

INTRODUCTION TO THREE DIMENSIONAL GEOMETRY

1. **Coordinates- axes, planes, points in 3D**
2. **Distance between Two Points**
3. **Section Formula**

- **Coordinate axes:** In three dimensions, the coordinate axes of a rectangular Cartesian coordinate system are three mutually perpendicular lines. The axes are called the x-axis, y-axis and z-axis.
- **Planes:** The three planes determined by the pair of axes are the coordinate planes, called XY, YZ and ZX planes.

xy —plane i.e., $z = 0$

yz —plane i.e., $x = 0$

zx —plane i.e., $y = 0$

- **Octants:** The three coordinate planes divide the space into eight parts known as octants.
- **Points in 3D:** The coordinates of a point P in three dimensional geometry is always written in the form of triplet like (x, y, z) . Here x , y and z are the distances from the YZ, ZX and XY

Any point on XY $\rightarrow$ plane $(x, y, 0)$

Any point on YZ $\rightarrow$ plane $(0, y, z)$

Any point on ZX $\rightarrow$ plane $(x, 0, z)$

- **Distance formula between two points:** Distance between two points P (x_1, y_1, z_1) and Q (x_2, y_2, z_2) is

$$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Section Formula: The co-ordinates of R which divides a line segment joining the points P (x_1 , y_1 , z_1) and Q (x_2 , y_2 , z_2)

Internally and externally in the ratio m : n respectively

Internally: $R \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}, \frac{mz_2 + nz_1}{m+n} \right)$

Externally: $S \left(\frac{mx_2 - nx_1}{m-n}, \frac{my_2 - ny_1}{m-n}, \frac{mz_2 - nz_1}{m-n} \right)$

Centroid: 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) is

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