Homework 1 Write-Up

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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.

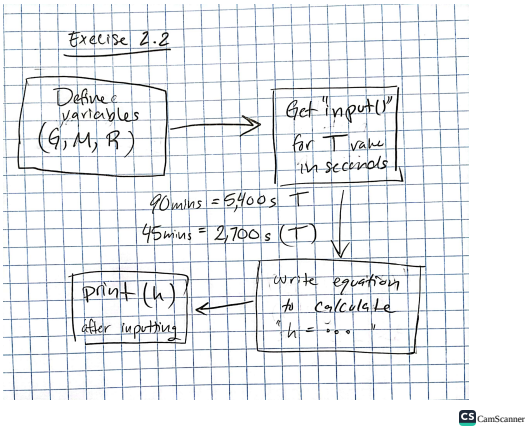

FIG. 1: Flow chart for exercise 2.2 to organize code.

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.

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

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

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

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

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

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.

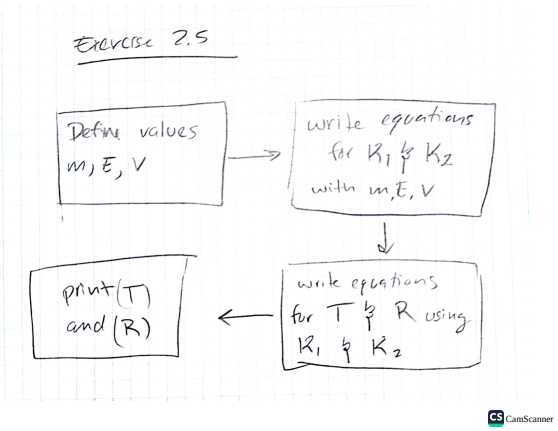

FIG. 2: Flow chart for exercise 2.5.

$$\kappa_1 = \sqrt{2mE}/\hbar \tag{5}$$

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

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

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

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

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

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

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.