## PART I

| Planet | Minimum $\Delta V$ (km/s) |
|---|---|
| Mercury | 13.4 |
| Mars | 11.6 |
| Jupiter | 14.0 |
| Neptune | 15.8 |
| Escape SS | 42.1 |

The table on the right shows the minimum $\Delta V$ it requires to go from low earth orbit to various planets (Escape SS means leave the solar system). The rocket equation can be rewritten to find how much payload we can lift for a given $\Delta V$ and $u$:

$$\frac{M}{M_0} = e^{-\Delta V/u} = \exp(-\Delta V/u)$$

$M/M_0$ is the fraction of the total rocket mass that is payload. For example, if $M/M_0 = 0.05$ that means that 5% of the rocket's mass can be payload.

For each of the worlds above, calculate what fraction of your rocket can be payload if you want to get to that world. Assume that $u = 3$ km/s. Express your answers in percentages (*i.e.* 5%). Show your work!

**Hint**: Try typing exp(-1.1/2.0) into Google (1e6 = $1 \times 10^6$ = 1,000,000. 1e-6 = $1 \times 10^{-6}$ = 0.000001)

**Mercury**:

**Mars**:

**Jupiter**:

**Neptune**:

**Escape SS**:

## Part II

Take a look at the notes for last Friday's lecture

http://www.astro.washington.edu/users/smith/Astro105/Lectures/Physics/Slide0.html

Determine how long it would take an astronaut to fall from a height of 2 meters on the Moon. Compare this time to the time it would take the astronaut to fall the same 2 meters on the Earth. Also, compare the time to the time it would take on the surface of the asteroid Vesta (g = 0.22 $m/s^2$). Make sure to show your work!

**Due: Fri Jan 18 in class (−2% for every hour late)**