Exercise 12.3

Question 1:

Find the coordinates of the point which divides the line segment joining the points (–2, 3, 5) and (1, –4, 6) in the ratio (i) 2:3 internally, (ii) 2:3 externally.

Answer

(i) The coordinates of point R that divides the line segment joining points P (x_1, y_1, z_1) and Q (x_2, y_2, z_2) internally in the ratio m: n are

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

Let R (x, y, z) be the point that divides the line segment joining points(–2, 3, 5) and (1, –4, 6) internally in the ratio 2:3

$$x=\frac{2(1)+3(-2)}{2+3}, y=\frac{2(-4)+3(3)}{2+3}, \text{ and } z=\frac{2(6)+3(5)}{2+3}$$

$$\text{i.e., } x=\frac{-4}{5}, y=\frac{1}{5}, \text{ and } z=\frac{27}{5}$$

Thus, the coordinates of the required point are $\left(-\frac{4}{5},\frac{1}{5},\frac{27}{5}\right)$.

(ii) The coordinates of point R that divides the line segment joining points P (x_1, y_1, z_1) and Q (x_2, y_2, z_2) externally in the ratio m: n are

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

Let R (x, y, z) be the point that divides the line segment joining points(–2, 3, 5) and (1, –4, 6) externally in the ratio 2:3

$$x=\frac{2(1)-3(-2)}{2-3}, y=\frac{2(-4)-3(3)}{2-3}, \text{ and } z=\frac{2(6)-3(5)}{2-3}$$

$$\text{i.e., } x=-8, y=17, \text{ and } z=3$$

Thus, the coordinates of the required point are (–8, 17, 3).

Question 2:

Given that P (3, 2, −4), Q (5, 4, −6) and R (9, 8, −10) are collinear. Find the ratio in which Q divides PR.

Answer

Let point Q (5, 4, −6) divide the line segment joining points P (3, 2, −4) and R (9, 8, −10) in the ratio *k*:1.

Therefore, by section formula,

$$(5,4,-6)=\left(\frac{k(9)+3}{k+1},\frac{k(8)+2}{k+1},\frac{k(-10)-4}{k+1}\right)$$

$$\Rightarrow \frac{9k+3}{k+1}=5$$

$$\Rightarrow 9k+3=5k+5$$

$$\Rightarrow 4k=2$$

$$\Rightarrow k=\frac{2}{4}=\frac{1}{2}$$

Thus, point Q divides PR in the ratio 1:2.

Question 3:

Find the ratio in which the YZ-plane divides the line segment formed by joining the points (−2, 4, 7) and (3, −5, 8).

Answer

Let the YZ planedivide the line segment joining points (−2, 4, 7) and (3, −5, 8) in the ratio *k*:1.

Hence, by section formula, the coordinates of point of intersection are given by

$$\left(\frac{k(3)-2}{k+1},\frac{k(-5)+4}{k+1},\frac{k(8)+7}{k+1}\right)$$

On the YZ plane, the *x*-coordinate of any point is zero.

$$\frac{3k-2}{k+1}=0$$

$$\Rightarrow 3k-2=0$$

$$\Rightarrow k=\frac{2}{3}$$

Thus, the YZ plane divides the line segment formed by joining the given points in the ratio 2:3.

Question 4:

Using section formula, show that the points A (2, −3, 4), B (−1, 2, 1) and $C\left(0,\frac{1}{3},2\right)$ are collinear.

Answer

The given points are A (2, −3, 4), B (−1, 2, 1), and $C\left(0,\frac{1}{3},2\right)$.

Let P be a point that divides AB in the ratio *k*:1.

Hence, by section formula, the coordinates of P are given by

$$\left(\frac{k(-1)+2}{k+1},\frac{k(2)-3}{k+1},\frac{k(1)+4}{k+1}\right)$$

Now, we find the value of *k* at which point P coincides with point C.

By taking $\frac{-k+2}{k+1}=0$, we obtain $k = 2$.

For $k = 2$, the coordinates of point P are $\left(0,\frac{1}{3},2\right)$.

i.e., $C\left(0,\frac{1}{3},2\right)$ is a point that divides AB externally in the ratio 2:1 and is the same as point P.

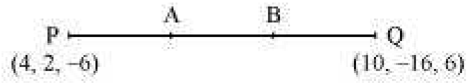
Hence, points A, B, and C are collinear.

Question 5:

Find the coordinates of the points which trisect the line segment joining the points P (4, 2, −6) and Q (10, −16, 6).

Answer

Let A and B be the points that trisect the line segment joining points P (4, 2, −6) and Q (10, −16, 6)



Point A divides PQ in the ratio 1:2. Therefore, by section formula, the coordinates of point A are given by

$$\left(\frac{1(10)+2(4)}{1+2}, \frac{1(-16)+2(2)}{1+2}, \frac{1(6)+2(-6)}{1+2}\right) = (6, -4, -2)$$

Point B divides PQ in the ratio 2:1. Therefore, by section formula, the coordinates of point B are given by

$$\left(\frac{2(10)+1(4)}{2+1}, \frac{2(-16)+1(2)}{2+1}, \frac{2(6)-1(6)}{2+1}\right) = (8, -10, 2)$$

Thus, (6, −4, −2) and (8, −10, 2) are the points that trisect the line segment joining points P (4, 2, −6) and Q (10, −16, 6).