Assignment1

Shufan Xia
(Dated: January 2020)

1. 2.10

a) The binding energy of an atom with A = 58 and Z = 28 is 4.982MeV.
b) The binding energy per nucleon of an atom with A = 58 and Z = 28 is 8.58MeV
c) For an atom with Z=28, the atomic mass number for the most stable nucleus A is 62 and the value of the largest binding energy per nucleon is 8.70MeV.
d) At Z = 28 and A = the maximum binding energy per nucleon occurs and the binding energy per nucleon is 8.70MeV.

For each part of this question, I used a function I defined in the previous section. In part a), I used *if* control flow to check the condition that whether A and Z is odd or even when defining the constant a_5. For part c), I used *for* loop to iterate the possible value of A, and append the result of binding energy per nucleon in a list. When the loop stops, the program find the maximum value in the list, and the index of the maximum value can used to find the corresponding A value by adding Z. For part d), it is similar to part c, but this time the program iterates through a list of possible Z value, and store the result of part c) for each Z in a list. After the loop ends, the program return the maximum value of B/A, and index+1 in the list is the corresponding Z value.

2. 2.13

The 100^th Catalan number is 89651994709013167... = 8.965×10^{56}

I used recursion. The base case is n=0 and the program will return 0. If $n \neq 0$, the Catalan number is $\frac{4n-2}{n+1}$ multiply the result of $C_(n-1)$. With each recursion call, n is decreased by 1 and gets closer to 0. When n=0 (reaches the base case), the program ends the recursion and returns the result.

3. 2.6

a) Because of energy conservation:

$$\frac{1}{2}mv_2^2 - G\frac{mM}{l_2} = \frac{1}{2}mv_1^2 - G\frac{mM}{l_1} \tag{1}$$

For a quadratic equation, we can use

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

to find the two roots of the equation. The two roots are

$$\frac{-GM}{v_1 l_1} \pm \frac{\mid GM - v_1^2 l_1 \mid}{v_1 l_1}. \tag{3}$$

Regardless of if $GM \geq$ or $\leq v_1^2 l_1$, the two roots simplify to v_1 and $\frac{2GM}{v_1 l_1} - v1$. We also know

$$v_1 l_1 = v_2 l_2, l_1 < l_2 \tag{4}$$

so v_2 must be smaller than v_1 Therefore, the smaller roots of Eq1 is the solution for v_2.

c) For Earth's orbit, the aphelion distance is 1.5236×10^{11}m and the velocity at aphelion is 2.9262×10^4m/s. The orbital period is 1.00 year and orbital eccentricity is 1.7214×10^{-2}. For the orbit of Halley's comet, the aphelion distance is 5.2985×10^{12}m and the velocity at aphelion is 9.0389×10^2m/s. The orbital period is 76.43 year and orbital eccentricity is 9.6739×10^{-1}.

This question is nothing really special. The program first asks user inputs and read the inputs as float numbers. Then it just defines all variables based on the equations given, and prints out the results in scientific notation.

4. SURVEY QUESTION

The homework took 6 hours I learned using *if* flow and *for* loop and *recursion* in programming, formatting numbers(how many significant digits, scientific notation?) when they are printed, and calling already defined functions in a program, which was the most interesting part for me because it makes longer programs much cleaner. The problem set for this week is just right as it touched on all three big ideas.