Atoms to Universe
Physics 340
Assignment 3

1)Compound motion: Consider Galileo's description of a body which both falls and travells horizontally at the same time. Assume that horizontally the body travels 1 cm in a unit of time and vertically it falls .5 cm in the first unit of time. Plot the trajectory of the body for at least 5 units of time.

2) Give Galileo's argument that all bodies fall in the same way "in the void". If you take into account the air, do you expect bodies to behave in thesame way? What effect (qualitatively) would you expect the air to have on the falling of different bodies?

3) Why was Galileo's theory of tides in contradiction with his theory of "relativity".

4) Two bodies, one with mass twice that of the other, travel toward each other. You have measured that if the heavier one has a speed of 1m/sec and the lighter has a speed of 2m/sec, both directed toward the collision point, the heavier one bounces back with a speed of 1m/sec, and the light one bounces back with a speed of 2m/s. Use Huygen's argument to determine what would happen if the light one hit the heavier one, which is at rest, with a speed of 3m/sec. What would the speed and direction of the boat need to be for the person in the boat to see the original collision as having these values?

5) With what speed would a canon ball have to travel just above the surface of the earth (assuming the earth to be a perfect sphere) so as to have its centrifugal acceleration to be just equal to the Galileo's falling acceleration? (Remember that Huygens showed that the centrifugal acceleration is the velocity squared over the radius of the circle, and Galileo's acceleration down to the earth at the earth's surface is 10m/(second squared) . How long would it take such a canon ball to circle the earth? Compare this to how long it takes the International Space Station to circle the earth? (You can look that up on Wikipedia).

[Brief table of commonly used prefixes: n = nano = 10^{-9} = 1/1,000,000,000
μ = micro = 10^{-6} = 1/1,000,000
m = milli = 10^{-3} = 1/1,000
c = centi = 10^{-2} = 1/100
d = deci = 10^{-1} = 1/10
h = hecta= 10^{2} = 100
K = kilo = 10^{3} = 1000
M = Mega = 10^{6} = 1,000,000

G = giga = 10^9 = 1,000,000,000]

It is interesting that in scientific notation, names are given only up to Y= Yotta= 10^{24}, whereas in classical Japanese there are names for numbers at least all the way up to 10^{52}.

http://en.wikipedia.org/wiki/Japanese_numerals.

(The Japanese use 10000=10^4 as the multiple for names, rather than our 1000.) Why in the 16th century anyone would need to give such a large number a name I do not know. This aside is of course totally irrelevant to the course.