Pre-Lab 2

Read through the following tutorials 1-3 and complete the problems. Do not worry about getting every

Tutorial 1 - Beginner's Programming

Problem 1

In the cell provided below create a variable x equal to your favorite number. Print out the variable.

```
#Define the variable
x = 4

#Print the variable
print(x)
```

```
4
```

Problem 2

In the spaces provided below, write a code to determine the kinetic energy of a 10 kg mass going 5 m

The kinetic energy of the mass is 125 kgm^2/s^2

```
# Define the mass
mass = 10

# Define the velocity
velocity = 5

# Calculate K = (1/2) m v^2
K = (1/2) * mass * velocity**2
# Print your result here
print('The kinetic energy of the mass is ' + str(K) + ' kgm^2/s^2')
```

```
The kinetic energy of the mass is 125.0 kgm^2/s^2
```

Problem 3

As an example of these functions, let's calculate the position of a standing wave at some point in tim

x = A * sin(ω t + ϕ)

where A = 5

$\omega = \pi/4$

$\phi = 0.1$

Calculate the position x at t = 0.2,0.5 and 0.6

```
import numpy as np

# Define all of the variables here
A=5
w=np.pi/4.
phi=0.1

# Calculate and print the position at t = 0.2 here

# Calculate and print the position at t = 0.5 here


# Calculate and print the position at t = 0.6 here




t=np.array([0.2,0.5,0.6])
x=A*np.sin(w*t+phi)
print(x)
```

```
[1.27128623 2.3650283  2.70337332]
```

Tutorial 2 - Beginner's Arrays

Problem 4

The following are the x and y coordinates for a number of objects. Run the cell below

```
import numpy as np
positions = np.array([[2., 4.],
             [1., 3.],
             [7., 2.],
             [1., 8.],
             [9., 2.]])
```

Calculate the distances to each of the objects

```
# Separate out the x coordinates here
x=positions[:,0]
#print(x)
# Separate out the y coordinates here
y=positions[:,1]
```

```
y=positions[:,1]
# Calculate the distances
dist = np.sqrt(x**2.+y**2.)
# Print the distances
print(dist)
```

```
[4.47213595 3.16227766 7.28010989 8.06225775 9.21954446]
```

Tutorial 3 - Plotting

Problem 5

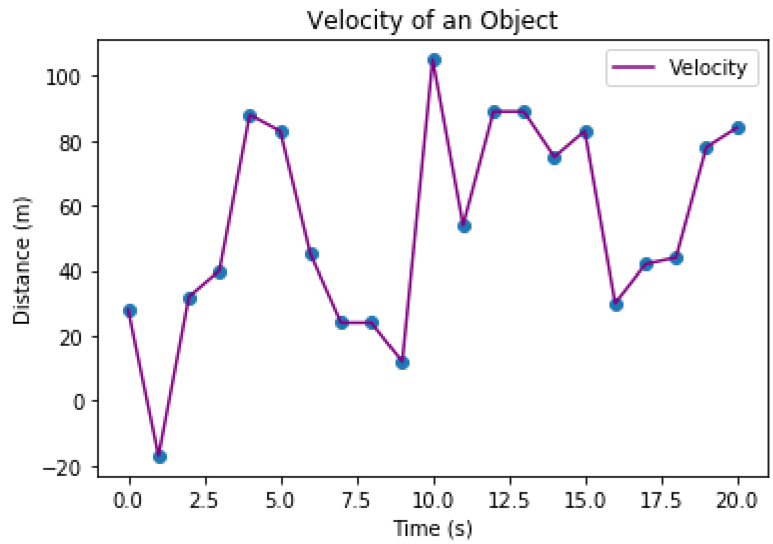
Consider the data array in the cell below.

```
import numpy as np;
# Assume the first element in each object is time in seconds and the second element is positi
data_array=np.array([[0.,28.],[1.,-17.],[2.,32.],[3.,40.],[4.,88.],[5.,83.],[6.,45.],[7.,24.]
```

We see that this numpy array has two columns. Separate out the first one and the second one. Plot a plot (plt.plot). Provide axes labels

```
import numpy as np;
import matplotlib.pyplot as plt
data_array=np.array([[0.,28.],[1.,-17.],[2.,32.],[3.,40.],[4.,88.],[5.,83.],[6.,45.],[7.,24.]

# x-array
t = data_array[:,0] #s
# y-array
pos = data_array[:,1] #m
# Make the scatter plot
plt.scatter(t,pos)

# Make the continuous plot
plt.plot(t,pos, color = 'purple', label = "Velocity")

# Label the x axis
plt.xlabel('Time (s)')
# Label the y axis
plt.ylabel('Distance (m)')
# Give the plots a title
plt.title('Velocity of an Object')

# Create a legend

plt.legend()
```

```
<matplotlib.legend.Legend at 0x7f33afeb15c0>
```



Problem 6

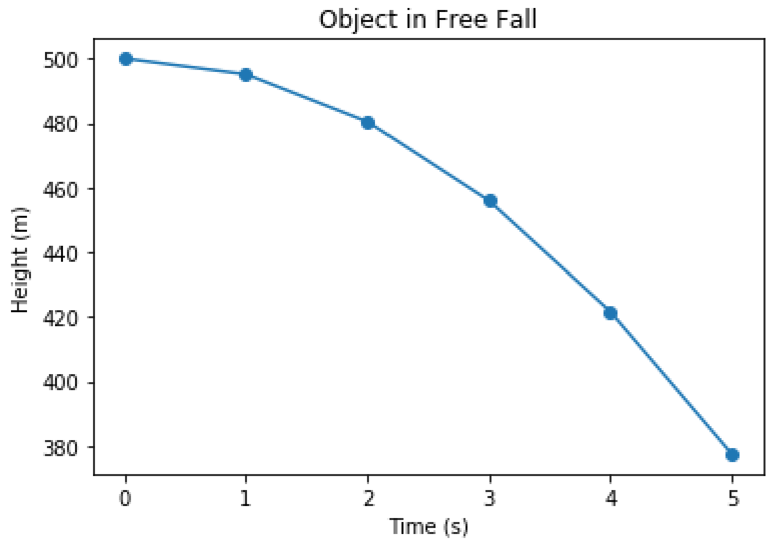
The position of an object in motion can be given by $x = x_0 + ut + \frac{1}{2}at^2$. Plot the position of the ob starting from t=0 to t=5 seconds for the following cases.

1. Object falls freely from a height of 500 metres. Assume acceleration due to gravity as 9.8 m/s^2.
2. Object is thrown upwards at a speed of 10 m/s from a height of 500 metres and then it falls down due to g.
3. Object is thrown upwards at a speed of 20 m/s from a height of 500 metres and then it falls down due to g.

```
#Case 1

import numpy as np;
import matplotlib.pyplot as plt




data_array=np.array([[0., 500.], [1., 495.1], [2, 480.4], [3, 455.9], [4, 421.6], [5, 377.5]]
# x-array
t = data_array[:,0]
# y-array
pos = data_array[:,1]
# Make the scatter plot
plt.scatter(t,pos)

# Make the continuous plot
plt.plot(t,pos)

# Label the x axis
plt.xlabel('Time (s)')
# Label the y axis
```

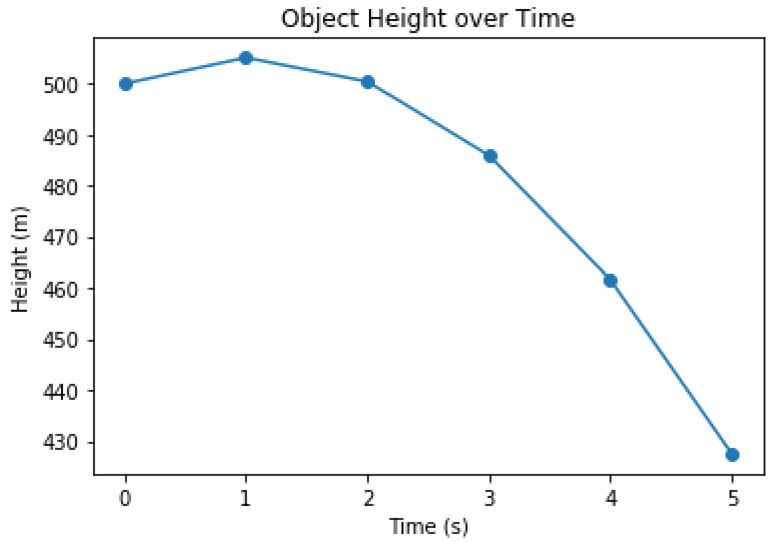
```
plt.ylabel('Height (m)')

# Give the plots a title
plt.title('Object in Free Fall')
```

```
Text(0.5, 1.0, 'Object in Free Fall')
```



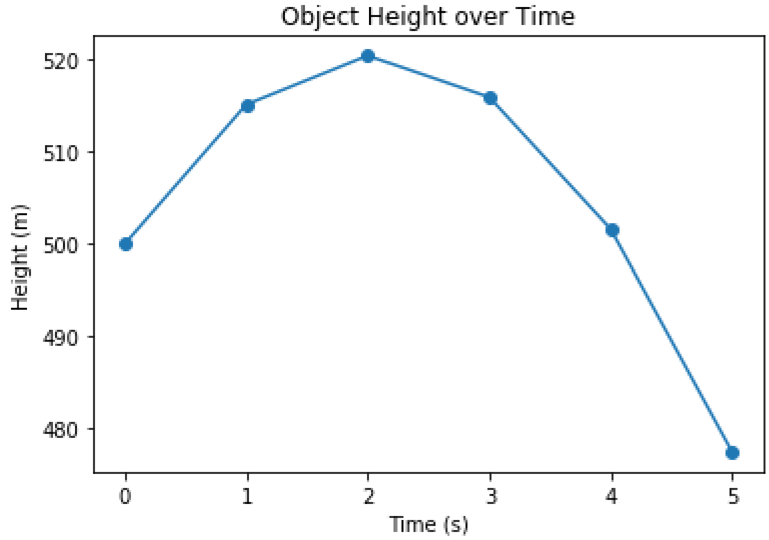

```
#Case 2

import numpy as np;
import matplotlib.pyplot as plt



data_array=np.array([[0., 500.], [1., 505.1], [2, 500.4], [3, 485.9], [4, 461.6], [5, 427.5]]
# x-array
t = data_array[:,0]
# y-array
pos = data_array[:,1]
# Make the scatter plot
plt.scatter(t,pos)

# Make the continuous plot
plt.plot(t,pos)

# Label the x axis
plt.xlabel('Time (s)')
# Label the y axis
plt.ylabel('Height (m)')

# Give the plots a title
plt.title('Object Height over Time')
```

```
Text(0.5, 1.0, 'Object Height over Time')
```




```
#Case 3

import numpy as np;
import matplotlib.pyplot as plt


data_array=np.array([[0., 500.], [1., 515.1], [2, 520.4], [3, 515.9], [4, 501.6], [5, 477.5]]
# x-array
t = data_array[:,0]
# y-array
pos = data_array[:,1]
# Make the scatter plot
plt.scatter(t,pos)

# Make the continuous plot
plt.plot(t,pos)

# Label the x axis
plt.xlabel('Time (s)')
# Label the y axis
plt.ylabel('Height (m)')

# Give the plots a title
plt.title('Object Height over Time')
```

```
Text(0.5, 1.0, 'Object Height over Time')
```



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