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

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

- The three coordinate planes divide the space into eight parts known as octants.

- 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-planes.

  (i) Any point on x-axis is of the form (x, 0, 0)

  (ii) Any point on y-axis is of the form (0, y, 0)

  (iii) Any point on z-axis is of the form (0, 0, z).

- Distance between two points P(x1, y1, z1) and Q (x2, y2, z2) is given by

  $PQ = \sqrt{(x2-x1)^2+(y2-y1)^2+(z2-z1)^2}$

- The coordinates of the point R which divides the line segment joining two points P (x1 y1 z1) and Q (x2, y2, z2) internally and externally in the ratio m : n are given by

  [(mx2+nx1)/(m+n), (my2+ny1)/(m+n), (mz2+nz1)/(m+n)] and [(mx2-nx1)/(m+n), (my2-ny1)/(m+n), (mz2-nz1)/(m+n)]

- The coordinates of the mid-point of the line segment joining two points P(x1, y1, z1) and Q(x2, y2, z2) are

  [(x1+x2)/2, (y1+y2)/2, (z1+z2)/2]

- The coordinates of the centroid of the triangle, whose vertices are (x1, y1, z1) (x2, y2, z2) and (x3, y3, z3), are

  [(x1+x2+x3)/2, (y1+y2+y3)/2, (z1+z2+z3)/2]

Sample Examples

- Find the distance between the points P(1, –3, 4) and Q (– 4, 1, 2).

  Solution:-

  The distance PQ between the points P (1,–3, 4) and Q (– 4, 1, 2) is

  $PQ = \sqrt{(-4-1)^2+(1-(-3))^2+(2-4)^2}$

  $= \sqrt{45}$ units

- Find the equation of the set of the points P such that its distances from the points A (3, 4, −5) and B (− 2, 1, 4) are equal.

  Solution:-

  If P (x, y, z) be any point such that PA = PB

  $$\sqrt{(x-3)^2 + (y-4)^2 + (z+5)^2} = \sqrt{(x+2)^2 + (y-1)^2 + (z-4)^2}$$
  $$(x-3)^2 + (y-4)^2 + (z+5)^2 = (x+2)^2 + (y-1)^2 + (z-4)^2$$
  $$10x + 6y - 18z - 29 = 0$$

- The centroid of a triangle ABC is at the point (1, 1, 1). If the coordinates of A and B are (3, –5, 7) and (–1, 7, – 6), respectively, find the coordinates of the point C.

  Solution:-

  Let the coordinates of C be (x, y, z) and the coordinates of the centroid G be (1, 1, 1). Then

  (x+3-1)/3 = 1

  x = 1

  (y-5+7)/3 = 1

  y = 1

  (z+7-6)/3 = 1

  z = 2