

ω and α derived from θ

Friday, 29 January, 2021 21:38

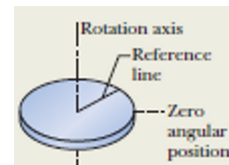
A reference line in a spinning disk has an angular position given by $\theta = 3t^2 - 12t + 9$, where θ is in radians and t is in seconds.

- Find ω and α as a function of time.
- Find the times when the angular position θ and the angular velocity ω become zero.

ω derived from θ

Saturday, 30 January, 2021 16:16

A disk is rotating about its central axis like a merry-go-round. The angular position of a reference line on the disk is given by $\theta = 0.25 t^2 - 0.6 t - 1$ with t in seconds, θ in radians, and the zero angular position as indicated in the figure. At what time does θ reach the minimum value? What is that minimum value?



ω derived from α

Saturday, 30 January, 2021 16:16

A child's top is spun with angular acceleration $\alpha = 5t^3 - 4t$, with t in seconds and α in rad/s^2 . At $t = 0$, the top has angular velocity 5 rad/s , and a reference line on it is at angular position $\theta = 2 \text{ rad}$.

- Obtain an expression for the angular velocity ω of the top.
- Obtain an expression for the angular position θ of the top.

Rotating Wheel 1

Saturday, 30 January, 2021 16:16

A wheel rotates with a constant angular acceleration of 3.5 rad/s^2 .

- If the angular speed of the wheel is 2 rad/s at $t_i = 0$, through what angular displacement does the wheel rotate in 2 s ?
- Through how many revolutions has the wheel turned during this time interval?
- What is the angular speed of the wheel at $t = 2 \text{ s}$?

Quadratic equation

Saturday, 30 January, 2021 16:17

A grindstone rotates at constant angular acceleration 0.35 rad/s^2 . At time $t = 0$, it has an angular velocity of -4.6 rad/s and a reference line on it is horizontal, at the angular position $\theta_i = 0$. At what time after $t = 0$ is the reference line at the angular position $\theta_f = 5 \text{ rev.}$?

Rotating Wheel 2

Saturday, 30 January, 2021 16:17

A wheel accelerates uniformly from rest to an angular speed of 25 rad/s in 10 s .

- Find the angular acceleration of the wheel.
- Find the tangential and radial acceleration of a point 10 cm from the wheel's center.
- How many revolutions has the wheel turned during this time interval?
- Find the wheel's angular deceleration if it comes to a full stop after 5 rev.

CD Player

Saturday, 30 January, 2021 16:17

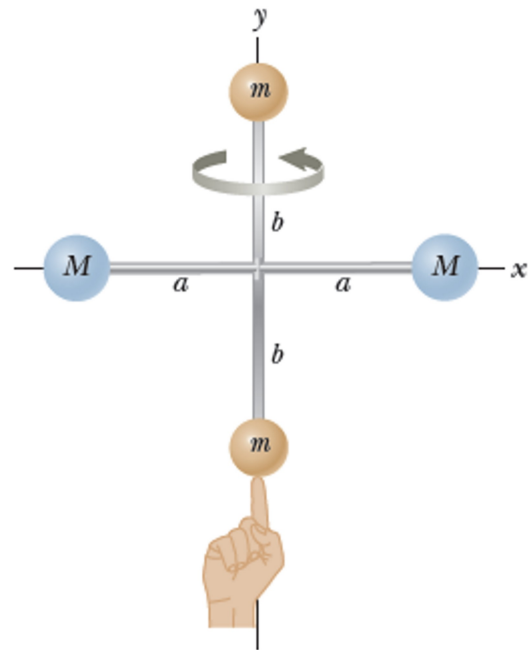
In a typical CD player, the constant speed of the surface at the point of the laser– lens system is 1.3 m/s .

- Find the angular speed of the disc in revolutions per minute when information is being read from the innermost first track $r = 23 \text{ mm}$ and the outermost final track $r = 58 \text{ mm}$.
- The maximum playing time of a standard music disc is 74 min. and 33 s . How many revolutions does the disc make during that time?
- What is the angular acceleration of the compact disc over the 4473 s time interval?

An Unusual Baton

Saturday, 30 January, 2021 16:18

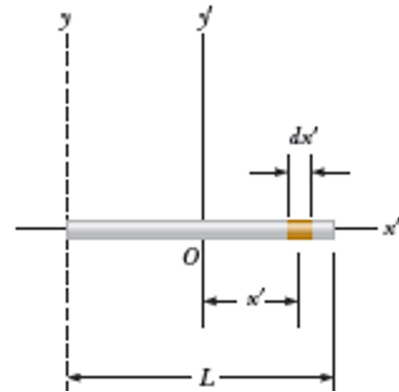
Four tiny spheres are fastened to the ends of two rods of negligible mass lying in the xy plane to form an unusual baton. If the system rotates about the y axis with an angular speed ω , find the moment of inertia about this axis.



Applying the Parallel-Axis Theorem

Saturday, 30 January, 2021 16:18

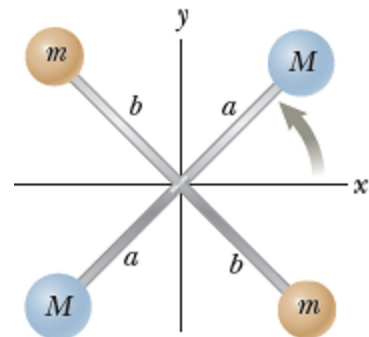
Find the moment of inertia of the rod about an axis perpendicular to the rod through one end (the y axis in the figure).



An Unusual Baton

Saturday, 30 January, 2021 16:19

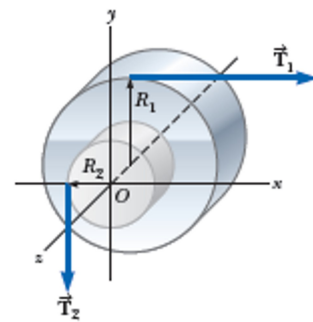
Four tiny spheres are fastened to the ends of two rods of negligible mass lying in the xy plane to form an unusual baton. Suppose the system rotates in the xy plane about the z axis through the center of the baton. Calculate the moment of inertia and rotational kinetic energy about this axis.



The Net Torque on a Cylinder

Saturday, 30 January, 2021 16:19

- What is the net torque acting on the cylinder about the rotation axis (which is the z axis)?
- Suppose $T_1 = 5\text{ N}$, $R_1 = 1\text{ m}$, $T_2 = 15\text{ N}$ and $R_2 = 0.5\text{ m}$. What is the net torque about the rotation axis, and which way does the cylinder rotate starting from rest?



The Torque Vector

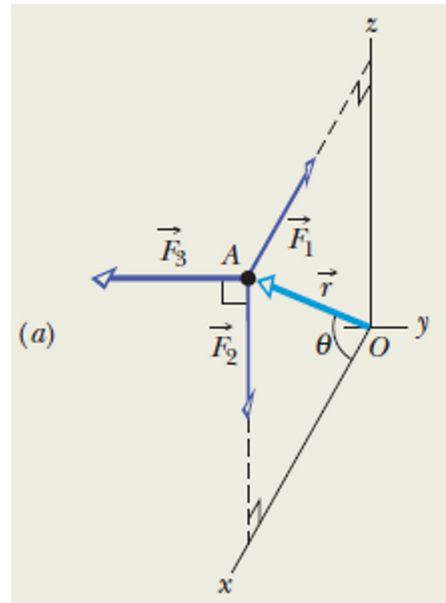
Saturday, 30 January, 2021 16:24

A force of $\vec{F} = 2\hat{i} + 3\hat{j}$ (N) is applied to an object that is pivoted about a fixed axis aligned along the z coordinate axis. The force is applied at a point located at $\vec{r} = 4\hat{i} + 5\hat{j}$ (m). Find the torque applied to the object.

Torque on a particle due to a force

Saturday, 30 January, 2021 16:19

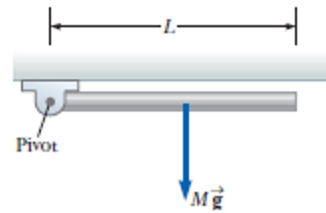
Three forces, each of magnitude 2 N , act on a particle, as shown. The particle is in the xz plane at point A given by position vector \vec{r} , where $r = 3\text{ m}$ and $\theta = 30^\circ$. What is the torque, about the origin O , due to each force?



Rotating Rod

Saturday, 30 January, 2021 16:20

A uniform rod of length L and mass M is attached at one end to a frictionless pivot and is free to rotate about the pivot in the vertical plane. The rod is released from rest in the horizontal position. What are the initial angular acceleration of the rod and the initial translational acceleration of its right end?

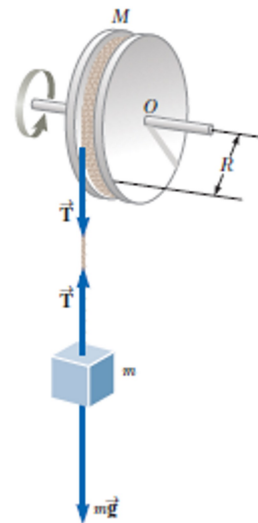


Angular Acceleration of a Wheel

Saturday, 30 January, 2021 16:20

A wheel of radius R , mass M , and moment of inertia I is mounted on a frictionless horizontal axle. A light cord wrapped around the wheel supports an object of mass m . When the wheel is released, the object accelerates downward, the cord unwraps off the wheel, and the wheel rotates with an angular acceleration. Calculate:

- the angular acceleration of the wheel,
- the translational acceleration of the object, and
- the tension in the cord.

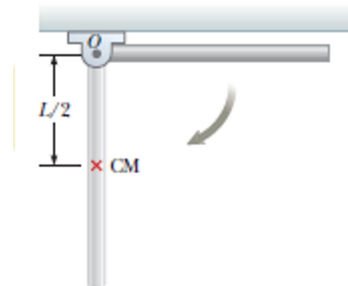


Rotating Rod

Saturday, 30 January, 2021 16:21

A uniform rod of length L and mass M is free to rotate on a frictionless pin passing through one end. The rod is released from rest in the horizontal position.

- What is its angular speed when the rod reaches its lowest position?
- Determine the tangential speed of the center of mass and the tangential speed of the lowest point on the rod when it is in the vertical position.

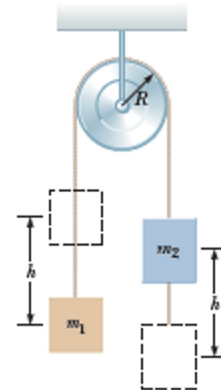


Energy and the Atwood Machine

Saturday, 30 January, 2021 16:21

Two blocks having different masses m_1 and m_2 are connected by a string passing over a pulley. The pulley has a radius R and moment of inertia I about its axis of rotation. The string does not slip on the pulley, and the system is released from rest.

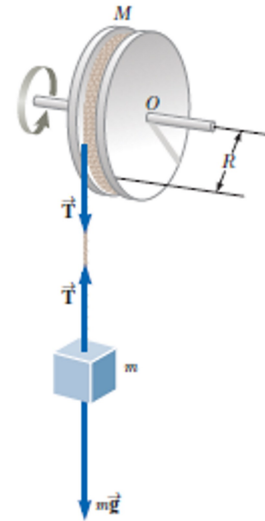
- Find the translational speeds of the blocks after block 2 descends through a distance h and
- Find the angular speed of the pulley at this time.



Work, rotational kinetic energy, torque, disk

Saturday, 30 January, 2021 16:21

Let the wheel shown in the figure start from rest at time $t = 0$ and also let the tension in the cord be 6 N and the angular acceleration of the disk be -24 rad/s^2 . What is its rotational kinetic energy at $t = 2.5\text{ s}$?

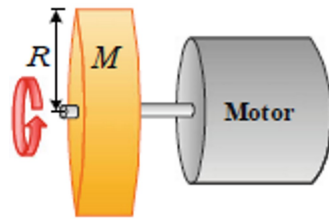


Power

Saturday, 30 January, 2021 16:22

A disk of mass $M = 0.2 \text{ kg}$ and radius $R = 5 \text{ cm}$ is attached coaxially to the massless shaft of an electric motor. The motor runs steadily at 900 rpm and delivers 2 hp .

- What is the angular speed of the disk in SI units?
- What is the rotational kinetic energy of the disk?
- How much torque does the motor deliver?

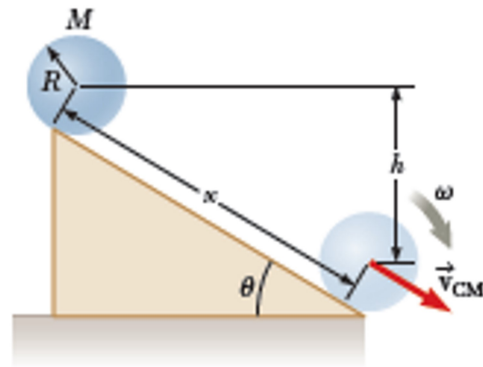


Sphere Rolling Down an Incline

Saturday, 30 January, 2021 16:22

For the solid sphere shown:

- calculate the translational speed of the center of mass at the bottom of the incline, and
- the magnitude of the translational acceleration of the center of mass.
- what are the magnitude and direction of the frictional force on the ball as it rolls down the ramp?



A disk rolls horizontally

Saturday, 30 January, 2021 16:23

A disk of mass $M = 1.5 \text{ kg}$ and radius $R = 8 \text{ cm}$ rolls horizontally without sliding with a center-of-mass speed $v_{com} = 4 \text{ m/s}$.

- What is the angular speed of the disk?
- What is the kinetic energy of the rolling disk?

A solid sphere, a disk and a thin hoop

Saturday, 30 January, 2021 16:23

Three objects (a solid sphere, a disk, and a thin hoop) each having a mass M are at rest at the same height h . At the exact same instant, these objects start to roll without sliding down the incline. In what order do they arrive at the bottom?

