PURDUE UNIVERSITY DEPARTMENT OF PHYSICS

Physics 22000

General Physics

Lecture 16 – Rotational Motion

Fall 2016 Semester

Prof. Matthew Jones

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SUPPLEMENTAL INSTRUCTION

Free Study Sessions!

Rachel Hoagburg

Come to SI for more help in **PHYS 220**

Tuesday and Thursday	7:30-8:30PM Shreve C113

Office Hour
Tuesday 1:30-2:30 4th floor of Krach

For other SI-linked courses and schedules, visit purdue.edu/si or purdue.edu/boilerguide

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Even More Examples

- Try to identify what class of problem a question pertains to…
  - Description of motion
  - Free-body diagrams/Newton's 2nd law
    - Statics
    - Dynamics
  - Collision problems
    - Elastic (conserves kinetic energy)
    - Inelastic (does not conserve kinetic energy)
  - Energy conservation
  - Momentum conservation

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Examples

31. **Merry-go-round** A mechanic needs to replace the motor for a merry-go-round. What torque specifications must the new motor satisfy if the merry-go-round should accelerate from rest to 1.5 rad/s in 8.0 s? You can consider the merry-go-round to be a uniform disk of radius 5.0 m and mass 25,000 kg.

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Examples

32. * A small 0.80-kg train propelled by a fan engine starts at rest and goes around a circular track with a 0.80-m radius. The fan air exerts a 2.0-N force on the train. Determine (a) the rotational acceleration of the train and (b) the time interval needed for it to acquire a speed of 3.0 m/s. Indicate any assumptions you made.

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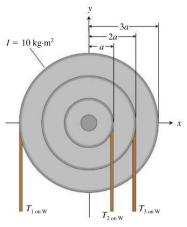
Examples

25. * A pulley such as that shown in Figure P8.25 has rotational inertia 10 kg·m^2. Three ropes wind around different parts of the pulley and exert forces $T_{1\text{ on W}} = 80$ N, $T_{2\text{ on W}} = 100$ N, and $T_{3\text{ on W}} = 50$ N. Determine (a) the rotational acceleration of the pulley and (b) its rotational velocity after 4.0 s. It starts at rest.

Figure P8.25



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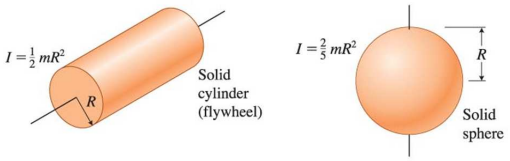
Examples

42. (a) Determine the rotational momentum of a 10-kg disk-shaped flywheel of radius 9.0 cm rotating with a rotational speed of 320 rad/s. (b) With what magnitude rotational speed must a 10-kg solid sphere of 9.0 cm radius rotate to have the same rotational momentum as the flywheel?



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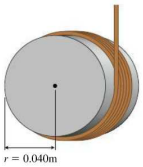
Examples

38. ** **Like a yo-yo** Sam wraps a string around the outside of a 0.040-m-radius 0.20-kg solid cylinder and uses it like a yo-yo (**Figure P8.38**). When released, the cylinder accelerates downward at (2/3) *g*. (a) Draw a force diagram for the cylinder and apply the translational form of Newton's second law to the cylinder in order to determine the force that the string exerts on the cylinder. (b) Determine the rotational inertia of the solid cylinder. (c) Apply the rotational form of Newton's second law and determine the cylinder's rotational acceleration. (d) Is your answer to part (c) consistent with the application of $a = r\alpha$, which relates the cylinder's linear acceleration and its rotational acceleration? Explain.

Figure P8.38



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Examples

$$R = 1\,m$$
$$\rho = 2750\,kg/m^3$$
$$V = \frac{4}{3}\pi R^3$$

- How much energy is stored in the granite globe at the Columbian Park Zoo if it rotates once every two seconds?

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