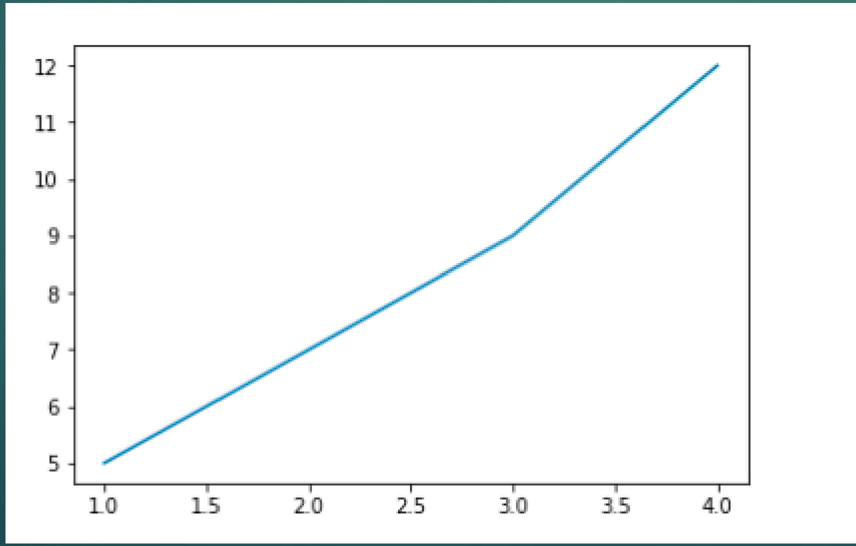
Python for Physics
Lab -4

Matplotlib

```
In [706]: import matplotlib.pyplot as plt

          x = np.array([1,2,3,4])
          y = np.array([5,7,9,12])

          plt.plot(x,y)
          plt.show()
```



Vectors

Magnitude of a Vector

$$A = Axi + Ayj + Azk$$

$$A = \sqrt(Ax^2 + Ay^2)$$

In [707]:
```
vector = np.array([2,4,7])
magnitude_vector = np.linalg.norm(vector)
print ("The magnitude of the vector ", vector , "is :", magnitude_vecto
r)
```

```
The magnitude of the vector  [2 4 7] is : 8.306623862918075
```

In [708]:
```
np.sqrt(2**2 + 4**2 + 7**2)
```

Horizontal and Vertical Components of a Vector

$$Ax = ACosx$$

$$Ay = ASinx$$

In [709]:
```
an= 45
A = np.array([5,4])
Ax= A[0]*np.cos(an)
Ay= A[1]*np.sin(an)
Ax, Ay
```

Out[709]: $(2.626609944088649, \quad 3.4036140981364738)$

Find the angle between “a” and “b”.

where

$$a = 5i + 4j - 6k$$

$$b = -2i + 2j + 3k$$

$$A.B = ABcos\theta$$

$$\theta = cos - 1(A.B/AB)$$

In [711]:
```python
import numpy as np

a =np.array([5,4,-6])
b =np.array([-2, 2,3])

# For a.b = cos theta
```

```python
a_dot_b = np.dot(a,b)


mag_a = np.linalg.norm(a)  # magnitude of a
mag_b = np.linalg.norm(b)  # magnitude of b


value = (a_dot_b / (mag_a * mag_b)) # this is in radian
angle = np.arccos(value)
direction = np.degrees(angle) # radian to degree
print ('The angle between a and b is:\n',  direction)
```

```
The angle between a and b is:
 123.55862948381244
```

In [712]:
```python
a*b
```

Out[712]:
```
array([-10,   8, -18])
```

In [ ]:

Angle with respect to x , y and z axes

In [713]:
```
def Angle(s):
    xcosine_angle = s[0] / (np.linalg.norm(s))
    x = np.arccos(xcosine_angle)
    anglex = np.degrees(x)

    ycosine_angle = s[1] / (np.linalg.norm(s))
    y = np.arccos(ycosine_angle)
    angley = np.degrees(y)

    zcosine_angle = s[2] / (np.linalg.norm(s))
    z = np.arccos(zcosine_angle)
    anglez = np.degrees(z)

    print('The angle with X is : ', anglex)
    print('The angle with Y is : ', angley)
    print('The angle with Z is : ', anglez)

vector =[2,-3,5]

Angle(vector)
```

```
The angle with X is :  71.06817681913482
The angle with Y is :  119.12156807035144
The angle with Z is :  35.795759914707084
```

One Dimensional Kinematics

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 position of the particle at t=1 sec

In [722]:

```
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

In [723]:

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

```
The velocity is :
```

Out[723]: $3t^2 + 8t + 2$

In [724]:

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

```
acceleration
```

```
The acceleration is :
```

Out[724]: $2(3t + 4)$