

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01

Spring 2005

PROBLEM SET 11

Tuesday, April 19, 2005

Due Date: Thursday, April 28, 2005, 3:00 p.m.

Reading Assignment: Young and Freedman, Chapter 12, omitting Section 12.7; Sections 13.1 – 13.6; Busza, Cartwright, and Guth: last paragraph on p. 318, first paragraph on p. 319; pp. 65–66, starting with 1st full paragraph on p. 65; pp. 122–123, starting in the middle of p. 122.

Topics for the week: Gravitation and Periodic Motion. Newton's law of gravity, gravitation of spherical mass distributions, gravitational potential energy, circular orbits, Kepler's laws for elliptical orbits, black holes and the Schwarzschild radius; simple periodic motion, amplitude, period, frequency, angular frequency, the simple pendulum, and the physical pendulum.

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 29, 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 28. 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 become a brain surgeon by listening to books on tape.*

Applications of Kepler's Laws

- 1) **DO:** Y&F:12.32 Planet Vulcan
- 2) **DO:** Y&F:12.34 Determining the mass of the Sun from the orbit of Venus
- 3) **DO:** Y&F:12.37 The orbit of *Helios B* around the Sun

More Sophisticated Orbit Problems

- 4) **STUDY:** SG:9B.2 (S) Kepler's second law of planetary motion and the conservation of angular momentum
- 5) **STUDY:** SG:9B.3 (S) Comet orbits
- 6) **DO:** SG:9B.4 (H) Disposing of nuclear waste in the Sun

— Problem Set continues on next page —

Black Holes

- 7) **DO:** Y&F:12.43 Black hole at the center of the Milky Way galaxy
- 8) **DO:** Y&F:12.87 Tidal forces near a black hole

Simple Harmonic Motion

- 9) **DO:** Y&F:13.27 The simple harmonic motion of an oscillating toy
- 10) **STUDY:** SG:2D.2 (S) Pendulum motion
- 11) **DO:** SG:2D.3 (H) A mass between two springs
- 12) **STUDY:** SG:4E.2 (S) Mass sliding in a spherical bowl

More Complicated Oscillators

- 13) **STUDY:** SG:4E.2 (S) Mass sliding in a spherical bowl
- 14) **DO:** SG:4E.5 (H) A mass suspended on a spring
- 15) **DO:** Y&F:13.36 A torsional pendulum
- 16) **DO:** Y&F:13.47 The relation between a simple pendulum and a physical pendulum