**Pseudocode**

START PendulumSimulation

INPUT ‘input initial angular speed’

INPUT ‘input initial position (rad)’

INPUT ‘input pendulum length (metres)’

INPUT ‘input gravitational acceleration’

time(1) = 0

timestep = 0.01

FOR i = 2:1000

Omega[final] = -(gravitational acc/Length)\*sin(theta[initial])\*timestep + omega[initial]

Theta[final] = Omega[final]\*timestep + theta[initial]

Time[final] = Time[initial] + timestep

ENDFOR

PLOT( INPUT[time],INPUT[theta] )

Title(STRING[pendulum motion across time])

Xlabel(STRING[time + units])

Ylabel(STRING[theta + units])

Maxima = findpeaks(theta[INPUT])

Gap = diff(maxima)

Period(OUTPUT) = Gap\*timestep

fileName = STRING[excelfilename.xlsx]

Convert time, theta and omega arrays to column vectors

WRITEMATRIX labels top row

WRITEMATRIX time array first column

WRITEMATRIX theta array second column

WRITEMATRIX omega array third column

WRITEMATRIX period 4th column

WRITEMATRIX gravity 5th column

WRITEMATRIX length 6th column

**Testing**

Introduction:

This program simulates the motion of a pendulum through simple harmonic motion (SHM) and non-SHM. Its position, speed, length of wire and gravitational acceleration are set by the user and the program outputs a graph of theta against time, showing its motion over time. The period is also calculated and displayed, along with all other data, on a separate excel file. The purpose of this program is to gain a better understanding of SHM and non-SHM by investigating how the variables affect the motion of the pendulum.

Instructions:

The user is prompted to input 4 variables, which are needed to calculate the motion of the pendulum. These are the initial angular speed (omega in rad/s), position (theta in rad), pendulum string length (in metres) and gravitational acceleration (in case the user would like to simulate this motion in a different planet such as mars). After entering the values, the user is presented with a graph showing the motion of the pendulum. The accompanying data is written over to an excel file to which the user is notified. There they can find the full list of outputs including the period.

Input Testing:

|  |  |  |
| --- | --- | --- |
| **Input** | **Result** | **Comments** |
| Letters instead of numbers for input prompts.  (omega = L) |  | Does not recognise letters as valid inputs for omega. Same for other 3 prompts. |
| Symbols for input prompts |  | Input is “invalid”. Asks for same input again. |
| All inputs Negative numbers |  | Graph seems to be ‘flipped’ upside-down. Also flipped laterally. Shape of graph is identical to positive version besides this. |
| Only omega is negative |  | Graph is flipped laterally. Otherwise, shape is identical to positive counterpart. |
| Only theta is negative |  | Graph flipped vertically. Otherwise shape identical to positive counterpart. |
| Only length is negative |  | Wave oscillates between about 1.5 and 4.75. It positive counterpart would oscillate between 2.5 and -2.5 |
| Only gravitational acceleration is negative |  | Same result for graph as previously when only length was negative. Point of oscillation changed. |
| Forward and backward slash for inputs |  | N/A |

Output testing

|  |  |  |
| --- | --- | --- |
| **Test** | **Result** | **Comments** |
| Identify whether at low amplitudes where SHM occurs, calculations agree with program output. : Period | This is in agreement with calculation of period of pendulum in SHM made using T = 2\*pi\*sqrt(1/9.81) | Output = 2.05  Calculation = 2.01  The program is off by 0.04. |
| High omega value |  | Non-SHM |
| High theta value |  | SHM  Y axis scale changes |
| Valid numbers to test expected output |  | Outputs expected graph.  Initial theta value 1, where wave begins.  Sin wave function. |