Department of Physics
Physics 2048 (Rabson) Fall semester, 1998

Homework for Week 12
Nominal due date: Friday, 13 November

Read chapter 15.
15.2Q, 15.3Q, 15.11Q
15.5E, 15.12E, 15.21P, 15.29E, 15.31E, 15.52P
15.53E, 15.63E, 15.66E, 15.77P

Answers to homework not out of the book from week 11

I. Maybe it isn't actually harder to crash a probe into the Sun than it is to shoot one out of the Solar System, but it is hard. It takes about \(9 \times 10^8\) Joules per kilogram \((GM_{\text{Sun}}/R_{\text{orbit}})\) to take an object from the radius of Earth's orbit about the Sun to infinity and around half that much energy \((1/2)v_{\text{orbital}}^2\) per kilogram to kill all the angular momentum an object starting starting on Earth inherits from Earth's motion. Because the Sun is such a small target relative to the area swept out by Earth's orbit, the thing can't fall into the Sun unless it has close to zero angular momentum. Of course, real probes shot out of the Solar System or into the Sun are sent on trajectories that take them close to planets, with which they can exchange energy and angular momentum (the "slingshot" effect).

14.2 The Schwartzchild radius of the Sun, 3 km, is five parts in a million of its current radius. The mean density of a sphere of that radius with the mass of the Sun is \(2 \times 10^{19}\) kg/m\(^3\). Perhaps a better way to appreciate this density is in c.g.s. units: a cubic centimeter of material (if that were a sensible concept) would have a mass of \(2 \times 10^{16}\) grams. The Schwartzchild radius of the Earth is a little under 9 mm.

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