48 + 52 + 5 - 1 = 104

104/117

separate .py files should be submitted for each problem -1

Homework 1 Write-Up

Petra Budavari*
Haverford College Department of Physics

(Dated: February 8, 2024)

1. EXERCISE 2.2

This exercise used the example of calculating the altitude of a satellite. The satellite is launched into orbit and the code user determines how long an orbit should be in seconds to calculate the altitude after launching.

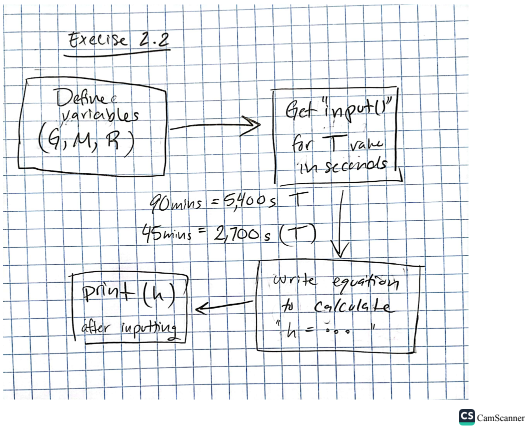

FIG. 1: Flow chart for exercise 2.2 to organize code.

The figure above shows my thought-process when planning the code. Part (c) asks you to calculate the altitude of satellites that orbit the Earth once a day, once every 90 minutes, and once every 45 minutes using the given equation below.

For pt. (a) you must include a deriv-ation of Eq. 1 + need a description of physical context

$$h = \left(\frac{GMT^2}{4\pi^2}\right)^{1/3} - R \quad (1)$$

The answers to Part (c) once inputting the appropriate T values are:

$$h(1\text{day}) \approx 42220540 \text{ meters} \quad (2)$$

$$h(90\text{minutes}) \approx 6643950 \text{ meters} \quad (3)$$

$$h(45\text{minutes})) \approx 4183070 \text{ meters} \quad (4)$$

pt. (c) asks for an explanation of the last result (which is off due to unit conversion error)

*Electronic address: pbudavari@haverford;
URL: Optionalhomepage

In Part (d) it explains that a geosynchronous satellite orbits the Earth every 23.93 hours because a sidereal day is also determined by the Earth's rotational motions, not just it's orbit. This creates a **82,148 meter** different in the altitude of the satellite.
[1]

2. EXERCISE 2.5

In this exercise we calculate the probabilities for transmission (T) and reflection (R) of a particle with mass (m) based on a quantum potential step.

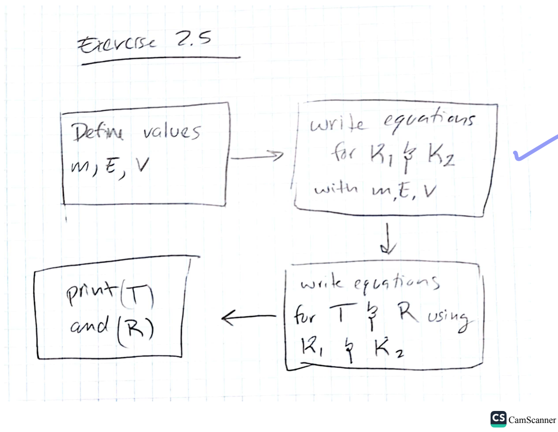

FIG. 2: Flow chart for exercise 2.5.

$$\kappa_1 = \sqrt{2mE}/\hbar \quad (5)$$

$$\kappa_2 = \sqrt{2m(E-V)}/\hbar \quad (6)$$

Equations (5) and (6) show the how the wavevectors are determined by the initial kinetic energy (E) and the potential energy (V).

$$T = \frac{4\kappa_1\kappa_2}{(\kappa_1+\kappa_2)^2} \quad (7)$$

$$R = \left(\frac{\kappa_1-\kappa_2}{\kappa_1+\kappa_2}\right)^2 \quad (8)$$

After plugging in the suggested values for E =10 and V=9, I used Equ. (7) and (8) to solve that the transmission probability (T) is 73% and the reflection probability

Great explanation!

is 27%. Because calculations in python are not perfect the calculated probabilities are 99.99999999999% rather than 100%.

+5

3. SURVEY QUESTIONS

The homework this week took approximately 3 hours. I learned basic python coding and how to add figures and citations in LaTeX. I thought the problems were fairly interested and at the right level of difficulty.

[1] *Oxford review, sidereal day*, URL https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100504691#:~:text=The%20sidereal%20day%2C%20of%2023,imposed%20on%20its%20rotational%20motion.

Ex 2.2 48/56

Computational Physics/Astrophysics, Winter 2024:

Grading Rubrics [1]

Haverford College, Prof. Daniel Grin

For coding assignments, roughly 56 points will be available per problem. Partial credit available on all non-1 items.

4 1. Does the program complete without crashing in a reasonable time frame? (+4 points)

0 2. Does the program use the exact program files given (if given), and produce an answer in the specified format? (+2 points) All answers should print without an input −1 and answers should have a description such as "altitude for 45 min is ..." −1

3 3. Does the code follow the problem specifications (i.e numerical method; output requested etc.) (+3 points)

5 4. Is the algorithm appropriate for the problem? If a specific algorithm was requested in the prompt, was it used? (+5 points)

4 5. If relevant, were proper parameters/choices made for a numerically converged answer? (+4 points) remember to convert km to m, answers slightly off −1

3 6. Is the output answer correct? (+4 points).

2 7. Is the code readable? (+3 points)

. 5.1. Are variables named reasonably?

. 5.2. Are the user-functions and imports used?

---

[1] Inspired by rubric of D. Narayanan, U. Florida, and C. Cooksey, U. Hawaii

. 5.3. Are units explained (if necessary)? Please comment units next to your variables, and final answer should have units -1

. 5.4. Are algorithms found on the internet/book/etc. properly attributed?

1 8. Is the code well documented? (+3 points)

. 6.1. Is the code author named? Please comment your name at the top of your code -1

. 6.2. Are the functions described and ambiguous variables defined? need more comments describing how your code works -1

. 6.3. Is the code functionality (i.e. can I run it easily enough?) documented?

9. Write-up (up to 28 points)

5 . Is the problem-solving approach clearly indicated through a flow-chart, pseudo-code, or other appropriate schematic? (+5 points)

✓ . Is a clear, legible LaTeX type-set write up handed in?

2 . Are key figures and numbers from the problem given? (+ 3 points) Derivation is missing -1

4 . Do figures and or tables have captions/legends/units clearly indicated. (+ 4 points)

3 . Do figures have a sufficient number of points to infer the claimed/desired trends? (+ 3 points)

0 . Is a brief explanation of physical context given? (+2 points) physical context not given -2

1 . If relevant, are helpful analytic scalings or known solutions given? (+1 point)

3 . Is the algorithm used explicitly stated and justified? (+3 points)

2 . When relevant, are numerical errors/convergence justified/shown/explained? (+2 points)

2 . Are 3-4 key equations listed (preferably the ones solved in the programming assignment) and algorithms named? (+2 points)

1 . Are collaborators clearly acknowledged? (+1 point)

2 . Are any outside references appropriately cited? (+2 point)

EX. 2.5 52/56

Computational Physics/Astrophysics, Winter 2024:

Grading Rubrics [1]

Haverford College, Prof. Daniel Grin

For coding assignments, roughly 56 points will be available per problem. Partial credit available on all non-1 items.

4 1. Does the program complete without crashing in a reasonable time frame? (+4 points)

1 2. Does the program use the exact program files given (if given), and produce an answer in the specified format? (+2 points) Answers should include descriptions such as "transmission probability is …" −1

3 3. Does the code follow the problem specifications (i.e numerical method; output requested etc.) (+3 points)

5 4. Is the algorithm appropriate for the problem? If a specific algorithm was requested in the prompt, was it used? (+5 points)

4 5. If relevant, were proper parameters/choices made for a numerically converged answer? (+4 points)

4 6. Is the output answer correct? (+4 points).

2 7. Is the code readable? (+3 points)

. 5.1. Are variables named reasonably?

. 5.2. Are the user-functions and imports used?

---

[1] Inspired by rubric of D. Narayanan, U. Florida, and C. Cooksey, U. Hawaii

. 5.3. Are units explained (if necessary)? please comment units next to your variables -1

. 5.4. Are algorithms found on the internet/book/etc. properly attributed?

1 8. Is the code well documented? (+3 points)

. 6.1. Is the code author named? please comment your name at the top of your code -1

. 6.2. Are the functions described and ambiguous variables defined? need more comments describing how your code works -1

. 6.3. Is the code functionality (i.e. can I run it easily enough?) documented?

9. Write-up (up to 28 points)

5 . Is the problem-solving approach clearly indicated through a flow-chart, pseudo-code, or other appropriate schematic? (+5 points)

✓. Is a clear, legible LaTeX type-set write up handed in?

3 . Are key figures and numbers from the problem given? (+ 3 points)

4 . Do figures and or tables have captions/legends/units clearly indicated. (+ 4 points)

3 . Do figures have a sufficient number of points to infer the claimed/desired trends? (+ 3 points)

2 . Is a brief explanation of physical context given? (+2 points)

1 . If relevant, are helpful analytic scalings or known solutions given? (+1 point)

3 . Is the algorithm used explicitly stated and justified? (+3 points)

2 . When relevant, are numerical errors/convergence justified/shown/explained? (+2 points)

2 . Are 3-4 key equations listed (preferably the ones solved in the programming assignment) and algorithms named? (+2 points)
1 . Are collaborators clearly acknowledged? (+1 point)
2 . Are any outside references appropriately cited? (+2 point)