Astronomy 105 Homework #1 Due: Wed Jan 13 in class

Answer all question on the back of this page (or on a separate sheet). Please be as neat as you can. Show all work, including units. Circle your final answer clearly.

Getting to Space

There is no obvious boundary between where the Earth's atmosphere ends and space begins. But since this is a class about sending people into space, let us use the the definition that the United States uses. To be designated an astronaut, you must travel above an altitude of 80 km (80,000 meters).

In order to throw and object, straight up, to a height **h**, you have to throw it with a velocity **v**:

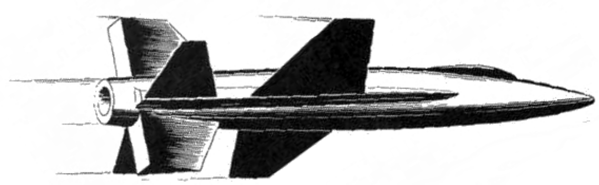
$$v = \sqrt{2gh}$$

where **g** is the acceleration due to gravity of the Earth (g = 9.8 m/s^2). The velocity **v** is measured in meters per second (m/s) and the height **h** is in meters (m). Air resistance is ignored.

1 (5 pts) Calculate how fast you have to throw someone, straight up, to make them an astronaut.

2 (3 pts) Express your calculated speed in miles-per-hour. 1 m/s = 2.24 mph.

3 (2 pts) The fastest airplane (really rocket-plane) was the X-15 with a top speed of about 4,000 mph. Could the X-15 go to space?



The rocket equation can be rewritten to find how much payload we can lift if we are given a value for ΔV and u. **Payload Fraction** is the fraction of the total rocket mass that is payload. A value of 0.05 that means that 5% of the rocket's mass can be payload.

$$\text{Payload Fraction} = e^{-\Delta V/u} = \exp(-\Delta V/u)$$

4 (5 pts) Calculate the Payload Fraction of a rocket that is just able to make a person an astronaut. Assume that u = 2,300 m/s.