AOE 2104 Introduction to Aerospace
Engineering Problem Sheet 7

Due November 18, 2003

31-32 The X-Prize is an incentive award for the first privately supported organization to put an astronaut in space, return him/her to Earth safely and then repeat the mission within 14 days. We have discussed in class the mission profile for Scaled Composites' entry for this competition. You are to pick any one of the other entries and to describe its mission profile and any other facts that you can find out about the organization and its design. Your report should indicate the name of the organization, an over view of vehicle of vehicles involved, and a detailed mission profile.

33. Make a plot of final velocity over exhaust velocity vs payload fraction for various structural ratios. The range of structural ratios should include 0.2, 0.1, 0.05, 0.01, and the payload ratios should include the range from 0.001 to 1. It would help to plot the payload ratios on a log scale.

34. If we neglect the rotation of the Earth, and if we neglect the drag due to the atmosphere, we can make the following calculations:

A. Calculate the specific energy (Energy per unit mass) at the surface of the Earth

i) kinetic

ii) potential

B. Calculate the specific energy in a circular orbit of 400 km above the Earth' surface. At that altitude the velocity in a circular orbit is 7.6685 km/s

i) kinetic

ii) potential

C. Determine the change in total energy - the energy required to be supplied by the engine in Newton meters per unit mass or Joules per unit mass.

35. Assuming we used a single stage liquid rocket with an I_{sp} of 400 s, and that we had a structural mass ratio of 0.10:

A. What would be the maximum velocity achieved (if the payload fraction were 0)?

B. In light of your answer in A, what would be the maximum payload mass ratio that we could put in the orbit of problem (34) (both with and without gravity effects). If necessary, assume we want to put a 2000 kg mass in orbit and determine the gross lift-off weight (GLOW).