Experiment : 1

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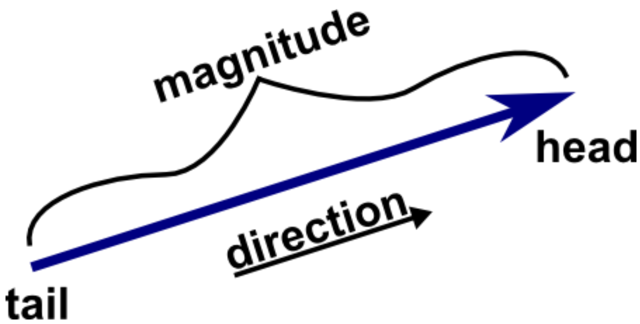
Course : B.Sc. Hons. Electronics
Semester : 5th

Experiment : 1

Aim : Understanding and Plotting Vectors.

Apparatus Required : A desktop with Scilab installed in it.

Theory : A vector is an object that has both a magnitude and a direction. Geometrically, we can picture a vector as a directed line segment, whose length is the magnitude of the vector and with an arrow indicating the direction. The direction of the vector is from its tail to its head.



Vector quantities include velocity, force, displacement, and electric field intensity. A vector is represented by a letter with an arrow on top of it, such as $\vec{A}$ and $\vec{B}$, or by a letter in boldface type such as A and B.

$$A = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

A unit vector a_A along A is defined as a vector whose magnitude is unity (i.e., 1) and its direction is along A, that is,

$$a_A = \frac{A}{|A|} = \frac{A}{A}$$

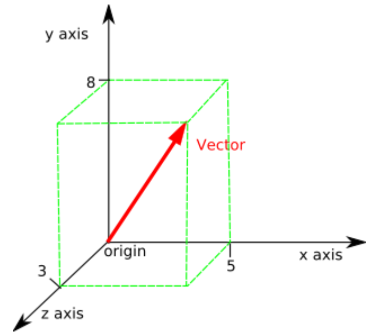
Note that $|a_A| = 1$. Thus, we may write A as

$$A = A\, a_A$$

which completely specifies A in terms of its magnitude A and its direction aA.

A vector A in Cartesian (or rectangular) coordinates may be represented as

$$(A_x ,\ A_y , A_z) \quad \text{or} \quad (A_x a_x + A_y a_y + A_z a_z)$$



where Ax , Ay and Az are called the components of A in the x, y, and z directions respectively; ax , ay and az are unit vectors in the x, y, and z directions, respectively. For example, ax is a dimensionless vector of magnitude one in the direction of the increase of the x-axis. The unit vectors ax , ay , and az are illustrated in Figure 1.1 (a), and the components of A along the coordinate axes are shown in Figure 1.1 (b). The magnitude of vector A is given by

$$A = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

and the unit vector along A is given by

$$a_A = \frac{A_x a_x + A_y a_y + A_z a_z}{\sqrt{A_x^2 + A_y^2 + A_z^2}}$$

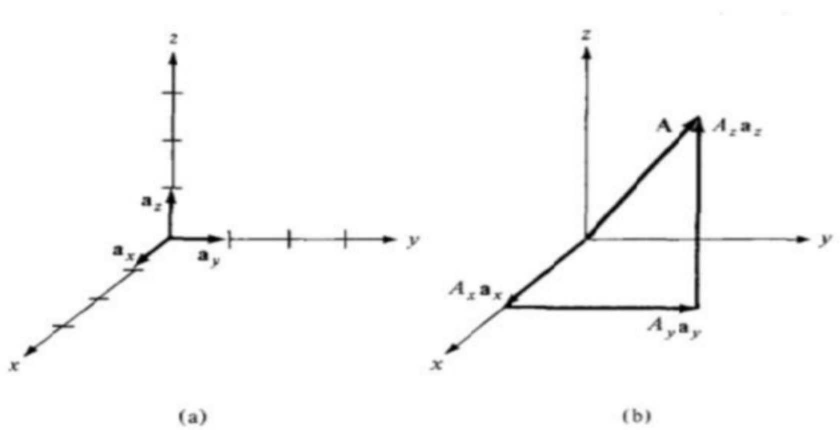


Figure 1.1 **(a)** Unit vectors $\mathbf{a}_x$, $\mathbf{a}_y$, and $\mathbf{a}_z$, **(b)** components of **A** along $\mathbf{a}_x$, $\mathbf{a}_y$, and $\mathbf{a}_z$.

Problem :

Vector in 2 D

Case 1 :- Plot vector $\vec{AB}$ = $a_x + a_y$

A(2,7) & B(3,8)

$\vec{AB}$= (3-2 , 8-7)

$\vec{AB}$= (1 , 1)

Case 2 :- Plot vector $\vec{XY}$ = $-3a_x + 5a_y$

X(-2,-3) & Y(-5,2)

$\vec{XY}$= (-5+2 , 2+3)

$\vec{XY}$= (-3 , 5)

Case 3 :- Plot vector $\vec{PQ}$ = $-3a_x - 5a_y$

P(-1,5) & Q(-4,2)

$\vec{PQ}$= (-4+1 , 2-5)

$\vec{PQ}$= (-3 , -5)

Case 4 :- Plot vector $\vec{RS}$ = $3a_x - 3a_y$

R(-1,1) & S(2,-2)

$\vec{RS}$= (2+1 , -2-1)

$\vec{RS}$= (3 , -3)

Vector in 3 D

Case 1 :- Plot vector $\vec{AB}$ = $0a_x + 6a_y + 0a_z$

A(4,0,2) & B(4,6,2)

$\vec{AB}$= (4-4 , 6-0 , 2-2)

$\vec{AB}$= (0 , 6 , 0)

Case 2 :- Plot vector $\vec{RS}$ = -9a_x +6a_y +9a_z

R(6,0,3) & S(-3,6,12)

$\vec{RS}$= (-3-6 , 6-0 , 12-3)

$\vec{RS}$= (-9,6,9)

Case 3 :- Plot vector $\vec{MN}$ = -a_x - 2a_y - 3a_z

M(2,0,1) & N(1,-2,4)

$\vec{MN}$= (1-2 , 2-0 , 4-1)

$\vec{MN}$= (-1,-2,3)

Case 4 :- Plot vector $\vec{PQ}$ = -2a_x + 4a_y - 10a_z

P(4,0,2) & Q(2,4,-8)

$\vec{PQ}$= (2-4 , 4-0 , -8-2)

$\vec{PQ}$= (-2,4,-10)

Code :

Vector in 2 D

Case 1 :- Plot vector $\vec{AB}$ = a_x + a_y

```
clc;
A=[2,7];
B=[3,8];
subplot(2,2,2);
plot2d4(A,B,rect=[0,0,10,10]);
title("1st Quadrant");
xlabel("x-axis");
ylabel("y-axis");
```

Case 2 :- Plot vector $\vec{XY}$ = -3a_x + 5a_y

```
clc;
X=[-2,-3];
Y=[-5,2];
subplot(1,1,1);
plot2d4(X,Y,rect=[0,0,-10,10]);
title("2nd Quadrant");
xlabel("x-axis");
ylabel("y-axis");
```

Case 3 :- Plot vector $\vec{PQ}$ = -3a_x - 5a_y

```
clc;
P=[-1,5];
Q=[-4,2];
subplot(1,1,1);
plot2d4(P,Q,rect=[6,6,-6,-6]);
title("3rd Quadrant");
xlabel("x-axis");
ylabel("y-axis");
```

Case 4 :- Plot vector $\vec{RS}$ = $\vec{RS}$ = 3a_x - 3a_y

```
clc;
R=[-1,1];
S=[2,-2];
subplot(1,1,1);
plot2d4(R,S,rect=[-6,0,6,-6]);
title("4th Quadrant");
xlabel("x-axis");
ylabel("y-axis");
```

Vector in 3 D

Case 1 :- Plot vector $\vec{AB}$ = 0a_x + 6a_y + 0a_z

```
clc;
x=4;
y=0;
z=2;
x1=4;
```

```
y1=6;
z1=2;
plot3d([x;x1],[y;y1],[z;z1],'b',"X-axis@Y-axis@z-axis",ebox=[-10,10,-10,10,-10,10]);
xarrows([x;x1],[y;y1],[z;z1],2,5);
```

Case 2 :- Plot vector $\vec{RS}$ = -9a_x +6a_y +9a_z

```
clc;
x=6;
y=0;
z=3;
x1=-3;
y1=6;
z1=12;
plot3d([x;x1],[y;y1],[z;z1],'b',"X-axis@Y-axis@z-axis",ebox=[-10,10,-10,10,-10,10]);
xarrows([x;x1],[y;y1],[z;z1],5,5);
```

Case 3 :- Plot vector $\vec{MN}$ = -a_x - 2a_y - 3a_z

```
clc;
x=2;
y=0;
z=1;
x1=1;
y1=-2;
z1=4;
plot3d([x;x1],[y;y1],[z;z1],'b',"X-axis@Y-axis@z-axis",ebox=[-5,5,-5,5,-5,5]);
xarrows([x;x1],[y;y1],[z;z1],5,5);
```

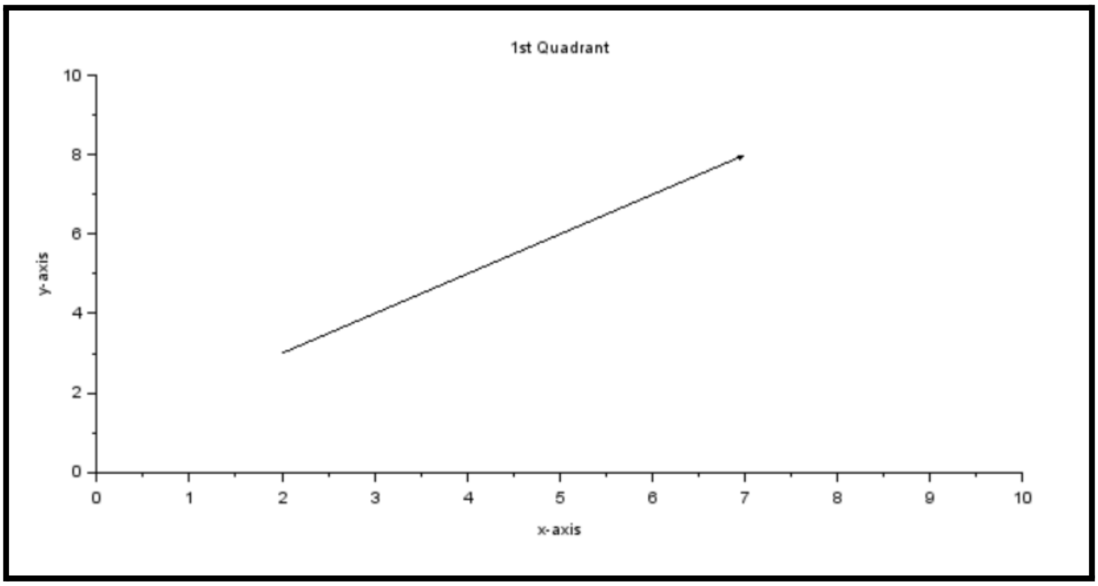
Case 4 :- Plot vector $\vec{PQ}$ = -2a_x + 4a_y - 10a_z

```
clc;
x=4;
y=0;
z=2;
x1=2;
y1=4;
z1=-8;
plot3d([x;x1],[y;y1],[z;z1],'b',"X-axis@Y-axis@z-axis",ebox=[-5,5,-5,5,-5,5]);
xarrows([x;x1],[y;y1],[z;z1],2,5);
```

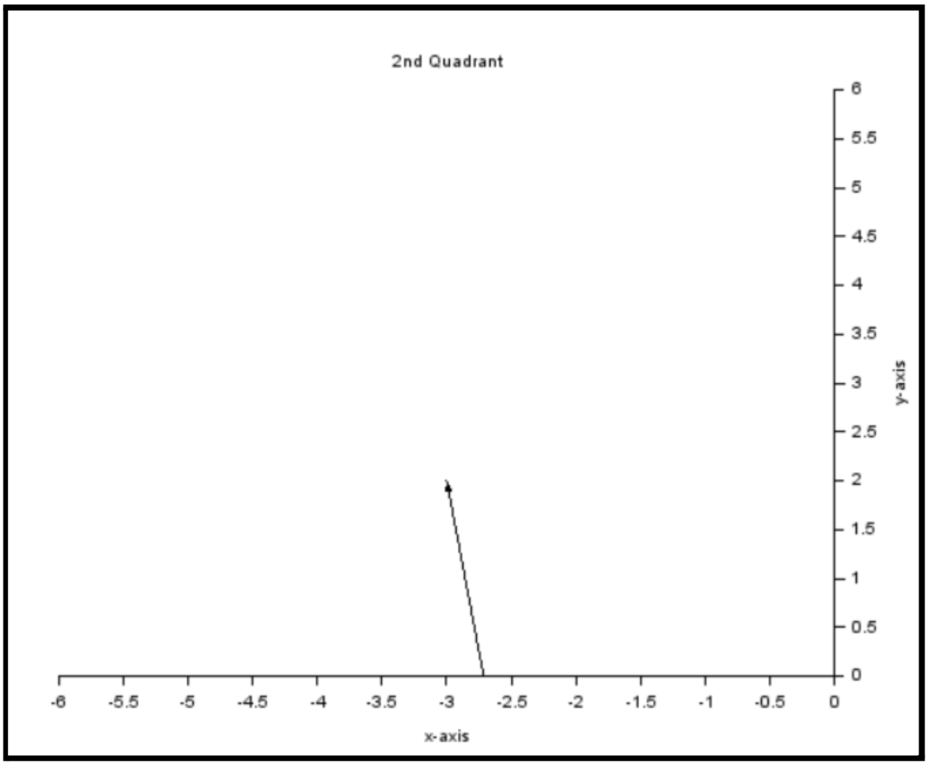
Observation :

Vector in 2 D

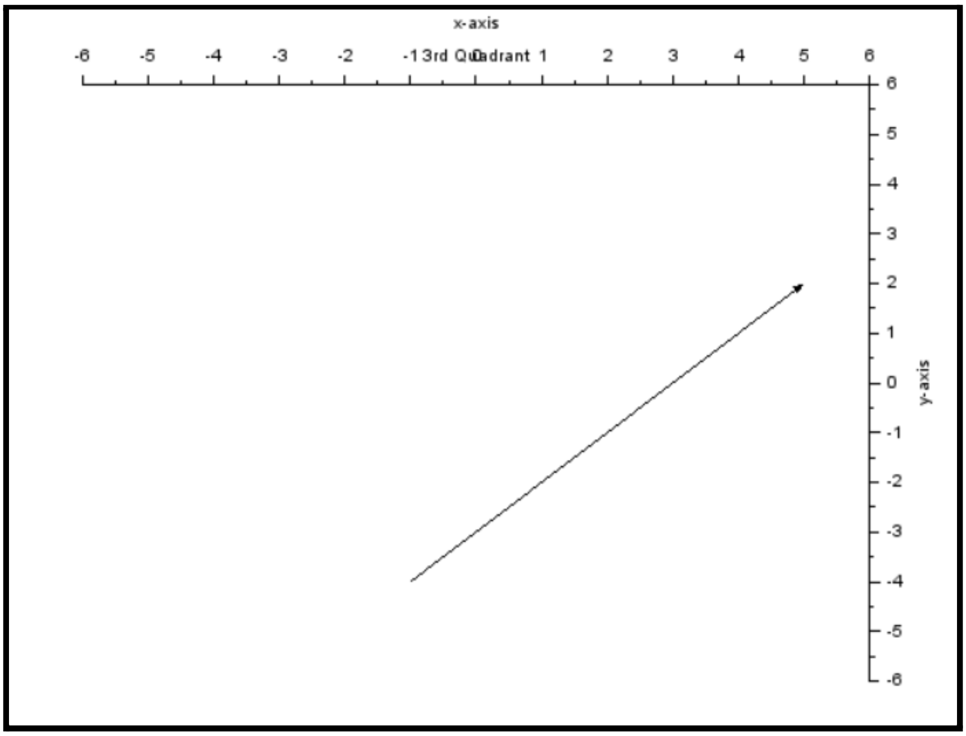
Case 1 :- Plot vector $\vec{AB}$ = $a_x + a_y$



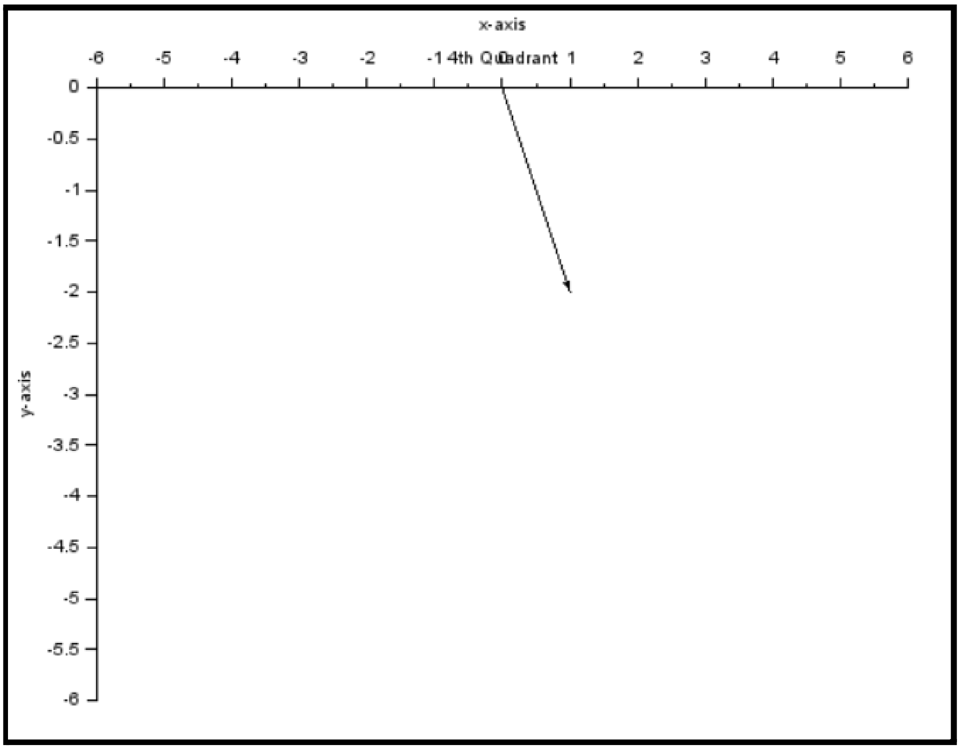
Case 2 :- Plot vector $\vec{XY}$ = $-3a_x + 5a_y$



Case 3 :- Plot vector $\vec{PQ}$ = -3a_x - 5a_y

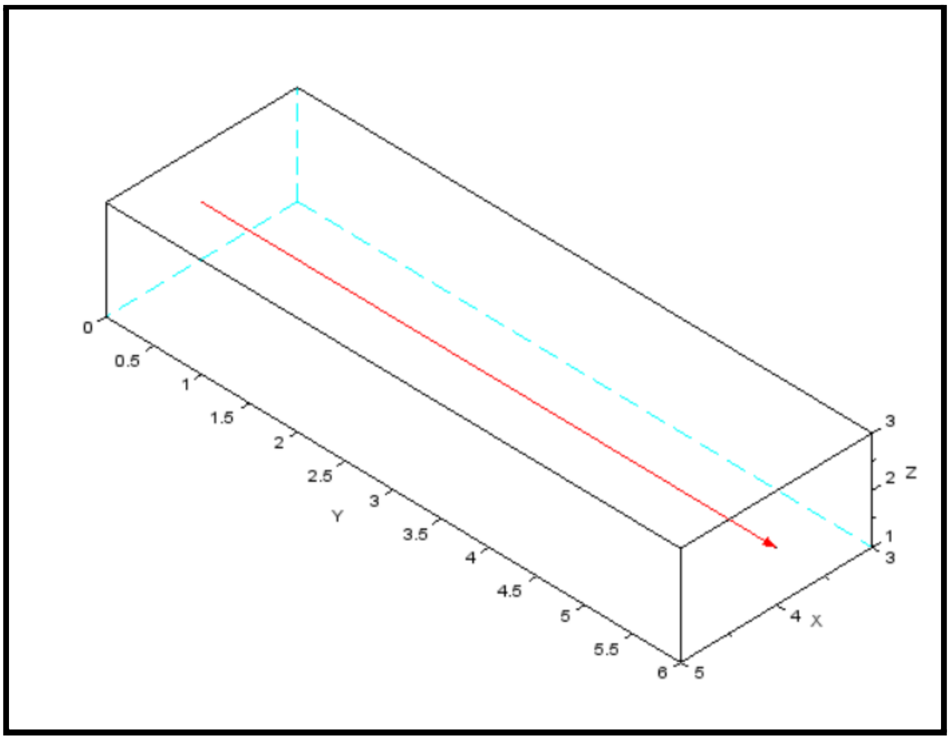


Case 4 :- Plot vector $\vec{RS}$ = $\vec{RS}$ = 3a_x - 3a_y

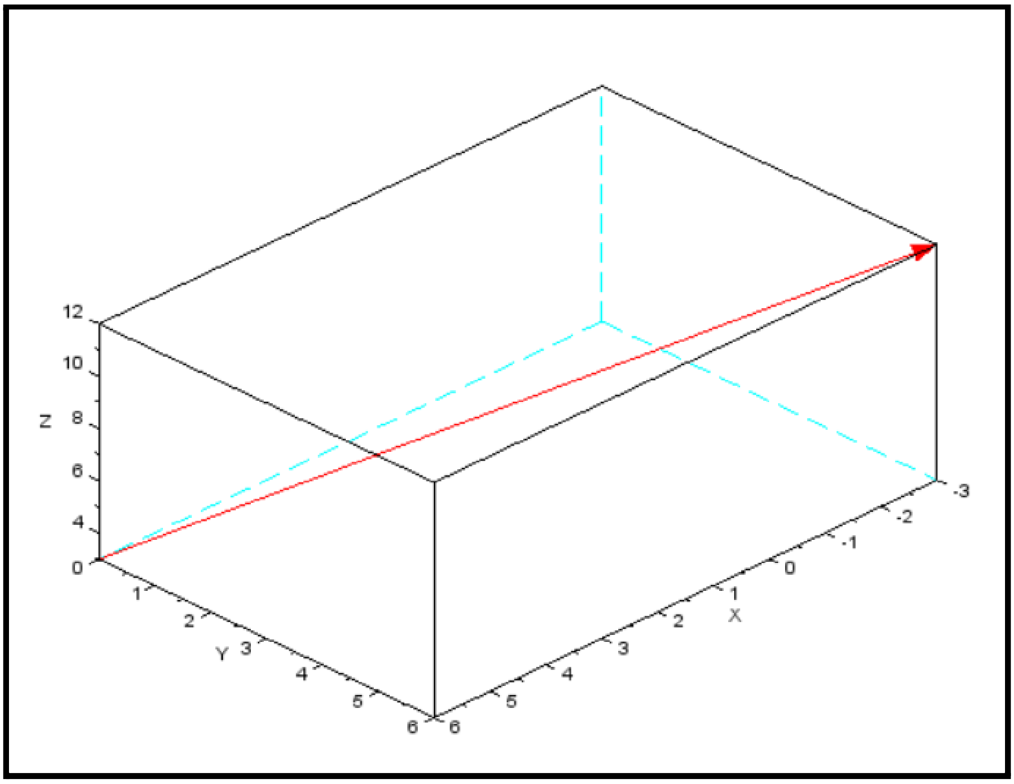


Vector in 3 D

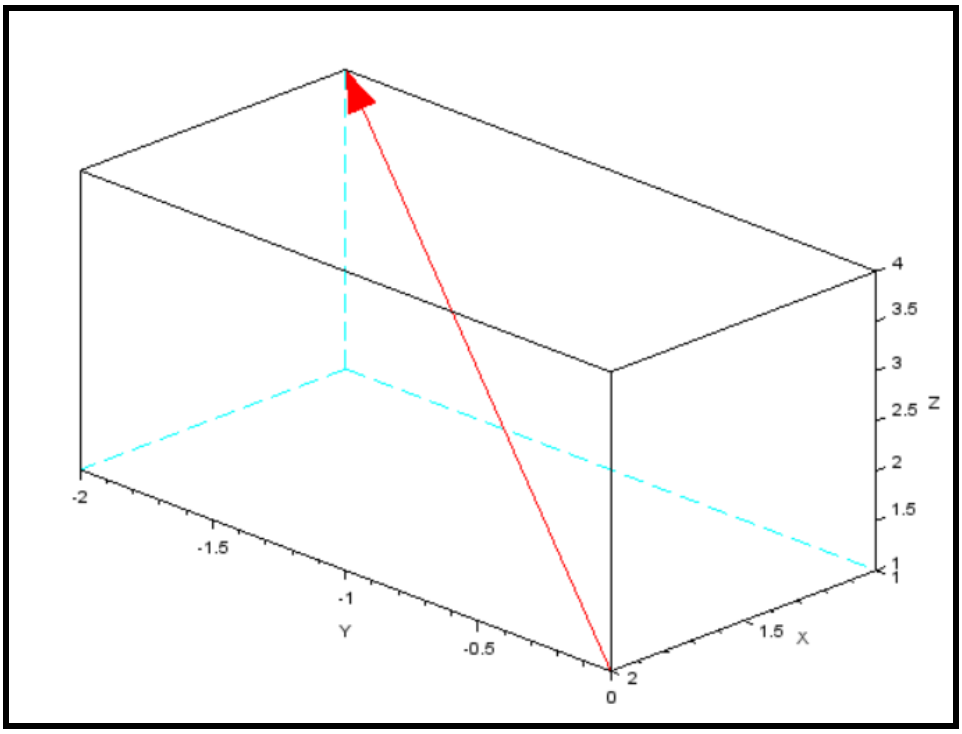
Case 1 :- Plot vector $\vec{AB}$ = $0a_x + 6a_y + 0a_z$



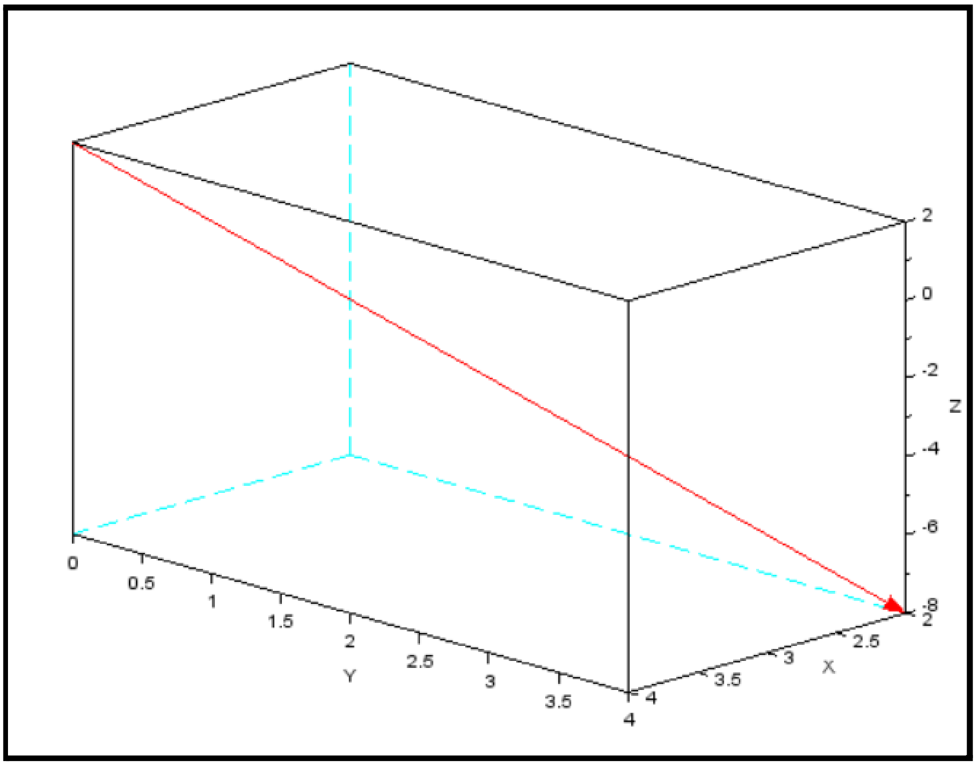
Case 2 :- Plot vector $\vec{RS}$ = $-9a_x +6a_y +9a_z$



Case 3 :- Plot vector $\vec{MN}$ = -a_x - 2a_y - 3a_z



Case 4 :- Plot vector $\vec{PQ}$ = -2a_x + 4a_y - 10a_z



Result : 2-D & 3-D vectors has been plotted successfully in all 4 quadrants.