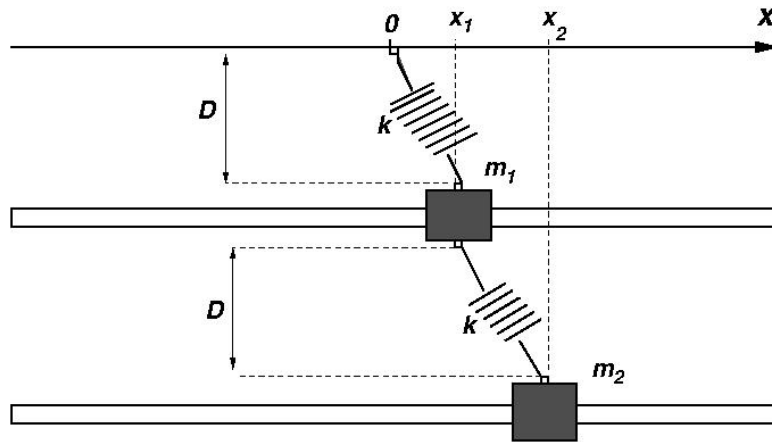


Phys 124 - Freshman Project
Spring 2025
Simulation Homework I

Two masses are free to slide horizontally without friction on the bars as shown in the figure. They are connected to one another and the origin with springs of stiffness k . The length of the springs when they are neither compressed or stretched is equal to the separation D between the masses. You can use the following parameters for the simulation of the motion of this system:

$$\begin{aligned} D &= 10 \text{ cm} \\ m_1 &= 0.1 \text{ Kg} \\ m_2 &= 0.2 \text{ Kg} \\ k &= 100 \text{ N/m} \end{aligned}$$



Construct a computer code to simulate the motion of the masses, assuming that they were both initially at rest at time $t = 0$. Place the masses some initial positions of your own choice such that they start moving. Make plots of the x_1 and x_2 coordinates versus time for a few periods of oscillation.

As an example, my code contains

```
import matplotlib.pyplot as plt
import numpy as np

#####
# Double pendulum

plt.clf()

n = 5000
dt = 0.0005

D=0.1
k=100.

mass1= 0.1
mass2= 0.12

x1=[]
x2=[]

t=[]

# My initial conditions:
x1.append(0.1)
x2.append(0.11)
t.append(0.)

v1=0.
v2=0.

for i in range(1,n):
    x1.append(<new x1-value due to v1>)
    x2.append(<new x2-value due to v2>)
    t.append(<new t-value>)
# separation of the masses:
    d1 = <calculate distance of m1 from origin>
    d2 = <calculate the distance between m1 and m2>
# force from spring:
    F1 = <force developed by the first spring>
    F2 = <force developed by the second spring>

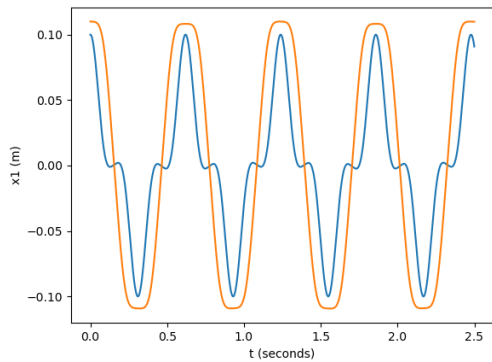
    v1 = v1 + dt* . . . <update v1 due to F1 and F2>
    v2 = v2 + dt* . . . <update v2 due to F2>

plt.plot(t,x1)
```

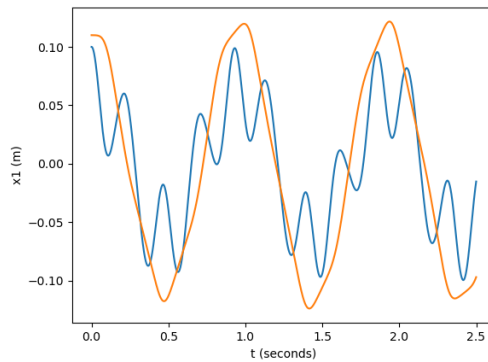
```
plt.plot(t,x2)
plt.xlabel("t (seconds)")
plt.ylabel("y (m)")

plt.show()
```

My program gives the plots



For $m_1 = 0.1$ Kg and $m_2 = 0.12$ Kg



For $m_1 = 0.1$ Kg and $m_2 = 0.33$ Kg

You can check that the size of the timestep (Δt) strongly influences the accuracy of the solution.

Please display your results in a PDF manuscript format, using the double-column format of the APS journals and submit it through the Moodle system.

An example LaTeX file is provided through the assignment page to serve as a template which you can modify for your assignment.