



Science Virtual Learning

MPI Physics 210

Rotational Dynamics 11

Rotational Kinetic Energy

May 1, 2020



Lesson: MPI Rotational Kinetic Energy
May 1, 2020

Objective: To understand the concept of Rotational Kinetic Energy, and how to calculate it

This video introduces rotational kinetic energy, and how it is calculated.

<https://youtu.be/hbDLWZhJNMs>

Video: Rotational KE



1. A 0.0500-kg pizza cutter wheel of radius 0.0530 m is spinning at 3.00 rotations per second. How much rotational KE does it have?

2. The propellers on a World War II fighter plane had 4 blades, each 1.70 m long and with a mass of 105 kg. When the engine starts, it speeds up the propeller from rest to 1260 rpm in 12.0 seconds.

a) What is the moment of inertia of the propellers?

b) How much rotational KE do the propellers have at the end?

c) How much Work did the engine do on the propellers?

d) How much power P does the engine produce?

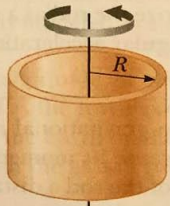
Video: <https://youtu.be/Hlrt6r5Im8U>



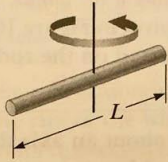
Rotational KE Examples

TABLE 10.2 Moments of Inertia of Homogeneous Rigid Objects with Different Geometries

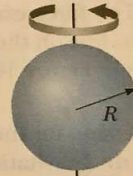
Hoop or thin cylindrical shell
 $I_{CM} = MR^2$



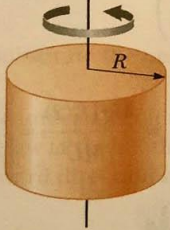
Long, thin rod with rotation axis through center
 $I_{CM} = \frac{1}{12} ML^2$



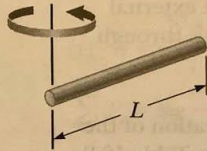
Solid sphere
 $I_{CM} = \frac{2}{5} MR^2$



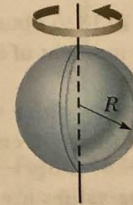
Solid cylinder or disk
 $I_{CM} = \frac{1}{2} MR^2$



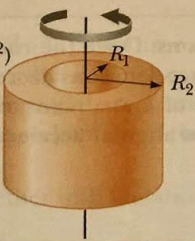
Long, thin rod with rotation axis through end
 $I = \frac{1}{3} ML^2$



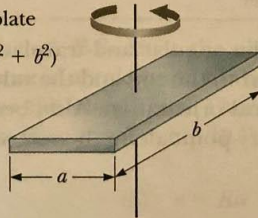
Thin spherical shell
 $I_{CM} = \frac{2}{3} MR^2$



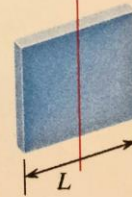
Hollow cylinder
 $I_{CM} = \frac{1}{2} M(R_1^2 + R_2^2)$



Rectangular plate
 $I_{CM} = \frac{1}{12} M(a^2 + b^2)$



Thin rectangular sheet, axis parallel to one edge and passing through center of other edge



$$I = \frac{1}{12} ML^2$$

Thin rectangular sheet, axis along one edge



$$I = \frac{1}{3} ML^2$$

Moments of Inertia for Different Shapes



Equation

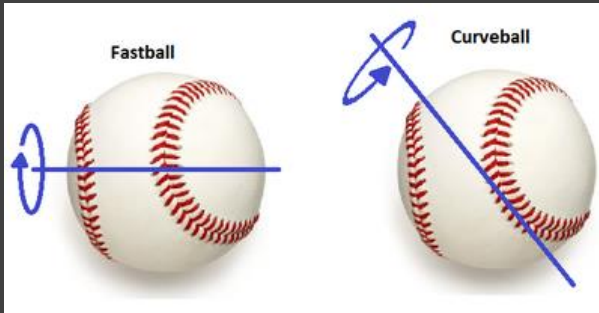
Missing

- | | |
|--|----------------|
| 1. $\omega_f = \omega_i + \alpha t$ | $\Delta\theta$ |
| 2. $\Delta\theta = \frac{1}{2}(\omega_f + \omega_i)t$ | α |
| 3. $\Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$ | ω_f |
| 4. $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ | t |
| 5. $\Delta\theta = \omega_f t - \frac{1}{2}\alpha t^2$ | ω_i |

Rotational Motion Equations



Homework 1

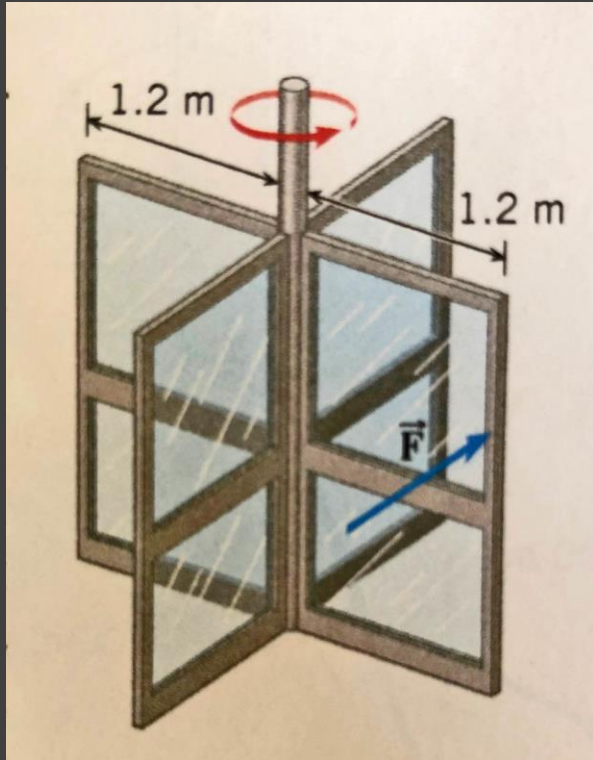


A baseball is a solid sphere of mass 0.150 kg and radius 0.0375 m . To throw a curveball, pitchers spin the ball at 2500 rpm .

- What is its rotational KE?
- If it is also moving at 35.0 m/s toward the batter, what is its linear KE?

- Try to solve the problem yourself, then watch the first part of the solution video:
- <https://youtu.be/1jzWn16ckgM>

Homework 2



A revolving door at a hospital consists of four doors, each 1.20 m wide and of mass 85.0 kg, rotating about a central axis; see picture. A person does 9.73 J of work pushing the door. If all of that Work goes into rotational KE, what is the final angular speed of the door?

- Try to solve the problem yourself, then watch the first part of the solution video:
- <https://youtu.be/3VsjLdglCio>



That's it!

