

Tutorial 1 - Rotational Kinetics and Moment of Inertia

Rotational Kinetics

- 1 When a slice of buttered toast is accidentally pushed over the edge of a counter, it rotates as it falls. If the distance to the floor is 76 cm and for rotation less than 1 rev, what are the
 - (a) Smallest angular speed and
 - (b) largest angular speeds that cause the toast to hit and then topple to be butter-side down?

- 2 A flywheel turns through 40 rev as it slows from an angular speed of 1.5 rad s^{-1} to a stop.
 - (a) Assuming a constant angular acceleration, find the time for it to come to rest.
 - (b) What is its angular acceleration?
 - (c) How much time is required for it to complete the first 20 of the 40 revolutions?

- 3 Starting from rest, a wheel has constant $\alpha = 3.0 \text{ rad s}^{-2}$. During a certain 4.0 s interval, it turns through 120 rad.

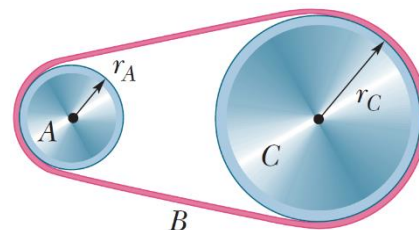
How much time did it take to reach that 4.0 s interval?

- 4 A seed is on a turntable rotating at 33.3 rev/min, 6.0 cm from the rotation axis.

What are

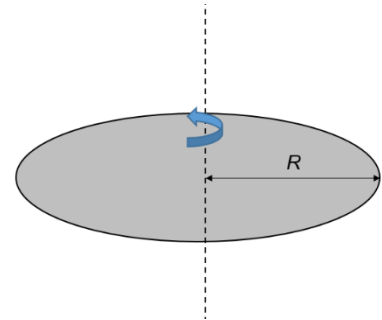
 - (a) the seed's acceleration and
 - (b) the least coefficient of static friction to avoid slippage?
 - (c) If the turntable had undergone constant angular acceleration from rest in 0.25 s, what is the least coefficient to avoid slippage?

- 5 In the figure, wheel A of radius $r_A = 10 \text{ cm}$ is coupled by belt B to wheel C of radius $r_C = 25 \text{ cm}$. The angular speed of wheel A is increased from rest at a constant rate of 1.6 rad s^{-2} . Find the time needed for wheel C to reach an angular speed of 100 rev/min, assuming the belt does not slip.

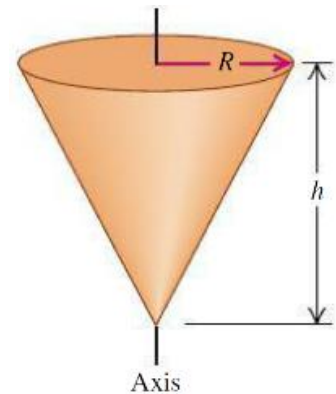


Moment of inertia

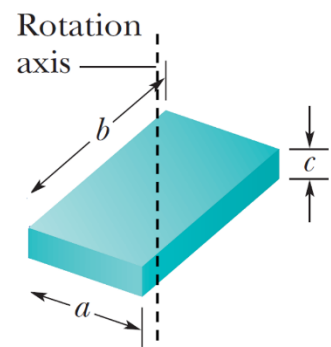
- 6 (a) Calculate the moment of inertia of a thin circular solid disk about an axis that go through its centre perpendicular to the disk. The disk has a mass M and radius R .



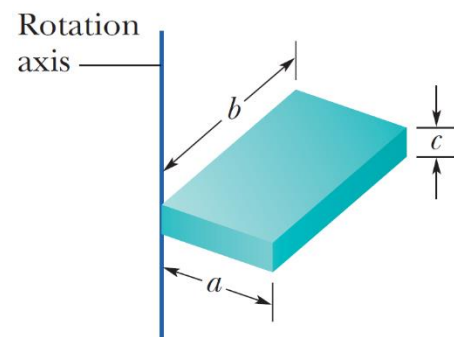
- (b) Calculate the moment of inertia of a uniform solid cone about an axis through its center. The cone has mass M and altitude h . The radius of its circular base is R .



- 7 (a) Calculate the moment of inertia of a uniform solid block with edge length, a , b and c about an axis through its centre of mass and perpendicular to the large faces.



- (b) The uniform solid block has mass 0.172 kg and edge lengths $a = 3.5$ cm, $b = 8.4$ cm, and $c = 1.4$ cm. Calculate its rotational inertia about an axis through one corner and perpendicular to the large faces.



Answers

1	(a)	4.0 rad s^{-1}
	(b)	12.0 rad s^{-1}
2	(a)	335 s
	(b)	$-4.5 \times 10^{-3} \text{ rad s}^{-2}$
	(c)	98 s
3		8.0 s
4	(a)	0.73 m s^{-2}
	(b)	0.074
	(c)	0.11
5		16 s
6	(a)	$I = \frac{1}{2}MR^2$
	(b)	$I = \frac{3}{10}MR^2$
7	(a)	$I_{CM} = \frac{M}{12}(a^2 + b^2)$
	(b)	$4.7 \times 10^{-4} \text{ kg m}^2$