PHYS 371 - Assignment I

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I. INTRODUCTION

A. Question I

A quantum square well with equations for calculating energy levels was administered. The equations could not be exactly solved, yet approximates of energy levels were looked for.

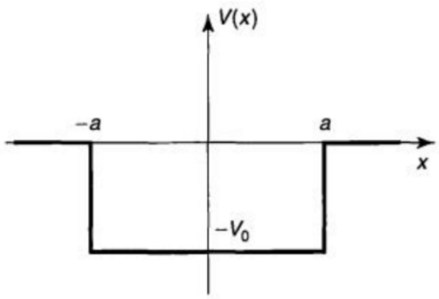

FIG. 1. Taken from Question 1.

B. Question II

Two spring system seen as below has been administered to find its static equilibrium point $\vec{F} = -\nabla V = 0$ for part(a) using given equation below.

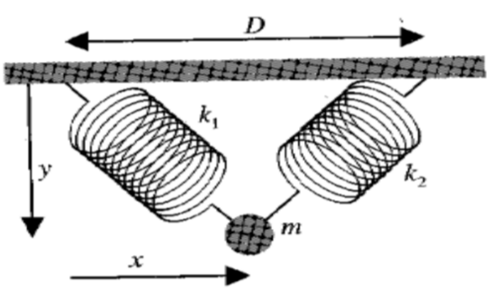

FIG. 2. Taken from Question 2.

$$V(x, y) = \frac{1}{2}k_1(\sqrt{x^2+y^2} - L_1)^2 + \frac{1}{2}k_2(\sqrt{(x-D)^2+y^2} - L_2)^2$$

II. METHOD

A. Question I

Firstly, constants were defined and equations were scripted in (non-symbolically). Then after seeking solutions with `vpasolve()`, a numerical approach seemed more fit. A `linspace()` of possible energy levels ($-13.6 < E < 0$ eV) was formed. Combination of 2 `for` and `if` conjunctions were facilitated to collect 10 approximate energy levels. The key was to use a `linspace()` as big as possible and an error as low as possible, resulting in desired number of answers only (hopefully).

B. Question II

Firstly, constants were defined here too and equation given have been formed symbolically in MATLAB®. Afterwards a `for` loop was set for length of k_2 as it wouldl be required in part(b). Within the loop, potential was calculated and then its `gradient()` was taken. As the initial approach `solve()` function was tried to have an exact solution, yet it was pointless. However, that trial led MATLAB®to suggest `vpasolve` for a numerical approach, and that worked marvelously. There as `solution.x` and `solution.y` laid the coordinates to the static equilibrum. Plotting these was the main objective in part(b), which was accomplished using the `for` loop mentioned.

III. VERIFICATION OF THE PROGRAM

For this project verifications were left aside, having trust in computers results.

IV. DATA

A. Question I

Running the code would provide with energy levels seeked.

B. Question II

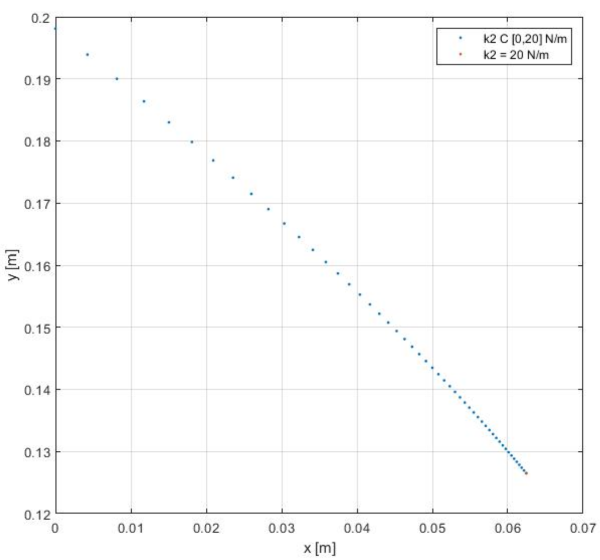

FIG. 3. x versus y for different k_2 values

V. ANALYSIS

A. Question I

There was a flow for the algorithm written. That it could find as many possible levels as there are for first equation to be cheked, yet the second logic run for finding oter levels with the second equation was flawed since it did not over-write first values , leaving some possible error. However the quite small accuracy resulted in both equations finding same levels and leaving the second run with practically no reason.

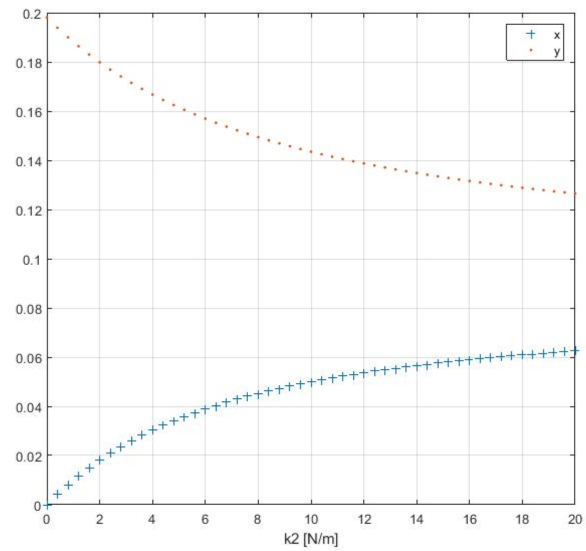

FIG. 4. k_2 versus x, y

B. Question II

As k_2 increased, x increased and y decreased to accommodate for the stronger pull of spring to the right, as expected. As of accuracy, 6 significant figures default for floating numbers in MATLAB®was a bit overkill, as $g = 9.81$ and other constants only have one significant figure. Yet calculations carried out would not have an effect if constants were reliable to that degree.