All Assignments

Help

HW #6: Angular momentum

Edit

Overview Diagnostics Print View with Answers

HW #6: Angular momentum

Due: 11:59pm on Wednesday, October 23, 2024

You will receive no credit for items you complete after the assignment is due. Grading Policy

Parallel Axis Theorem

Description: This problem introduces the parallel axis theorem. Use the theorem to find the moment of inertia of a rod about its end and that of a cube about its edge.

The parallel axis theorem relates I_{cm}, the moment of inertia of an object about an axis passing through its center of mass, to I_{p}, the moment of inertia of the same object about a parallel axis passing through point p. The mathematical statement of the theorem is $I_p = I_{cm} + Md^2$, where d is the perpendicular distance from the center of mass to the axis that passes through point p, and M is the mass of the object.

Part A

Suppose a uniform slender rod has length L and mass m. The moment of inertia of the rod about about an axis that is perpendicular to the rod and that passes through its center of mass is given by $I_{cm} = \frac{1}{12}mL^2$. Find I_{end}, the moment of inertia of the rod with respect to a parallel axis through one end of the rod.

Express I_{end} in terms of m and L. Use fractions rather than decimal numbers in your answer.

Hint 1. Find the distance from the axis to the center of mass

Find the distance d appropriate to this problem. That is, find the perpendicular distance from the center of mass of the rod to the axis passing through one end of the rod.

ANSWER:

$d = \frac{L}{2}$

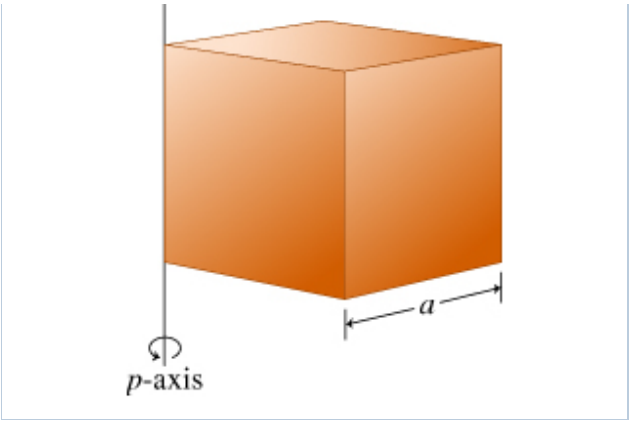
ANSWER:

$I_{\text{end}} = \frac{1}{3}mL^2$

Part B

Now consider a cube of mass m with edges of length a. The moment of inertia I_{cm} of the cube about an axis through its center of mass and perpendicular to one of its faces is given by $I_{cm} = \frac{1}{6}ma^2$. Find I_{edge}, the moment of inertia about an axis p through one of the edges of the cube

Express I_{edge} in terms of m and a. Use fractions rather than decimal numbers in your answer.



Hint 1. Find the distance from the o axis to the p axis

Find the perpendicular distance d from the center of mass axis to the new edge axis (axis labeled p in the figure).

ANSWER:

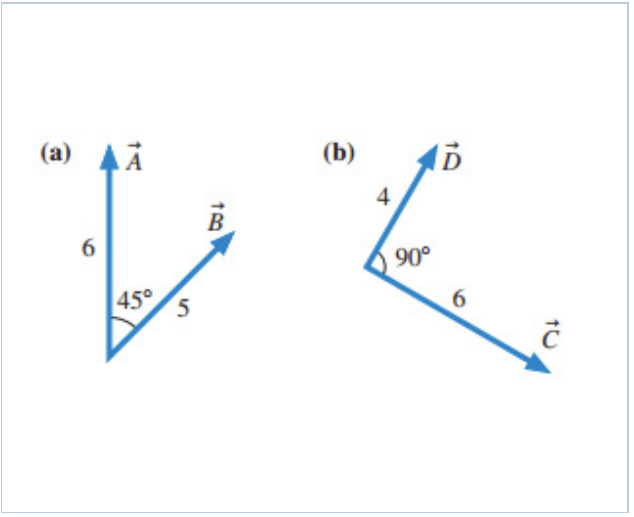
$$d = \frac{a}{\sqrt{2}}$$

ANSWER:

$$I_{\text{edge}} = \frac{2}{3}ma^2$$

Problem 12.37

Description: (a) Evaluate the magnitude of the cross product A_vec * B_vec. (b) Choose the correct direction of the cross product A_vec * B_vec. (c) Evaluate the magnitude of the cross product C_vec * D_vec. (d) Choose the correct direction of the cross...



Part A

Evaluate the magnitude of the cross product $\vec{A} \times \vec{B}$.

ANSWER:

$\left|\vec{A} \times \vec{B}\right| = 21$

Also accepted: 21.2, 21

Part B

Choose the correct direction of the cross product $\vec{A} \times \vec{B}$.

ANSWER:

- It is opposite to the direction of $\vec{A}$
- It is opposite to the direction of $\vec{B}$
- It is zero vecor
- Into the page
- Out of the page

Part C

Evaluate the magnitude of the cross product $\vec{C} \times \vec{D}$.

ANSWER:

$\left|\vec{C} \times \vec{D}\right| = 24$

Also accepted: 24.0, 24

Part D

Choose the correct direction of the cross product $\vec{C} \times \vec{D}$.

ANSWER:

- Into the page
- It is opposite to the direction of $\vec{D}$
- It is zero vecor
- It is opposite to the direction of $\vec{C}$
- Out of the page

Problem 12.45

Description: A ## kg, ##-cm-diameter turntable rotates at ## rpm on frictionless bearings. Two ## g blocks fall from above, hit the turntable simultaneously at opposite ends of a diameter, and stick. (a) What is the turntable's angular velocity, in rpm, just...

A 2.2 kg , 20-cm-diameter turntable rotates at 110 rpm on frictionless bearings. Two 540 g blocks fall from above, hit the turntable simultaneously at opposite ends of a diameter, and stick.

Part A

What is the turntable's angular velocity, in rpm, just after this event?

Express your answer in revolutions per minute.

ANSWER:

$$\omega = \frac{mw}{m+4m_2} = 56\,\mathrm{rpm}$$

Problem 12.78

Description: A 10 g bullet traveling at ## m/s strikes a ## kg, ##-m-wide door at the edge opposite the hinge. The bullet embeds itself in the door, causing the door to swing open. (a) What is the angular velocity of the door just after impact?

A 10 g bullet traveling at 450 $\mathrm{m/s}$ strikes a 11 kg , 0.80-m-wide door at the edge opposite the hinge. The bullet embeds itself in the door, causing the door to swing open.

Part A

What is the angular velocity of the door just after impact?

Express your answer with the appropriate units.

ANSWER:

$$w = \frac{0.01v}{d\left(\frac{m}{3}+0.01\right)} = 1.5\,\frac{\mathrm{rad}}{\mathrm{s}}$$

All Assignments

Physics for Scientists and Engineers with Modern Physics, 5e
Knight
amundson44156
Ends: 12/21/24