

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Physics

Physics 8.01

Spring 2005

**PROBLEM SET 8**

**Saturday, March 26, 2005**

**Due Date: Thursday, March 31, 2005, 3:00 p.m.**

**Reading Assignment:** Young and Freedman, Chapter 9 (skipping Examples 9.13 and 9.14) and Sections 10.1 and 10.2; Busza, Cartwright, and Guth: pp. 266–277 of Chapter 8. You will not be responsible for the paragraphs on pp. 274–75 labeled “Difficult Material”.

**Topics for the week:** Rotation of Rigid Bodies in Two Dimensions. Rotational kinematics (angular velocity and acceleration), motion with constant angular acceleration, relation between linear and angular kinematics, rotational kinetic energy, moments of inertia, parallel and perpendicular axis theorems, torque and its relation to angular acceleration. You will be expected to learn to calculate moments of inertia for systems built from point particles, and for solid bodies when they can be found by using tables in combination with the parallel and perpendicular axis theorems. You will be expected to understand in principle how to calculate moments of inertia for solid bodies using integration, although in practice you will not be required to integrate over any volume more complicated than the uniform thin rod of Young and Freedman’s Example 9.12.

**Instructions:**

If a problem is marked **DO**, you should write a solution to hand in to be graded. The graders will read your answers to one or two questions on each problem set, and they will check whether the other problems have at least been handed in.

The quiz on this material, to be given at 10:05 am on Friday, April 1, will include at least one problem that is at most a slight modification of one of the problems (**DO** or **STUDY**) on this problem set.

Your written solutions are due by 3:00 pm in room 4-339B on Thursday, March 31. Please indicate the number, instructor, and time of your recitation section, and be sure to submit your paper to the correct bin. Solutions will be made available on the 8.01 website shortly afterward, so that you will be able to use them in studying for the quiz.

Remember: *Trying to learn physics without doing problems is like trying to learn to sing by studying waveforms.*

*Rotational Kinematics*

- 1) **DO:** SG:8A.1 Motion of a CD with constant angular acceleration
- 2) **DO:** Y&F:9.66 Motion with non-constant angular acceleration
- 3) **STUDY:** SG:8A.2 (S) Acceleration of a point on a rotating object

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*Moment of Inertia*

- 4) **STUDY:** SG:8C.3 (S) Proof of the parallel and perpendicular axis theorems
- 5) **DO:** Y&F:9.78 Comparing moments of inertia of simple objects
- 6) **STUDY:** SG:8C.4 (S) Moments of inertia of rods, disks, and spheres (integration, and parallel and perpendicular axis theorems)
- 7) **DO:** SG:8C.5 (H) Moments of inertia of a flat square and a flat disk

*Kinetic Energy and Rotational Motion about a Fixed Axis*

- 8) **DO:** Y&F:9.85 Two blocks, a pulley, and a tabletop with friction
- 9) **DO:** Y&F:9.89 Two disks pivoted on a rod

*Torque and Angular Acceleration*

- 10) **DO:** SG:8B.2 (H) Calculating torques about an axis
- 11) **DO:** SG:8E.2 Torque and angular acceleration of a pivoted rod
- 12) **DO:** Y&F:10.7 Frictional torque and a spinning spherical shell with point masses attached
- 13) **DO:** SG:10.10 A yo-yo unwinding under the force of gravity

— *End of Problem Set* —