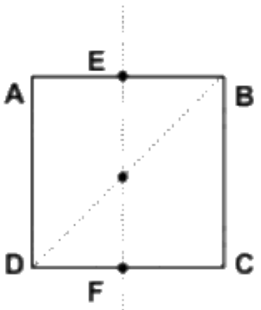
(A) 1/3
(B) 1/2
(C) 1/6
(D) 1/4

Answer: (A) 1/3 · Key from source paper

Q294 AIEEE 2007 MCQ

see figure

Q8.



For the given uniform square lamina ABCD, whose centre is O,

(1) $\sqrt{2}I_{AC} = I_{EF}$ (2) $I_{AD} = 3I_{EF}$

(3) $I_{AC} = I_{EF}$ (4) $I_{AC} = \sqrt{2}I_{EF}$

(A) $\sqrt{2}I_{AC} = I_{EF}$
(B) $I_{AD} = 3I_{EF}$
(C) $I_{AC} = I_{EF}$
(D) $I_{AC} = \sqrt{2}I_{EF}$

Answer: (C) $I_{AC} = I_{EF}$ · Key from source paper

Q295 AIEEE 2007 MCQ

A round uniform body of radius R, mass M and moment of inertia 'I', rolls down (without slipping) an inclined plane making an angle θ with the horizontal. Then its acceleration is

(A) $\frac{g\sin\theta}{1+\frac{I}{MR^2}}$
(B) $\frac{g\sin\theta}{1+\frac{MR^2}{I}}$
(C) $\frac{g\sin\theta}{1-\frac{I}{MR^2}}$
(D) $\frac{g\sin\theta}{1-\frac{MR^2}{I}}$

Answer: (A) $\frac{g\sin\theta}{1+\frac{I}{MR^2}}$ · Key from source paper

Q296 AIEEE 2007 MCQ

Angular momentum of the particle rotating with a central force is constant due to

(A) Constant Force
(B) Constant linear momentum.
(C) Zero Torque
(D) Constant Torque

Answer: (C) Zero Torque · Key from source paper

Q297 AIEEE 2006 MCQ

Consider a two particle system with particles having masses m_1 and m_2. If the first particle is pushed towards the centre of mass through a distance d, by what distance should the second particle be moved, so as to keep the centre of mass at the same position?

(A) d
(B) $\frac{m_2}{m_1}$ d
(C) $\frac{m_1}{m_1+m_2}d$
(D) $\frac{m_1}{m_2}$ d

Answer: (D) $\frac{m_1}{m_2}$ d · Key from source paper

Q298 AIEEE 2006 MCQ

A force of $-F\hat{k}$ acts on O, the origin of the coordinate system. The torque about the point $(1, -1)$

(A) $-F(\hat{i}-\hat{j})$
(B) $F(\hat{i}-\hat{j})$
(C) $-F(\hat{i}+\hat{j})$
(D) $F(\hat{i}+\hat{j})$

Answer: (C) $-F(\hat{i}+\hat{j})$ · Key from source paper

Q299 AIEEE 2006 MCQ

A thin circular ring of mass m and radius R is rotating about its axis with a constant angular velocity ω. Two objects each of mass M are attached gently to the opposite ends of a diameter of the ring. The ring now rotates with an angular velocity ω' =

(A) $\frac{\omega m}{(m+2M)}$
(B) $\frac{\omega(m+2M)}{m}$
(C) $\frac{\omega(m-2M)}{(m+2M)}$
(D) $\frac{\omega m}{(m+M)}$

Answer: (A) $\frac{\omega m}{(m+2M)}$ · Key from source paper

Q300 AIEEE 2006 MCQ

Four point masses, each of value m, are placed at the corners of a square $ABCD$ of side ℓ. The moment of inertia through A and parallel to BD is

(A) $m\ell^2$
(B) $2\,m\ell^2$
(C) $\sqrt{3}\,m\ell^2$
(D) $3\,m\ell^2$

Answer: (D) $3\,m\ell^2$ · Key from source paper

Q301 AIEEE 2005 MCQ

A and B are two like parallel forces. A couple of moment H lies in the plane of A and B and is contained with them. The resultant of A and B after combining is displaced through a distance

(A) $\frac{2H}{A-B}$
(B) $\frac{H}{A+B}$
(C) $\frac{H}{2(A+B)}$
(D) $\frac{H}{A-B}$

Answer: (B) $\frac{H}{A+B}$ · Key from source paper

Q302 AIEEE 2005 MCQ

An annular ring with inner and outer radii R_1 and R_2 is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring, F_1/F_2 is

(A) $\frac{R_2}{R_1}$
(B) $\left(\frac{R_1}{R_2}\right)^2$
(C) 1
(D) $\frac{R_1}{R_2}$

Answer: (D) $\frac{R_1}{R_2}$ · Key from source paper

Q303 AIEEE 2005 MCQ

A body A of mass M while falling vertically downwards under gravity breaks into two parts; a body B of mass $1/3M$ and a body C of mass $2/3M$. The centre of mass of bodies B and C taken together shifts compared to that of body A towards

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(A) depends on height of breaking
(B) does not shift
(C) body C
(D) body B

Answer: (B) does not shift · Key from source paper

Q304 AIEEE 2005 MCQ

The moment of inertia of a uniform semicircular disc of mass M and radius r about a line perpendicular to the plane of the disc through the centre is

(A) $\frac{1}{4}\mathrm{Mr}^2$
(B) $\frac{2}{5}\mathrm{Mr}^2$
(C) Mr^2
(D) $\frac{1}{2}\mathrm{Mr}^2$

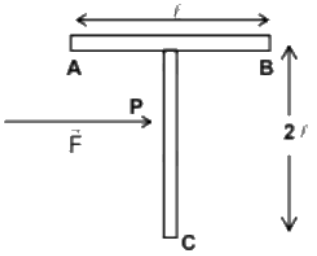
Answer: (D) $\frac{1}{2}\mathrm{Mr}^2$ · Key from source paper

Q305 AIEEE 2005 MCQ

A 'T' shaped object with dimensions shown in the figure, is lying on a smooth floor. A force F is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the location of P with respect to C

(see the figure above)

Q23. A 'T' shaped object with dimensions shown in the figure, is lying on a smooth floor. A force F is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Find the



location of P with respect to C

(1) $\frac{2}{3}\ell$
(2) $\frac{3}{2}\ell$
(3) $\frac{4}{3}\ell$
(4) ℓ

(A) $\frac{2}{3}\ell$
(B) $\frac{3}{2}\ell$
(C) $\frac{4}{3}\ell$
(D) ℓ

Answer: (C) $\frac{4}{3}\ell$ · Key from source paper

Q306 AIEEE 2004 MCQ

A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same which one of the following will not be affected?

(A) moment of inertia
(B) angular momentum
(C) angular velocity
(D) rotational kinetic energy.

Answer: (B) angular momentum · Key from source paper

Q307 AIEEE 2004 MCQ

One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moment of inertia about their diameters are respectively $\mathrm{I_A}$ and $\mathrm{I_B}$ such that

(A) $I_A = I_B$
(B) $I_A > I_B$
(C) $I_A < I_B$
(D) yes, 45° $I_A/I_B = d_A/d_B$ Where d_A and d_B are their densities.

Answer: (C) $I_A < I_B$ · Key from source paper

Q308 AIEEE 2003 MCQ

A circular disc X of radius R is made from an iron plate of thickness t, and another disc Y of radius 4R is made from an iron plate of thickness $\frac{t}{4}$. Then the relation between the moment of inertia $\mathrm{I_X}$ and $\mathrm{I_Y}$ is

(A) $\mathrm{I_Y} = 32\mathrm{I_x}$
(B) $\mathrm{I_Y} = 16\mathrm{I_x}$
(C) $\mathrm{I_Y} = \mathrm{I_X}$
(D) $\mathrm{I_Y} = 64\mathrm{I_X}$

Answer: (D) $\mathrm{I_Y} = 64\mathrm{I_X}$ · Key from source paper

Q309 AIEEE 2003 MCQ

A particle performing uniform circular motion has angular frequency is doubled & its kinetic energy halved, then the new angular momentum is

(A) $\frac{L}{4}$
(B) 2 L
(C) 4 L
(D) $\frac{L}{2}$

Answer: (A) $\frac{L}{4}$ · Key from source paper

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Q310 AIEEE 2003 MCQ

Let F be the force acting on a particle having position vector $\vec{r}$ and T be the torque of this force about the origin. Then

(A) $\vec{r} \cdot \vec{T} = 0$ and $\vec{F} \cdot \vec{T} \neq 0$
(B) $\vec{r} \cdot \vec{T} \neq 0$ and $\vec{F} \cdot \vec{T} = 0$
(C) $\vec{r} \cdot \vec{T} \neq 0$ and $\vec{F} \cdot \vec{T} \neq 0$
(D) $\vec{r} \cdot \vec{T} = 0$ and $\vec{F} \cdot \vec{T} = 0$

Answer: (D) $\vec{r} \cdot \vec{T} = 0$ and $\vec{F} \cdot \vec{T} = 0$ · Key from source paper

Q311 AIEEE 2003 MCQ

Two spherical bodies of mass M and $5M$& radii R&$2R$ respectively are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smaller body just before collision is

(A) 2.5R
(B) 4.5R
(C) 7.5R
(D) 1.5R

Answer: (C) 7.5R · Key from source paper

Q312 AIEEE 2002 MCQ

Two identical particles move towards each other with velocity $2v$ and v respectively. The velocity of centre of mass is

(A) v
(B) v/3
(C) v/2
(D) zero

Answer: (C) v/2 · Key from source paper

Q313 AIEEE 2002 MCQ

Initial angular velocity of a circular disc of mass M is ω_1. Then two small spheres of mass m are attached gently to diametrically opposite points on the edge of the disc. What is the final angular velocity of the disc?

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(A) $\left(\frac{M+m}{M}\right)\omega_1$
(B) $\left(\frac{M+m}{m}\right)\omega_1$
(C) $\left(\frac{M}{M+4m}\right)\omega_1$
(D) $\left(\frac{M}{M+2m}\right)\omega_1$

Answer: (C) $\left(\frac{M}{M+4m}\right)\omega_1$ · Key from source paper

Q314 AIEEE 2002 MCQ

Moment of inertia of a circular wire of mass M and radius R about its diameter is

(A) $MR^2/2$
(B) MR^2
(C) $2MR^2$
(D) $MR^2/4$

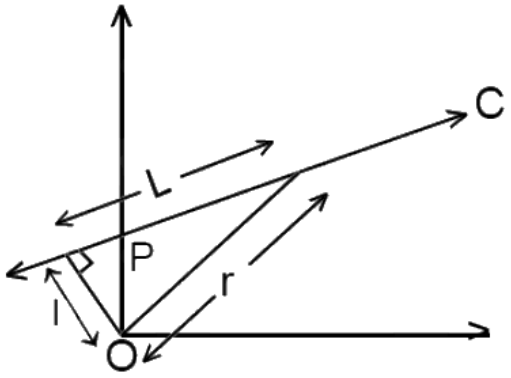
Answer: (A) $MR^2/2$ · Checked by our team

Q315 AIEEE 2002 MCQ

A particle of mass m moves along line PC with velocity v as shown. What is the angular momentum of the particle about P?

(see the figure above)

Q19. A particle of mass m moves along line PC with velocity v as shown. What is the angular momentum of the



particle about P?

(1) mvL (2) mvl
(3) mvr (4) zero

(A) mvL
(B) mvl
(C) mvr
(D) zero

Answer: (D) zero · Key from source paper