1. Programming on Formula and Standard Mathematical Function

1.1 Aim

- To use Python as a calculator
- To evaluate the trajectory of the Ball Kicked/thrown
- To determine the air resistance of the football using mathematical function.

1.2 Background

In this experiment, we have to use python to:

- Solve a simple mathematical equation.
- Find the trajectory of a ball that is thrown or kicked with an initial velocity vo and making an angle θ

$$y = x \tan \theta - \frac{gx^2}{2v_0^2 cos^2\theta}$$

y = refers to the vertical position of the object in meters
x = refers to the horizontal position of the object in meter

where,

vo= refers to the initial velocity of the object combined with meter per second
g = refers to the acceleration due to gravity that is 9.81 m/ 2
θ = refers to the initial angle from the horizontal plane in degrees or radians.

- Evaluate the air resistance (hard kick velocity and soft kick velocity) on a football.

The formula used are:

Drag force=(drag coefficient *density of air*cross sectional area of football*2)/2

Hard kick velocity=120*speed conversion

Soft kick velocity=10* speed conversion

For the formula of trajectory following URL was used. https://www.toppr.com/guides/physics-formulas/trajectory-formula /

TABLE 1. Data to be used in the Experiment

	Exp. 1.1	**Exp. 1.2**	**Exp. 1.3**
Imported data	pi, exponential, square-root	Pi, tan, cos	Pi
Pre-defined data	m=0, s=2.0, x=1.0	Y0=1, g=9.8 m/s^2	Drag coefficient(dc)= 0.2, Air density(ad)= 1.2, mass(m)= 0.43 kg, g=9.8 m/s^2
User-defined data	None	Degree, 'u', 'x'	None
Formula used	f=1/(sqrt(2*pi)*s) *exp(-0.5*((x-m)/s)**2)	1. rad=(pi/180)*deg 2. u=u/3.6 3. y= (x*tan(rad))+((g*(x**2))/(2*(u * *2)*(cos(rad)**2)))+y0	1. a=pi*0.11**2 2. F=m*g 3. sc=1000.0/3600 4. v=120*sc 5. v=10*sc 6. f=0.5*dc*ad*a*v **2

1.3 Software Used

1. Anaconda Navigator
2. Jupyter Notebook

1.4 Pre Lab Questions

1. What is Python?
2. What is an interpreted Language?
3. What are the supported data types in python

1.5 Procedure

1. After installing anaconda navigator, open anaconda navigator and then select Jupyter Notebook and click on 'Launch'.
2. In Jupyter Notebook click on 'New Launcher' and then single click on 'Python3' under Notebook.
3. Type your program to get the desired output.
4. To view the output, click on 'Run' or press 'Shift+Enter' to execute program of theselected cell. Note: In case of error, refer to the error message and do the required changes.

1.6 Observation

Exp. 1.1

Code:

```
from math import *
m=0
a=2.0
s=1.0
f=1/(sqrt(2*pi)*a)*exp(-0.5*((s-m)/a)**2)
print(f)
```

Output:

```
0.17603266338214976
```

Exp. 1.2

Code:

```
from math import *
y1=1
deg=float(input("Enter the angle="))                    #Taking input for angle in degree
g=9.81
u=float(input("Enter the initial velocity="))           #Taking input for velocity in km/hr
x=float(input("Enter the value of x="))                 #horizontalposition of object in meters

rad=(pi/180)*deg                                        #Converting degree to radian
u=u/3.6                                                 #Converting km/hr to m/sec
y=(x*tan(rad))+((g*(x**2))/(2*(u**2)*(cos(rad)**2)))+y1
print("The trajectory of the ball is=",y)
```

Output:

```
Enter the angle=45
Enter the initial velocity=10
Enter the value of x=2.5
The trajectory of the ball is= 11.446099999999998
```

Exp. 1.3

Code:

```
from math import *
dc=0.2                          #drag coefficient
ad=1.2                          #density of air(kg m^-3)
a=pi*0.11**2                    #football cross sectional area
m=0.43                          #mass of football
g=9.81                          #gravitational acceleration
Fg=m*g
sc=1000.0/3600
v=120*sc                        #hard kick velocity
fd=0.5*dc*ad*a*v**2
print("For hard kick velocity=",v,"the gravitational force is",Fg,"and the drag force is",fd)
v1=10*sc                        #soft kick velocity
fd1=0.5*dc*ad*a*v1**2
print("For a soft kick velocity=",v1,"the gravitational force is",Fg,"and drag force is",fd1)
```

Output:

```
For hard kick= 33.333333333333336 the gravitational force is 4.2183 and the drag force is 5.068436147
791534
For a soft kick velocity= 2.7777777777777777 the gravitational force is 4.2183 and drag force is 0.03
519747324855231
```

1.7 Post Lab Questions

1. Name three features of python.
2. What is Jupyter Notebook?
3. Name the Python IDEs?

1.8 Result

Thus Python was used as a calculator, code was written to evaluate the trajectory of a ball and code was written find air resistance of a football.