

## NCERT Solutions for Class-XI Maths

### Chapter-12 Exercise-12.3 NCERT Math Class 11

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.
1. Let the line segment joining the points P  $(-2, 3, 5)$  and Q  $(1, -4, 6)$  be PQ.

(i) By Section Formula,

We know that 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 in the ratio  $m : n$  is given by:

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

Comparing this information with the details given in the question, we have

$$x_1 = -2, y_1 = 3, z_1 = 5; x_2 = 1, y_2 = -4, z_2 = 6 \text{ and } m = 2, n = 3$$

So,

The coordinates of the point which divides the line segment joining the points P  $(-2, 3, 5)$  and Q  $(1, -4, 6)$  in the ratio  $2 : 3$  internally is given by:

$$\left( \frac{2 \times 1 + 3 \times (-2)}{2+3}, \frac{2 \times (-4) + 3 \times 3}{2+3}, \frac{2 \times 6 + 3 \times 5}{2+3} \right) = \left( \frac{2-6}{5}, \frac{-8+9}{5}, \frac{12+15}{5} \right) = \left( \frac{-4}{5}, \frac{1}{5}, \frac{27}{5} \right)$$

Hence, the coordinates of the point which divides the line segment joining the points

$$(-2, 3, 5) \text{ and } (1, -4, 6) \text{ is } \left( \frac{-4}{5}, \frac{1}{5}, \frac{27}{5} \right).$$

(ii) By Section Formula,

We know that the coordinates of the point R which divides the line segment joining two points P  $(x_1, y_1, z_1)$  and Q  $(x_2, y_2, z_2)$  externally in the ratio  $m : n$  is given by:

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

Comparing this information with the details given in the question, we have

$$x_1 = -2, y_1 = 3, z_1 = 5; x_2 = 1, y_2 = -4, z_2 = 6 \text{ and } m = 2, n = 3$$

So,

The coordinates of the point which divides the line segment joining the points P (-2, 3, 5) and Q (1, -4, 6) in the ratio 2 : 3 externally is given by:

$$\left( \frac{2 \times 1 - 3 \times (-2)}{2 - 3}, \frac{2 \times (-4) - 3 \times 3}{2 - 3}, \frac{2 \times 6 - 3 \times 5}{2 - 3} \right) = \left( \frac{2 - (-6)}{-1}, \frac{-8 - 9}{-1}, \frac{12 - 15}{-1} \right) = \left( \frac{8}{-1}, \frac{-17}{-1}, \frac{-3}{-1} \right) = (-8, 17, 3)$$

Hence, the coordinates of the point which divides the line segment joining the points (-2, 3, 5) and (1, -4, 6) is (-8, 17, 3).

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  $PR$ .
2. 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.

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).
3. Let the line segment formed by joining the points  $P(-2, 4, 7)$  and  $Q(3, -5, 8)$  be  $PQ$ . We know that any point on the  $YZ$ -plane is of the form  $(0, y, z)$ .

Now, let  $R(0, y, z)$  divides the line segment  $PQ$  in the ratio  $k : 1$ .

Then,

Comparing this information with the details given in the question, we have

$$x_1 = -2, y_1 = 4, z_1 = 7; x_2 = 3, y_2 = -5, z_2 = 8 \text{ and } m = k, n = 1$$

By section formula,

We know that 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 in the ratio  $m : n$  is given by:

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

So, we have

$$\left( \frac{3k-2}{k+1}, \frac{-5k+4}{k+1}, \frac{8k+7}{k+1} \right) = (0, y, z)$$

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

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

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

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

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.

4. 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.

5. Find the coordinates of the points which trisect the line segment joining the points P  $(4, 2, -6)$  and Q  $(10, -16, 6)$ .
5. Let A  $(x_1, y_1, z_1)$  and B  $(x_2, y_2, z_2)$  trisect the line segment joining the points P  $(4, 2, -6)$  and Q  $(10, -16, 6)$ .

⇒ A divides the line segment PQ in the ratio 1 : 2.

Then,

Comparing this information with the details given in the question, we have

$x_1 = 4, y_1 = 2, z_1 = -6; x_2 = 10, y_2 = -16, z_2 = 6$  and  $m = 1, n = 2$

By section formula,

We know that 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 in the ratio  $m : n$  is given by:

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

So, we have

The coordinates of A =

$$\left( \frac{1 \times 10 + 2 \times 4}{1+2}, \frac{1 \times (-16) + 2 \times 2}{1+2}, \frac{1 \times 6 + 2 \times (-6)}{1+2} \right) = \left( \frac{18}{3}, \frac{-12}{3}, \frac{-6}{3} \right) = (6, -4, -2)$$

Similarly, We know that B divides the line segment PQ in the ratio 2 : 1.

Then,

Comparing this information with the details given in the question, we have

$x_1 = 4, y_1 = 2, z_1 = -6; x_2 = 10, y_2 = -16, z_2 = 6$  and  $m = 2, n = 1$

By section formula,

We know that 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 in the ratio  $m : n$  is given by:

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

So, we have

The coordinates of B =

$$\left( \frac{2 \times 10 + 1 \times 4}{2+1}, \frac{2 \times (-16) + 1 \times 2}{2+1}, \frac{2 \times 6 + 1 \times (-6)}{2+1} \right) = \left( \frac{24}{3}, \frac{-30}{3}, \frac{6}{3} \right) = (8, -10, 2)$$

Hence, the coordinates of the points which trisect the line segment joining the points P (4, 2, -6) and Q (10, -16, 6) are (6, -4, -2) and (8, -10, 2).