One Dimension Kinematics

the position of a particle moving in a straight line is given by

$$X = 5 + 2t + 4t^2 - t^3$$

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

```
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(Position,t,2)
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 aceleration is: ")
acceleration
```

```
the aceleration is:
```

$$2(3t + 4)$$

Define function

```
import math
from scipy.misc import derivative
def f(x):
 fn = math.sin(x)
 return fn
derivative(f,45, dx =0.1)
```

$$0.5244468898338156$$

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

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

$$-0.8508893428794517$$

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

$$0.8509035245341184$$

```
def position (t):
  x=2*t+4*t**2+t**3+5
  return x
print('the velocity of the particle at t=1.0sec is: ')
derivative(position,1.0,dx=1e-5)
```

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

$$13.000000000129573$$

```
import autograd.numpy as np
from autograd import grad
def f(t):
  x=x=2*t+4*t**2+t**3+5
  return x
f_grad=grad(f)
print('the velocity of particle at t=1sec is: ')
f_grad(1.0)
```

```
the velocity of particle at t=1sec is:
```

$$13.0$$

Free Fall Motion

$g = f/m$

$v = g * t$

$h = -1/2 * g * t^2$

```
import numpy as np
np.arange(1,10,0.1)
```

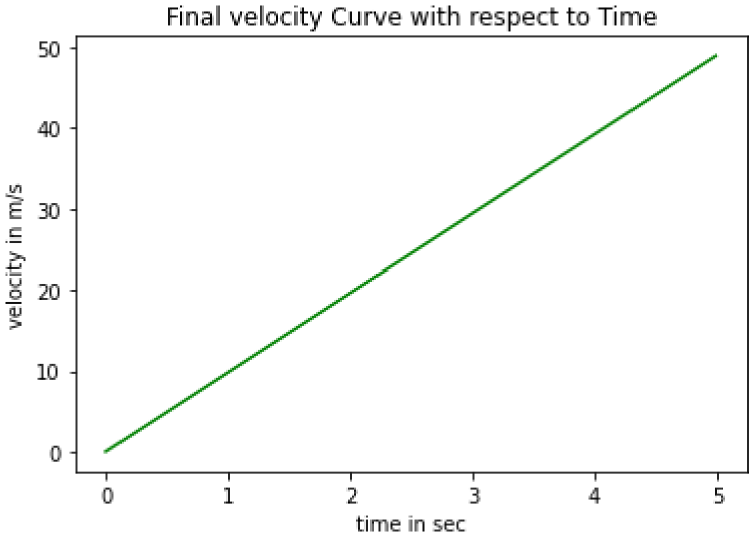
```
array([1. , 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2. , 2.1, 2.2,
       2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3. , 3.1, 3.2, 3.3, 3.4, 3.5,
       3.6, 3.7, 3.8, 3.9, 4. , 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,
       4.9, 5. , 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6. , 6.1,
       6.2, 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])
```

```
import matplotlib.pyplot as plt
```

```
g=9.81
```

```
tfinal=int(input('Enter the final value of time in seconds:'))
dt=tfinal/500
t=np.arange(0,tfinal,dt)
v=g*t
D=-(0.5*g*t**2)
plt.plot(t,v,'g')
plt.xlabel('time in sec')
plt.ylabel('velocity in m/s')
plt.title('Final velocity Curve with respect to Time')
```

```
Enter the final value of time in seconds:5
Text(0.5, 1.0, 'Final velocity Curve with respect to Time')
```




```
plt.plot(t,D,'y')
plt.xlabel('time in sec')
plt.ylabel('distance in m')
plt.title('Distance with respect to time')
plt.show
```

```
<function matplotlib.pyplot.show>
```