Assignment 2 — due Friday October 2nd [Revision : 1.3]

This assignment comprises questions 2.8, 2.12 and 2.14 from Chapter 2 of Ostlie & Carroll; questions 5.1, 5.2, 5.11 and 5.15 from Chapter 5; and questions 7.4, 7.5 and 7.6 from Chapter 7.

Bonus points can be obtained by answering the following question:

On June 21, 2004, SpaceShip One (see Wikipedia) made the first privately funded human spaceflight, and on October 4, it won the \$10 million Ansari X PRIZE, by reaching 100 kilometers in altitude twice in a two-week period with the equivalent of three people on board, with no more than ten percent of the non-fuel weight of the spacecraft replaced between flights.

On the October 4 flight, SpaceShip One reached a maximum altitude of 112 km above the Earth's surface. Consider an idealized model of the flight, where the spaceship began at rest on the ground (not actually true), and then thrusted only in a radial direction. Calculate the amount of energy per kilogram expended to reach the maximum altitude. You should neglect the change in the craft's mass due to the consuption of propellant, but you *should* account for the effects of the Earth's rotation (to do this, note that the launch location — Mojave, CA — has a latitude of 35° N). Compare your result to the energy per kilogram required to reach a circular orbit with the same altitude, from the same launch location; and comment on your findings in the context of the economics of private spaceflight.