HW1 Readme

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1 Readme

2 Question 1

Import matplotlib and numpy packages for the code and to make the graph for part e.

1a: A function for the binding energy is given within the code. The value for a5 can be determined by inputting the desired values for A and Z into the binding energy function.

1b: A function for the binding energy per nucleon is given. Binding energy and binding energy per nucleon can be calculated by giving values for A and Z. A print statement will state the binding energy and binding energy per nucleon based on your input A and Z values.

1c: A function for an input value of Z is used to determine the most stable nucleus with a given atomic number Z. The program will ask the user for an atomic number (Z) and run that value through a function to calculate an A value from Z to 3Z. The program will give out the most stable nucleus for the user's inputted atomic number.

1d: A function is used to run through atomic numbers (Z) from 1 to 100 and output the stable nucleus value (A). It will also produce the most stable nucleus (A) and it's corresponding binding energy per nucleon.

1e: A graph is then produced with the atomic number on the x-axis and binding energy per nucleon on the y-axis.

3 Question 2

For question 2, we import numpy to use for the square root part of the equation.

2b: For part b, we can solve the inverse of the quadratic equation by taking our quadratic equation as equal to x as:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

we can then multiply the numerator and denominator by:

$$\frac{-b \mp \sqrt{b^2 - 4ac}}{-b \mp \sqrt{b^2 - 4ac}} \tag{2}$$

To give us this expression:

$$x = \frac{-b \mp \sqrt{b^2 - 4ac}}{2a} * \frac{-b \mp \sqrt{b^2 - 4ac}}{-b \mp \sqrt{b^2 - 4ac}} \tag{3}$$

Our results will cancel out most of the values in the numerator and denominator leaving us with:

$$x = \frac{4ac}{-2a(b \mp \sqrt{b^2 - 4ac})} = \frac{2c}{-b \mp \sqrt{b^2 - 4ac}} \tag{4}$$

2c: For the given equations, our first solution for the quadratic equation gives us a large error. This is fixed with a more exact solution for the first solution of the inverse quadratic equation. By combining both the first equations of the quadratic and inverse quadratic, we can produce a more precise and accurate solution to the given values of a, b, and c.

4 Question 3

In order to create and run the simulation, the user must install vpython in order to have the code work. This can be done with the following pip install:

pip install vpython

All variables for the six planets of the solar system and the sun are imported from *Computational Physics, pg. 119* and the Astronomical Units the planets are away from the sun via *jpl.nasa.gov*.

Each celestial body is created into a sphere from the vpython package and put at a certain distance away from the Sun, making the sun the point of origin. A while loop is then introduced to simulate each planets change in position around the sun. The code, however, is not operational for the simulation due to unknown reasons.