

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01

Spring 2005

PROBLEM SET 9

Saturday, April 2, 2005

Due Date: Thursday, April 7, 2005, 3:00 p.m.

Reading Assignment: Young and Freedman, remainder of Chapter 10; Busza, Cartwright, and Guth: pp. 312–320 of Chapter 9.

Topics for the week: Rotation of Rigid Bodies in Three Dimensions. Rotation about a moving axis (including rolling), work and power in rotational motion, angular momentum, vector character of angular velocity, torque, and angular momentum, decomposition of motion into motion of center of mass and rotation about the center of mass, conservation of angular momentum, gyroscopes.

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 8, 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, April 7. 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.

Angular Momentum in Two Dimensions

- 1) **DO:** SG:8D.2 (H) Rotation of a ruler about an off-center hole. Include also the extension of the problem in 8E.4, when the same ruler is allowed to swing from a horizontal rod. Skip the last part of the question, however, where it asks about pendulums and simple harmonic motion.
- 2) **DO:** Y&F:10.39 More things that you can do when your frictionless table has a hole in it
- 3) **STUDY:** SG:10.1 (S) A ball of putty hitting a pivoted stick

Rotation about a Moving Axis: Rolling

- 4) **STUDY:** SG:8E.8 (S) Rolling without slipping
- 5) **DO:** SG:9D.6 (H) Spinning wheels on an aircraft as it lands
- 6) **DO:** Y&F:10.24 Marble rolling in a bowl, with and without slipping
- 7) **STUDY:** SG:10.11 (S) Pulling a yo-yo along the floor by its string
- 8) **DO:** Y&F:10.98 The center of percussion of a baseball bat

Energy, Power, and Rotations

- 9) **DO:** Y&F:10.27 A child's work in pushing a merry-go-round
- 10) **DO:** Y&F:10.55 Energy and power for a wheel undergoing uniform angular acceleration

Rotation, Angular Momentum, and Torque in Three Dimensions

- 11) **STUDY:** SG:9C.2 (S) Verifying that torque is the rate of change of angular momentum
- 12) **STUDY:** SG:9D.1 (S) A skewed rod on a turntable
- 13) **DO:** SG:9D.9 Rotating meteroid

Gyroscopes

- 14) **STUDY:** SG:9D.4 Motion of a gyroscope
- 15) **DO:** Y&F:10.48 Precession of a gyroscope and the force on its pivot

— End of Problem Set —