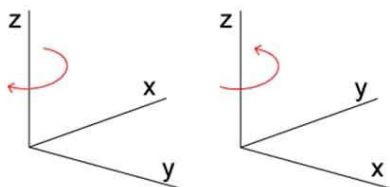**Class-XI**
Mathematics
Three Dimensional Geometry
**Chapter-12**
Chapter Notes

Key Concepts

1. A point in space has three coordinates.

2. Three dimensional system is an extension of two dimensional system.

Third axis z is added to XY plane. There are two possible orientations of x and y axis . These two orientations are known as left handed and right handed system.


Right handed system is used mostly.

5. In three dimension, the coordinate axes of a rectangular Cartesian coordinate system are three mutually perpendicular lines. The axes are called the x, y and z-axes.

6. The three planes determined by the pair of axes are the coordinate planes, called XY, YZ and ZX-planes

7. There are 3 coordinate planes namely XOY, YOZ and ZOX also called the XY-plane, YZ plane and the ZX plane respectively.
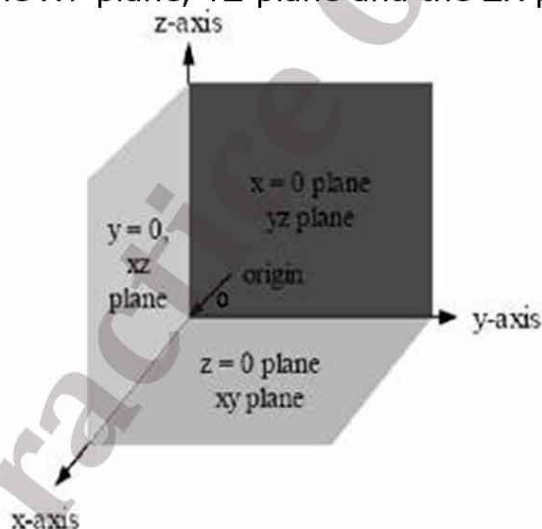

8. The three coordinate planes divide the whole space into 8 parts. Each of these parts is called an 'octant'. The octants are numbered as

roman numerals I,II,III ,… etc
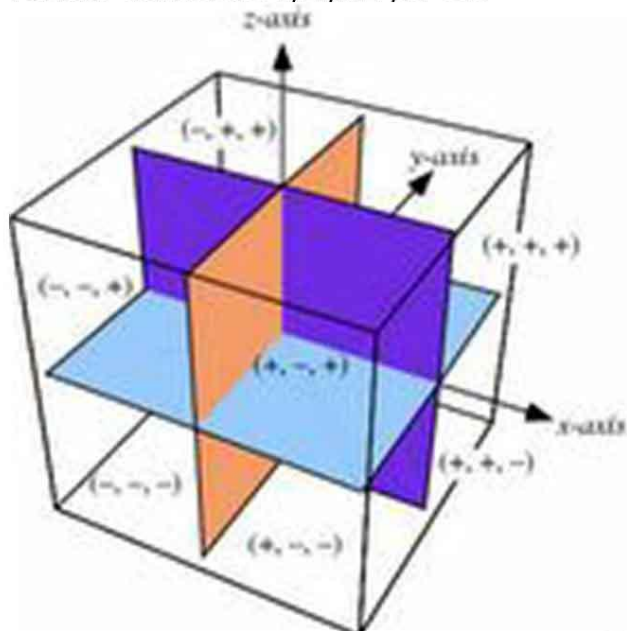
9. To each point in space, there corresponds an ordered triplet (x,y,z) of real numbers. There is a one to one correspondence between the points in space and ordered triplet (x,y,z) of real numbers.

10. If P(x, y, z) is any point in space, then x, y and z are perpendicular distances from YZ,ZX and XY planes.
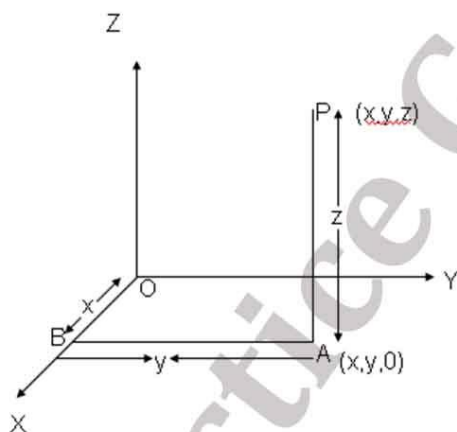
11. The coordinates of the origin O are (0,0, 0).

12. The coordinates of any point on the x –axis are of the type (x,0,0).
The coordinates of any point on the y –axis are of the type (0,y,0).
The coordinates of any point on the z –axis are of the type (0,0,z)

13. The x coordinate of the point in the YZ plane must be zero.
A point in the XY plane will have its z coordinate zero
A point in the XZ plane will have its y coordinate zero.

14. Three points are said to be collinear if the sum of distances between any two pairs of the points is equal to the distance between the third pair of points. Distance formula can be used to prove collinearity.

15. If we were dealing in one dimension then x=a is a single point and if it is two dimensions then it will be a straight line and in 3 D it's a plane || to YZ plane and passing through point a.

16. The distance of any point from the XY plane = | z coordinate | and similarly for the other 2 planes.

17. A line segment is trisected means it is divided into 3 equal parts by 2 points R and S. This is equivalent to saying that either R or S divides the line segment in the ratio 2:1 or 1:2.

Key Formulae

1.

Octants Coordinates	I	II	III	IV	V	VI	VII	VIII
x	+	-	-	+	+	-	-	+
y	+	+	-	-	+	+	-	-
z	+	+	+	+	-	-	-	-

2. Distance between two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ is given by $PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

3. Distance between two points $P(x_1, y_1, z_1)$ and $Q(0,0,0)$ is given by $PQ = \sqrt{x_1^2 + y_1^2 + z_1^2}$

4. The coordinates of the point R which divides the line segment joining two points $P(x_1 y_1 z_1)$ and $Q(x_2, y_2, z_2)$ internally and externally in the ratio m : n are given by
$$\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}, \frac{mz_2 + na_1}{m+n}\right) \text{ and } \left(\frac{mx_2 - nx_1}{m-n}, \frac{my_2 - ny_1}{m-n}, \frac{mz_2 - nz_1}{m-n}\right)$$

5. The coordinates of the mid-point of the line segment joining two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right)$.

6. The coordinates of the centroid of the triangle, whose vertices are (x_1, y_1, z_1) (x_2, y_2, z_2) and (x_3, y_3, z_3) are

$$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}, \frac{z_1 + z_2 + z_3}{3} \right).$$

7. The coordinates of the point R which divides the line segment joining two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ in the ratio $k:1$ are

$$\left(\frac{kx_2 + x_1}{1 + k}, \frac{ky_2 + y_1}{1 + k}, \frac{kz_2 + z_1}{1 + k} \right)$$