# Homework 1

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## 1. INTRODUCTION

This homework concerned the basics of python and involved applying these basics to physics problems. In this homework we covered recursion, loops ,and user defined functions.

## 2. 2.2

**Part A**
Problem 2.2 involved determining the necessary distance a satellite must be from the surface of the earth in order for it to revolve the earth in a given amount of time. This was derived using Gravitational Force and Centripetal force, setting them equal to one another, and solving for the height of the satellite.We derived this by

$$\begin{aligned}
\text{Gravitational Force} &= \text{Centripetal Force} \\
\frac{GM_{earth}M_{satellite}}{(R+h)^2} &= M_{satellite}\frac{v_{satellite}^2}{r} \\
\frac{GM_{earth}}{(R+h)^2} &= \frac{4\pi^2(R+h)}{T^2} \\
\frac{GM_{earth}}{(R+h)^3} &= \frac{4\pi^2}{T^2} \\
\frac{GM_{earth}T^2}{4\pi^2} &= (R+h)^3 \\
(\frac{GM_{earth}T^2}{4\pi^2})^{\frac{1}{3}} - R &= h \\
h = (\frac{GM_{earth}T^2}{4\pi^2})^{\frac{1}{3}} - R
\end{aligned}$$

**Part c** I found that it is impossible for a satellite to orbit earth in 45 minutes from just gravity alone because my code outputted a negative height. This would imply that the satellite would have to be within the earth to travel fast enough to orbit it in 45 minutes.
**Part d** The sidereal day is shorter than the solar day because you don't have to travel the extra distance caused by the earth revolving around the sun. As a result, there was a difference of 82147.84 meters between the two heights with the sidereal day having the shorter height of 35855910.17617497 meters.

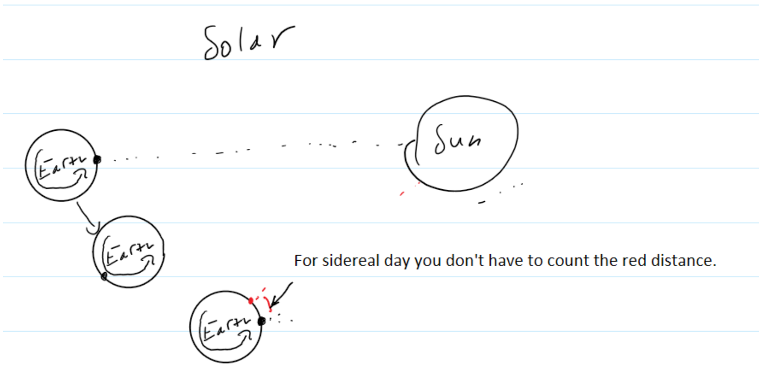


FIG. 1: The sidereal day is shorter than the solar day because you don't have to travel the extra distance caused by the earth revolving around the sun.

## 3. 2.10

This code involved computing the Binding energy of an atomic nucleus with atomic number Z and Mass number A. I found the binding energy of an Atom with $A = 58$ and $Z = 28$ to be $497.56 MeV$. The binding energy per nucleon was $8.70 \frac{MeV}{Nucleon}$. I then modified my code to find the most stable A for a given Z. For the case of $Z = 28$ the most stable stable A was 63.070. When iterating through all Z's and A's I found the max binding energy to be at Z=36 with 8.70 $\frac{MeV}{Nucleon}$.

## 4. 2.13

All the values are reported in the code after you run it. I found the 100th Catalan number to be 8.965e+56. I also found the greatest common divisor between 108 and 192 to be 12. This was done by using a recursive technique where the function repetitively called itself until a base case was reached.

## 5. CONCLUSIONS

Overall this homework was very instructive. I would have liked more hints for problem 2.2 and I would have liked if problem 2.13 required you to find the recursive formula yourself instead of simply giving it to you.