UNIV199 Introduction to Programming with Python
Homework #5

Due: December 14, 2022, Wednesday, 23:59.
Functions: Artemis Mission

By 2024, NASA plans to land the first woman and the first person of color on the Moon with the Artemis lunar exploration mission. Write a Python program that calculates the mission duration and the velocity required for the launch of the Artemis spacecraft.

There are two types of spacecrafts available: Orion and Hermes. Information on the technical specifications of both spacecrafts is given in the table below.

	Orion	**Hermes**
Cargo payload	20 to 100 (both included)	40 to 200 (both included)
Crew capacity	2 to 6 (both included)	2 to 10 (both included)
Mass	35000	65000
Volume	30	60

First of all, there are two constant values you need to use, which are Earth gravity and orbit constant. Define them at the top of your program. The values of these constants are as follows.

$$earth\_gravity = 9.807$$
$$orbit\_constant = 2.5$$

Next, you should write three functions: *launch_velocity*, *mission_duration*, and *validate*.

launch_velocity function
This function should receive three parameters: *spacecraft type*, *cargo payload*, and *crew capacity*. It needs to calculate the launch velocity using one of the formulas below based on the input spacecraft. The function should return the velocity of the spacecraft.

> For **Orion**:

$$launch\ velocity = 60.2 \times \frac{mass + cargo\ payload + (crew\ capacity \times 80)}{earth\ gravity \times \sqrt{volume}}$$

> For **Hermes**:

$$launch\ velocity = 50.7 \times \frac{mass\ +\ cargo\ payload\ +\ (crew\ capacity\ \times\ 100)}{earth\ gravity\ \times\ \sqrt{volume}}$$

_mission_duration_ function

This function should get only one parameter named *launch velocity*, and it should calculate the mission duration using the formula given below. The type of the spacecraft is not important for this part. The function should return the calculated duration.

$$mission\ duration = \frac{orbit\ constant\ \times\ 384400}{launch\ velocity}$$

validate function

This function will be used to validate whether the user enters an acceptable value or not. It needs to receive three arguments as well: *value*, *lower limit*, and *upper limit*. Based on upper and lower limits, it should check if the entered value is valid:

- o If the value is valid, the function should return that value.
- o If the value is invalid, it should print 'You have entered an invalid value.' and ask the user to enter the value again until it's valid and return that valid value.

After defining your constants and functions, you need to ask the user the type of spacecraft they want. If the user enters a value different from the available options (Orion: 1 or Hermes: 2), you should keep asking until a valid input is entered.

Similarly, you should ask the cargo payload and the crew capacity again and again until you get valid inputs. For each input (cargo payload and crew capacity), you are expected to use the **_validate_** function. Use the cargo payload and crew capacity rows in the table for upper and lower limits.

Then, you should call the **_launch_velocity_** function to calculate the spacecraft velocity. Using the returned value of the **_launch_velocity_** function, you should call the **_mission_duration_** function to calculate the duration.

Lastly, you should print the launch velocity and mission duration of the spacecraft on the screen. A sample program output is given on the next page.

The program output should be as follows (bold entries are sample input). Please keep in mind that slightly different results are acceptable.

Please enter the type of the spacecraft [Orion: 1/Hermes: 2]: **3**
Invalid spacecraft type.
Please enter the type of the spacecraft [Orion: 1/Hermes: 2]: **1**
Please enter the cargo payload: **50**
Please enter the crew capacity: **4**
Launch velocity of Orion spacecraft is 39640.100639313925 km/h.
Mission duration of Orion spacecraft is 24.243127149049354 days.

Please enter the type of the spacecraft [Orion: 1/Hermes: 2]: **2**
Please enter the cargo payload: **300**
You have entered an invalid value.
Please enter again: **-25**
You have entered an invalid value.
Please enter again: **150**
Please enter the crew capacity: **6**
Launch velocity of Hermes spacecraft is 43882.55602857169 km/h.
Mission duration of Hermes spacecraft is 21.899362456788026 days.

Please enter the type of the spacecraft [Orion: 1/Hermes: 2]: **1**
Please enter the cargo payload: **20**
Please enter the crew capacity: **0**
You have entered an invalid value.
Please enter again: **2**
Launch velocity of Orion spacecraft is 39427.16258103093 km/h.
Mission duration of Orion spacecraft is 24.374059330923128 days.

Please enter the type of the spacecraft [Orion: 1/Hermes: 2]: **2**
Please enter the cargo payload: **200**
Please enter the crew capacity: **10**
Launch velocity of Hermes spacecraft is 44182.89291393835 km/h.
Mission duration of Hermes spacecraft is 21.75049972105457 days.

Save your program as **hw05*yoursurname*.py**. Upload your file to Blackboard at "Homework 5".

Make sure you place comments in your program. Place your name, ID as comments at the top. **You should only use the features and commands you have learnt until this homework was given**. You are especially not allowed to use BREAK, RETURN, QUIT or any other statement that prematurely stops a loop or your program.