

Physics 106A: Classical Mechanics

Homework 5: Central Force Motion and Scattering

DUE: Thursday, November 14 2002

Remember: Late homework will be granted 50% credit up to 1 week late. After that, no credit will be given.

Reading Assignment: Hand and Finch Chapter 4.

1. (*Center of mass motion.*) Hand and Finch Chapter 4, problem 10.

2. (*The Supernova*) Two stars are in a circular orbit about a common, stationary center of mass. One of them has a supernova explosion resulting in it losing a mass ΔM spherically symmetrically in its frame in a time short compared with the orbital period and leaving behind a system with combined mass M . Show that the relative orbit is bound and develops an eccentricity $\varepsilon = \Delta M/M$ provided that less than half the combined mass is lost. Show also that if the orbit is unbound, the supernova remnant star moves with constant speed.

3. (*Scattering*) Examine the scattering produced by a repulsive central force $f = kr^{-3}$. Show that the differential cross section is given by:

$$\sigma(\Theta)d\Theta = \frac{k}{2E} \frac{(1-x) dx}{x^2 (2-x)^2 \sin \pi x}$$

where x is the ratio Θ/π and E is the energy.