

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01

Spring 2005

PROBLEM SET 7

Saturday, March 12, 2005

Due Date: Thursday, March 17, 2005, 3:00 p.m.

Corrected Version, 3/13/05, 5:00 pm: Problem 8 changed.*

Reading Assignment: Young and Freedman, Chapter 8; Busza, Cartwright, and Guth: pp. 164–170 of Chapter 5.

Topics for the week: Momentum and its conservation, impulse, elastic collisions, inelastic collisions, completely inelastic collisions, center of mass, external forces and the motion of the center of mass, and rocket propulsion.

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, March 18, 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 17. 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.

Momentum, Energy, and Force:

- 1) **DO:** Y&F:8.3 Kinetic energy and momentum
- 2) **DO:** Y&F:8.4 The momentum vector of a soccer ball
- 3) **DO:** Y&F:8.7 The force of a golf swing

Collisions and the Conservation of Momentum:

- 4) **DO:** SG:5B.3 (H) Elastic collisions in one and two dimensions
- 5) **DO:** Y&F:8.64 Completely inelastic collision of three spheres
- 6) **DO:** SG:7.13 (H) A ballistic pendulum: firing a bullet into a block of wood
- 7) **DO:** Y&F:8.32 A head-on collision of two cars
- 8) **DO:** Y&F:8.89 The beta decay of ^{210}Bi and the antineutrino.

— Problem Set continues on next page —

* The original version of this Problem Set listed Problem 8 as Y&F:8.88. It was my mistake, so if you have already done that problem, you can hand it in for full credit without doing Y&F:8.89.

Center of Mass:

- 9) **DO:** Y&F:8.45 The center of mass of the Sun-Jupiter system
- 10) **STUDY:** SG:5C.2 (S) Two skaters pulling themselves together with a rope
- 11) **DO:** SG:5C.4 Center of mass of combinations of shapes
- 12) **DO:** SG:7.19 (H) Two balls, a string, and a table

Impulse:

- 13) **DO:** Y&F:8.10 Orbital maneuvering system on the space shuttle

Rockets and other momentum exchange problems:

- 14) **DO:** SG:5A.4 (H) Reaction force of the water on a fire hydrant (Remember, an “(H)” in the *Study Guide* means there are hints. Be sure to take advantage of them for this problem.)
- 15) **DO:** Y&F:8.104 A rocket near the surface of the Earth