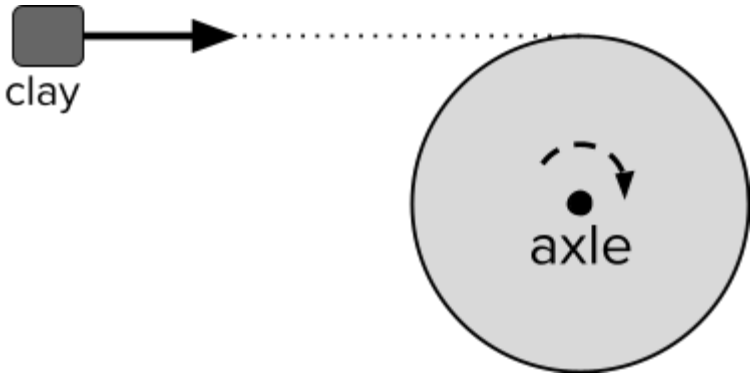
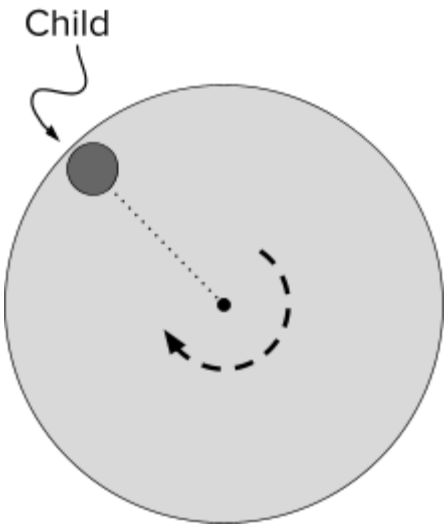
Torque impulse theorem (conservation of angular momentum)



A cylindrical turntable is at rest, but can rotate about a frictionless axle at its center which is secured to the ground. A piece of clay is shot at and sticks to the edge of a cylinder which causes it to rotate clockwise around the axle. What does the collision do to the magnitude of the total momentum and magnitude of the total angular momentum of the clay-turntable system?

	Total Momentum	Total Angular Momentum
(A)	Decreases since it was an inelastic collision	Increases due to the torque from the axle
(B)	Doesn't change since there is no external force	Doesn't change, since there is no external torque
(C)	Decreases due to the force of the axle	Doesn't change, since there is no external torque
(D)	Doesn't change since there is no external force	Increases due to the force from the clay

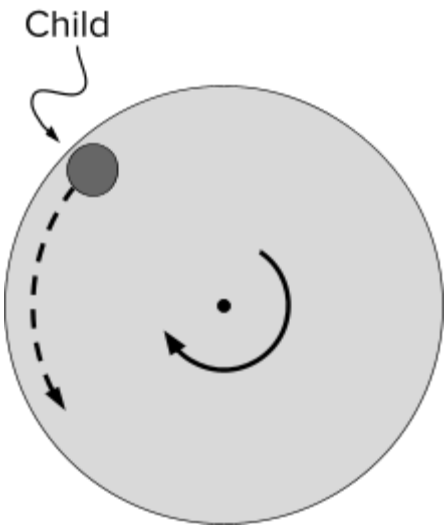
Answer:



A child is standing on the edge of a cylindrical platform of radius R which is rotating clockwise about a frictionless axle through its center. The child walks from the outside edge to the center of the cylindrical platform. What happens to the total angular momentum of the child-platform system and total kinetic energy of the child-platform system as the child walks toward the center?

	Total angular momentum	Total kinetic energy
(A)	Doesn't change	Increases
(B)	Decreases	Decreases
(C)	Increases	Increases
(D)	Doesn't change	Decreases

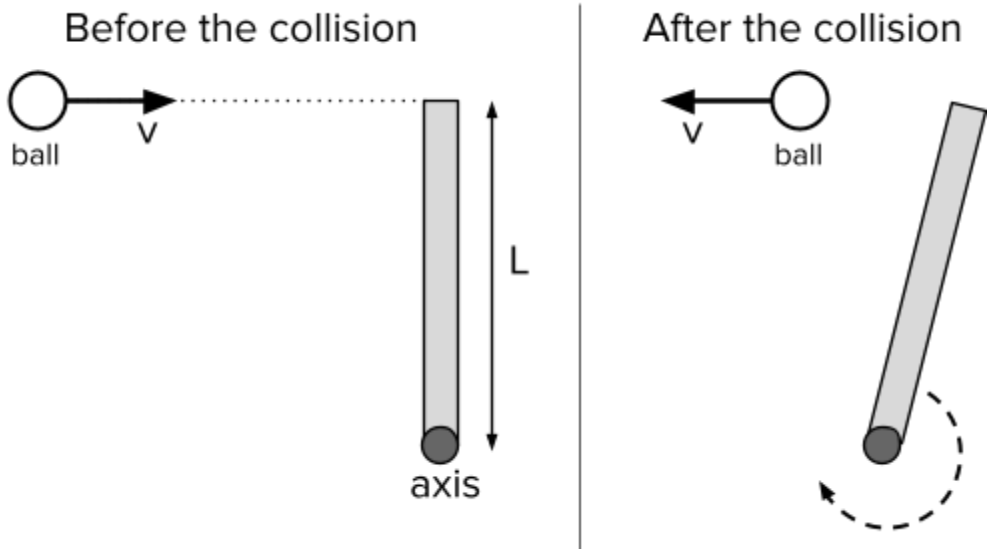
Answer:



A child is riding on the edge of a cylindrical platform which is rotating clockwise about a frictionless axle through its center. The child then proceeds to run in a circle around the edge of the platform in the counterclockwise direction. What happens to the angular momentum and kinetic energy of the system consisting of only the cylindrical platform?

	Angular momentum	**Kinetic energy**
(A)	Increases	Increases
(B)	Decreases	Increases
(C)	Increases	Decreases
(D)	Decreases	Decreases

Answer:



A rod of length L sits at rest on a frictionless table but can pivot about a frictionless fixed axis at one end. A ball of mass M strikes the end of the rod with a speed v and rebounds with a speed v, causing the rod to rotate clockwise as seen in the diagram above. The rotational inertia of the rod is I. What is the angular speed of the rod after the collision?

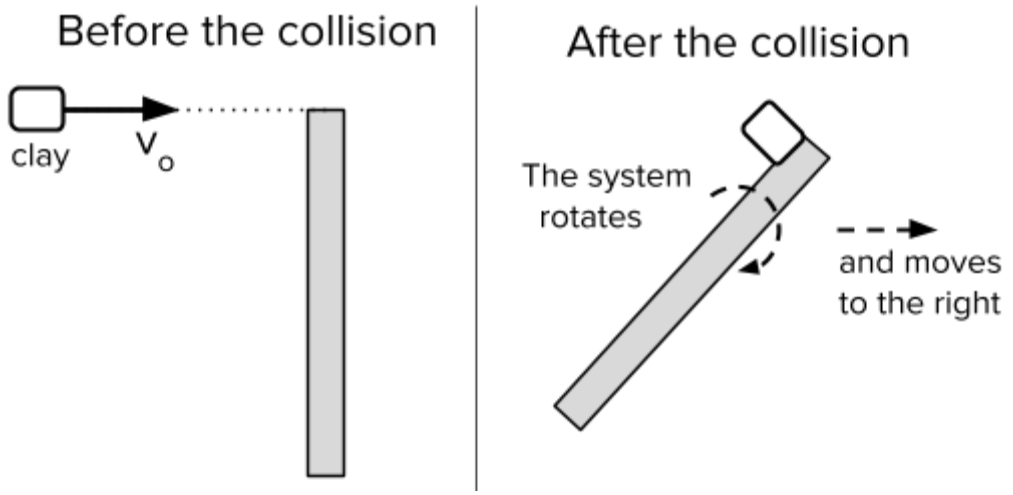
(A) $\frac{MvL}{2I}$

(B) $\frac{2MvL}{I}$

(C) $\frac{vI}{2ML}$

(D) $\frac{2vI}{ML}$

Answer:



A system consists of a rod of length L, sitting at rest on a frictionless frozen pond, and a piece of clay moving at speed v_o. The clay strikes and sticks to the end of the rod, causing it to rotate about the system's center of mass as well as causing the entire system to move to the right. Select the best choice below that represents what happens to the following quantities for the clay-rod system as a result of the collision?

	Total mechanical energy	**Total Momentum**	**Total Angular Momentum**
(A)	Remains constant	Decreases	Remains constant
(B)	Decreases	Decreases	Increases
(C)	Increases	Increases	Decreases
(D)	Decreases	Remains constant	Remains constant

Answer:

An ice skater is spinning with her arms close to her body with a rotational inertia I_o at an angular speed ω_o. The ice skater then extends her arms outward and which makes her rotational inertia I_f and her angular speed ω_f. What can be said about the rotational inertia and angular speeds? Select two correct choices.

(A) $I_f/I_o > 1$
(B) $I_f/I_o < 1$
(C) $\omega_f/\omega_o > 1$
(D) $\omega_f/\omega_o < 1$

Answer:

A wheel of radius R and rotational inertia I, which can rotate about a frictionless axle through its center, has a string wrapped around it that is connected to a force sensor. A student pulls on the string with a constant force F for a constant time period Δt and measures the final angular speed ω attained. The student repeats this process, using a different magnitude constant force F exerted for the same time interval Δt each trial. If the student plots the data on a graph of F vs. ω, what would the slope represent?

(A) $\frac{I\Delta t}{R}$

(B) $\frac{I}{R\Delta t}$

(C) $\frac{R\Delta t}{I}$

(D) $\frac{\Delta t}{IR}$

Answer: