Name: Mahad Hameed

Roll no:20K-0338

One Dimension Kinematics

The position of a particle moving in a straight line is given by
X=5 + 2t +4t2-t3
where x is in meter. (a) Find an expression for the Velocity and Acceleration as a function of time. (b) Find the velocity of the particle at t=1 sec

(a)

```
import sympy as sp
sp.init_printing()
t=sp.symbols('t')
position=2*t+4*t**2+t**3+5
velocity=sp.diff(position,t)
acceleration=sp.diff(velocity,t)
```

```
print("The position is : ")
position
```

```
The position is :
```

$$t^3 + 4t^2 + 2t + 5$$

```
print("The velocity is : ")
velocity
```

```
The velocity is :
```

$$3t^2 + 8t + 2$$

```
print("The acceleration is : ")
acceleration
```

```
The acceleration is :
```

$$6t + 8$$

Define Function

```
import math
from scipy.misc import derivative
```

```
def f(x):
    fn=math.sin(x)
```

```
    return fn
```

```
derivative(f,45,dx=0.1)
```

$$0.5244468898338156$$

Find velocity from both numpy and scipy

```
math.cos(45)
```

$$0.5253219888177297$$

```
derivative(math.cos,45,dx=1e-2)
```

$$-0.8508893428794517$$

```
math.sin(45)
```

$$0.8509035245341184$$

```
def position1(t):
  x=2*t+4*t**2+t**3+5
  return x
```

Finding velocity with scipy

```
print("The velocity of the particle at t=1.0 is :" )
derivative(position1,1.0,dx=1e-5)
```

```
The velocity of the particle at t=1.0 is :
```

$$13.000000000129573$$

Finding velocity with numpy

```
import numpy as np
def differentiation(t,h):
 return numpy.subtract(position1(t+h),position1(t))/h
```

```
differentiation(1,0.0000001)#Velocity
```

$$13.000000702589887$$

Free Fall motion

$g = \frac{F}{m}$

$v = g * t$

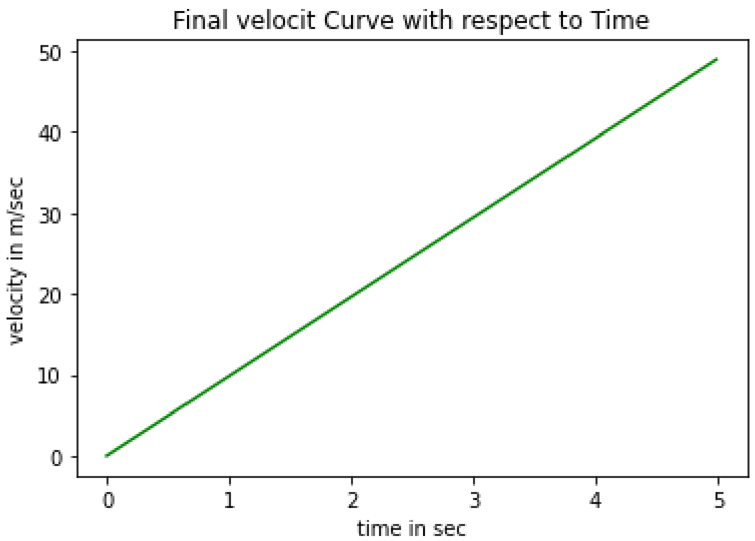
$h = \frac{-1}{2} * g * t^2$

```
np.arange(1,10,0.1)
```

```
array([1. , 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2. , 2.1, 2.2,
       2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3. , 3.1, 3.2, 3.3, 3.4, 3.5,
       3.6, 3.7, 3.8, 3.9, 4. , 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,
       4.9, 5. , 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6. , 6.1,
       6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7. , 7.1, 7.2, 7.3, 7.4,
       7.5, 7.6, 7.7, 7.8, 7.9, 8. , 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7,
       8.8, 8.9, 9. , 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9])
```

```
#input variable:
# tfinal = final time (in seconds)
# output Variables:
# t = array of times at which speed is % computed(in seconds)
# v = array of speeds (meters/seconds)
import matplotlib.pyplot as plt
g=9.81 #accelaration in SI units
tfinal = int(input('Enter final time (in seconds):'))
dt = tfinal/500
t=np.arange(0,tfinal,dt) #creates an array of 501 time values
# the final velocity
V=g*t
# The distance travelled by the object
D = -(0.5*g*t**2)
plt.plot(t,V,'g')
plt.xlabel('time in sec')
plt.ylabel('velocity in m/sec')
plt.title('Final velocit Curve with respect to Time')
plt.show()
```

```
Enter final time (in seconds):5
```




```
plt.plot(t,D,'r')
```

```
plt.xlabel('time in sec')
plt.ylabel('Distance in m')
plt.title('Distance with respect to time')
plt.show()
```