Phys 124 - Freshman Project
Spring 2023
Simulation Homework II

Little Prince[1] wants to kick a ball at a 45^o angle relative to his planet so that it lands exactly on the opposite side. With what velocity should he kick the ball? The following data is available for the problem:
radius of the planet = 3 meters
density of the planet = 4×10^3Kg/m^3

Construct a computer code to simulate the motion of the ball. Plot the x and y coordinates of the ball. Your code should track the ball until it hits the surface of the planet. Adjust the initial velocity so that you get as close to the target point as possible. Report your optimal velocity, how close you could get to the target point, and the flight time. (You may to study the example problem "Planet Tracectory" on the web page http://www.fen.bilkent.edu.tr/ yalabik/Phys_124/Simulation/)

[1]Figure modified from https://bookstr.com/article/celebrating-79-years-of-the-little-prince/

As an example, my code contains

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

# Little Prince plays ball
plt.clf()

n = 400000
dt = 0.1
# Gravitational constant:
G=6.6743e-11
# Radius
R=3.0
# Density
Rho=4000.0
# Mass
M = 4*np.pi * R**3 *Rho /3.
# Acceleration prefactor
Pre = G*M

# initial vx=vy for 45-degree takeoff
# adjust this value to get the solution
vx=0.001
vy=vx

x=[]
y=[]

x.append(0.)
y.append(R)


for i in range(1,n):
   x.append(. . .)
   y.append(. . .)
   vx = . . .
   vy = . . .
   if x[i]*x[i]+y[i]*y[i] < R*R :
      break

print("hit the planet at x=",x[i]," y=",y[i], "at time ",i*dt)

plt.plot(x,y)
```

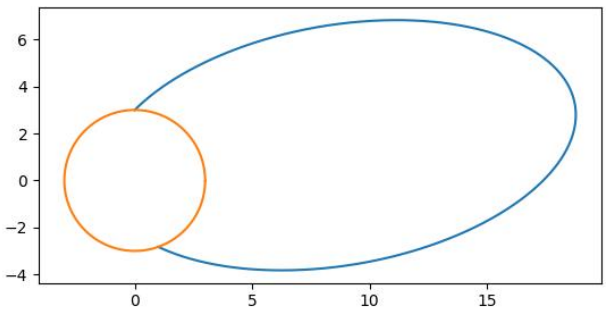
```
# draw a circle for the planet:
xc=[]
yc=[]
for i in range(0,360):
   xc.append(R*np.cos(i*np.pi/180.))
   yc.append(R*np.sin(i*np.pi/180.))

plt.plot(xc,yc)

# next two lines are for getting equal scales in x and y
# directions so that the planet looks like a circle.
axes=plt.gca()
axes.set_aspect(1)

plt.show()
```

My program gives the following plot. Not the final result, but close..



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.