

Exercise 11.1

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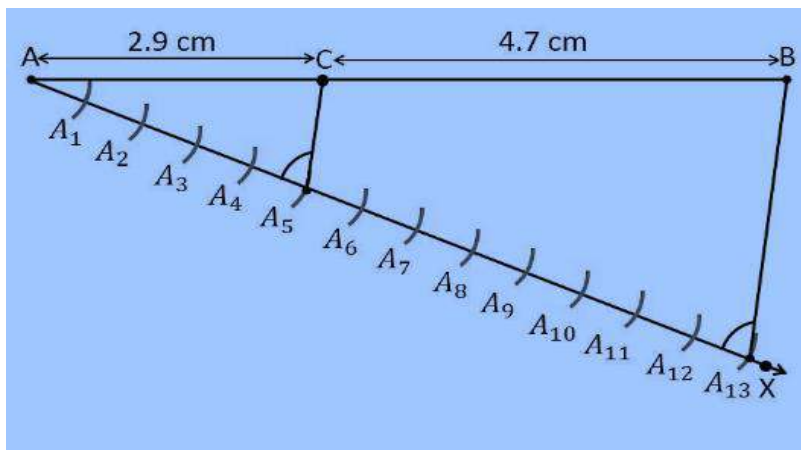
In each of the following, give the justification of the construction also:

1. Draw a line segment of length 7.6 cm and divide it in the ratio 5 : 8. Measure the two parts.

Construction Procedure:

A line segment with a measure of 7.6 cm length is divided in the ratio of 5:8 as follows.

1. Draw line segment AB with the length measure of 7.6 cm
2. Draw a ray AX that makes an acute angle with line segment AB.
3. Locate the points i.e., 13 (= 5+8) points, such as A₁, A₂, A₃, A₄ A₁₃, on the ray AX such that it becomes AA₁ = A₁A₂ = A₂A₃ and so on.
4. Join the line segment and the ray, BA₁₃.
5. Through the point A₅, draw a line parallel to BA₁₃ which makes an angle equal to ∠AA₁₃B
6. The point A₅ which intersects the line AB at point C.
7. C is the point divides line segment AB of 7.6 cm in the required ratio of 5:8.
8. Now, measure the lengths of the line AC and CB. It comes out to the measure of 2.9 cm and 4.7 cm respectively.



Justification:

The construction of the given problem can be justified by proving that

$$AC/CB = 5/8$$

By construction, we have A₅C || A₁₃B. From Basic proportionality theorem for the triangle AA₁₃B, we get $AC/CB = AA_5/A_5A_{13} \dots (1)$

From the figure constructed, it is observed that AA₅ and A₅A₁₃ contain 5 and 8 equal divisions of line segments respectively.

Therefore, it becomes

$$AA_5/A_5A_{13} = 5/8 \dots (2)$$

Compare the equations (1) and (2), we obtain

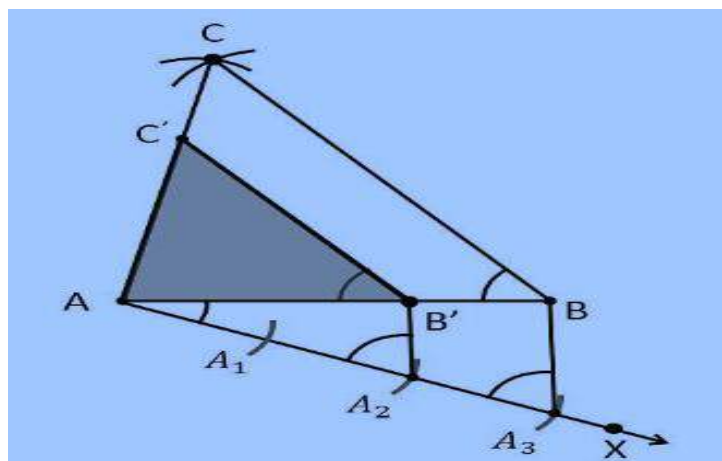
$$AC/CB = 5/8$$

Hence, Justified.

2. Construct a triangle of sides 4 cm, 5 cm and 6 cm and then a triangle similar to it whose sides are $\frac{2}{3}$ of the corresponding sides of the first triangle.

Construction Procedure:

1. Draw a line segment AB which measures 4 cm, i.e., $AB = 4$ cm.
2. Take the point A as centre, and draw an arc of radius 5 cm.
3. Similarly, take the point B as its centre, and draw an arc of radius 6 cm .
4. The arcs drawn will intersect each other at point C.
5. Now, we obtained $AC = 5$ cm and $BC = 6$ cm and therefore $\triangle ABC$ is the required triangle.
6. Draw a ray AX which makes an acute angle with the line segment AB on the opposite side of vertex C.
7. Locate 3 points such as A_1, A_2, A_3 (as 3 is greater between 2 and 3) on line AX such that it becomes $AA_1 = A_1A_2 = A_2A_3$.
8. Join the point BA_3 and draw a line through A_2 which is parallel to the line BA_3 that intersect AB at point B' .
9. Through the point B' , draw a line parallel to the line BC that intersect the line AC at C' .
10. Therefore, $\triangle AB'C'$ is the required triangle.



Justification:

The construction of the given problem can be justified by proving that

$$AB' = \left(\frac{2}{3}\right)AB$$

$$B'C' = \left(\frac{2}{3}\right)BC$$

$$AC' = \left(\frac{2}{3}\right)AC$$

From the construction, we get $B'C' \parallel BC$

$$\therefore \angle AB'C' = \angle ABC \text{ (Corresponding angles)}$$

In $\triangle AB'C'$ and $\triangle ABC$,

$$\angle ABC = \angle AB'C' \text{ (Proved above)}$$

$$\angle BAC = \angle B'AC' \text{ (Common)}$$

$$\therefore \triangle AB'C' \sim \triangle ABC \text{ (From AA similarity criterion)}$$

$$\text{Therefore, } AB'/AB = B'C'/BC = AC'/AC \dots (1)$$

In $\triangle AAB'$ and $\triangle AAB$,

$\angle A_2AB' = \angle A_3AB$ (Common)

From the corresponding angles, we get,

$\angle AA_2B' = \angle AA_3B$

Therefore, from the AA similarity criterion, we obtain

$\triangle AA_2B'$ and $\triangle AA_3B$

So, $AB'/AB = AA_2/AA_3$

Therefore, $AB'/AB = 2/3 \dots\dots (2)$

From the equations (1) and (2), we get

$AB'/AB = B'C'/BC = AC'/AC = 2/3$

This can be written as

$AB' = (2/3)AB$

$B'C' = (2/3)BC$

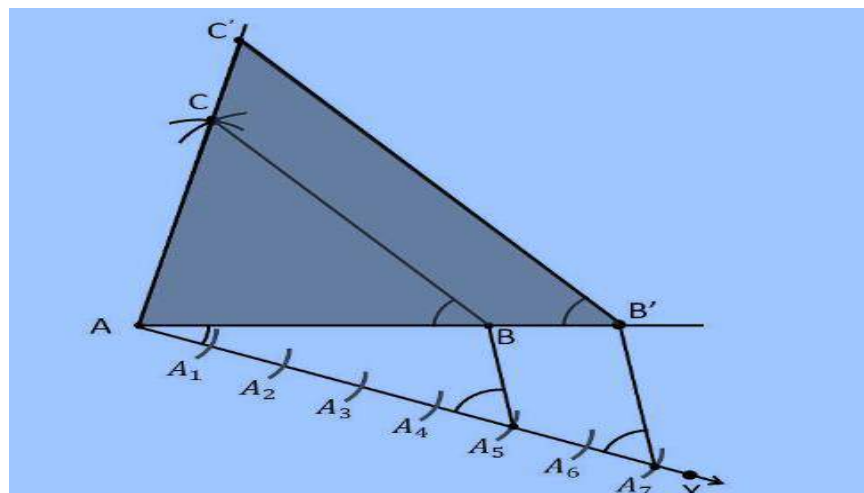
$AC' = (2/3)AC$

Hence, justified.

3. Construct a triangle with sides 5 cm, 6 cm and 7 cm and then another triangle whose sides are 7/5 of the corresponding sides of the first triangle

Construction Procedure:

1. Draw a line segment $AB = 5$ cm.
2. Take A and B as centre, and draw the arcs of radius 6 cm and 5 cm respectively.
3. These arcs will intersect each other at point C and therefore $\triangle ABC$ is the required triangle with the length of sides as 5 cm, 6 cm, and 7 cm respectively.
4. Draw a ray AX which makes an acute angle with the line segment AB on the opposite side of vertex C.
5. Locate the 7 points such as $A_1, A_2, A_3, A_4, A_5, A_6, A_7$ (as 7 is greater between 5 and 7), on line AX such that it becomes $AA_1 = A_1A_2 = A_2A_3 = A_3A_4 = A_4A_5 = A_5A_6 = A_6A_7$
6. Join the points BA_5 and draw a line from A_7 to BA_5 which is parallel to the line BA_5 where it intersects the extended line segment AB at point B' .
7. Now, draw a line from B' the extended line segment AC at C' which is parallel to the line BC and it intersects to make a triangle.
8. Therefore, $\triangle AB'C'$ is the required triangle.



Justification:

The construction of the given problem can be justified by proving that

$$AB' = (7/5)AB$$

$$B'C' = (7/5)BC$$

$$AC' = (7/5)AC$$

From the construction, we get $B'C' \parallel BC$

$\therefore \angle AB'C' = \angle ABC$ (Corresponding angles)

In $\triangle AB'C'$ and $\triangle ABC$,

$\angle ABC = \angle AB'C'$ (Proved above)

$\angle BAC = \angle B'AC'$ (Common)

$\therefore \triangle AB'C' \sim \triangle ABC$ (From AA similarity criterion)

Therefore, $AB'/AB = B'C'/BC = AC'/AC \dots (1)$

In $\triangle AA_7B'$ and $\triangle AA_5B$,

$\angle A_7AB' = \angle A_5AB$ (Common)

From the corresponding angles, we get,

$$\angle A_7B' = \angle A_5B$$

Therefore, from the AA similarity criterion, we obtain

$\triangle AA_2B'$ and $\triangle AA_3B$

So, $AB'/AB = AA_5/AA_7$

Therefore, $AB'/AB = 5/7 \dots (2)$

From the equations (1) and (2), we get

$$AB'/AB = B'C'/BC = AC'/AC = 7/5$$

This can be written as

$$AB' = (7/5)AB$$

$$B'C' = (7/5)BC$$

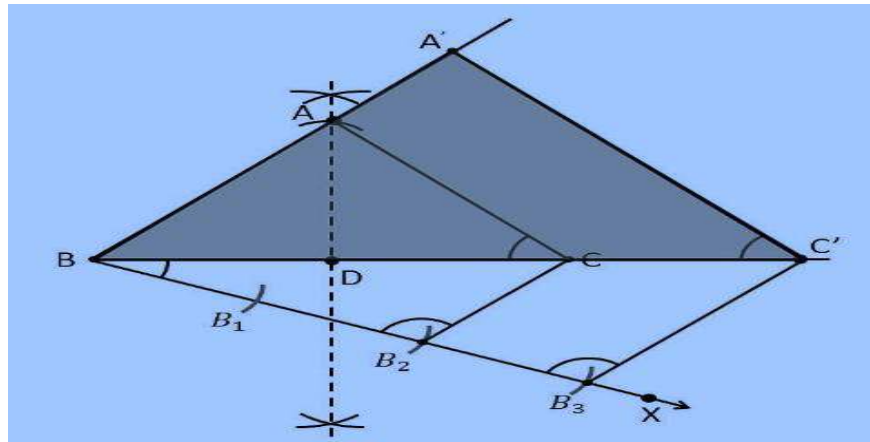
$$AC' = (7/5)AC$$

Hence, justified.

4. Construct an isosceles triangle whose base is 8 cm and altitude 4 cm and then another triangle whose sides are $1\frac{1}{2}$ times the corresponding sides of the isosceles triangle

Construction Procedure:

1. Draw a line segment BC with the measure of 8 cm.
2. Now draw the perpendicular bisector of the line segment BC and intersect at the point D
3. Take the point D as centre and draw an arc with the radius of 4 cm which intersect the perpendicular bisector at the point A
4. Now join the lines AB and AC and the triangle is the required triangle.
5. Draw a ray BX which makes an acute angle with the line BC on the side opposite to the vertex A.
6. Locate the 3 points B_1, B_2 and B_3 on the ray BX such that $BB_1 = B_1B_2 = B_2B_3$
9. Join the points B_2C and draw a line from B_3 which is parallel to the line B_2C where it intersect the extended line segment BC at point C' .
10. Now, draw a line from C' the extended line segment AC at A' which is parallel to the line AC and it intersects to make a triangle.
11. Therefore, $\triangle A'BC'$ is the required triangle.



Justification:

The construction of the given problem can be justified by proving that

$$A'B = (3/2)AB$$

$$BC' = (3/2)BC$$

$$A'C' = (3/2)AC$$

From the construction, we get $A'C' \parallel AC$

$$\therefore \angle A'C'B = \angle ACB \text{ (Corresponding angles)}$$

In $\Delta A'BC'$ and ΔABC ,

$$\angle B = \angle B \text{ (common)}$$

$$\angle A'BC' = \angle ACB$$

$$\therefore \Delta A'BC' \sim \Delta ABC \text{ (From AA similarity criterion)}$$

$$\text{Therefore, } A'B/AB = BC'/BC = A'C'/AC$$

Since the corresponding sides of the similar triangle are in the same ratio, it becomes

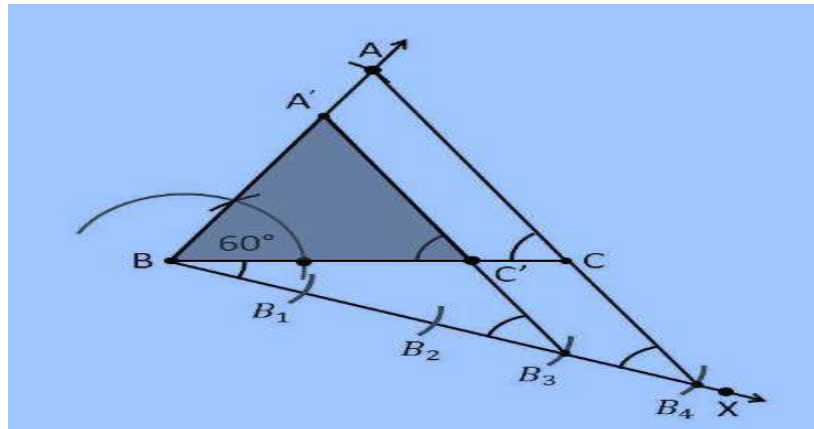
$$A'B/AB = BC'/BC = A'C'/AC = 3/2$$

Hence, justified.

5. Draw a triangle ABC with side BC = 6 cm, AB = 5 cm and $\angle ABC = 60^\circ$. Then construct a triangle whose sides are $3/4$ of the corresponding sides of the triangle ABC.

Construction Procedure:

1. Draw a ΔABC with base side BC = 6 cm, and AB = 5 cm and $\angle ABC = 60^\circ$.
2. Draw a ray BX which makes an acute angle with BC on the opposite side of vertex A.
3. Locate 4 points (as 4 is greater in 3 and 4), such as B₁, B₂, B₃, B₄, on line segment BX.
4. Join the points B₄C and also draw a line through B₃, parallel to B₄C intersecting the line segment BC at C'.
5. Draw a line through C' parallel to the line AC which intersects the line AB at A'.
6. Therefore, $\Delta A'BC'$ is the required triangle



Justification:

The construction of the given problem can be justified by proving that
Since the scale factor is $\frac{3}{4}$, we need to prove

$$A'B = \left(\frac{3}{4}\right)AB$$

$$BC' = \left(\frac{3}{4}\right)BC$$

$$A'C' = \left(\frac{3}{4}\right)AC$$

From the construction, we get $A'C' \parallel AC$

In $\Delta A'BC'$ and ΔABC ,

$$\therefore \angle A'C'B = \angle ACB \text{ (Corresponding angles)}$$

$$\angle B = \angle B \text{ (common)}$$

$$\therefore \Delta A'BC' \sim \Delta ABC \text{ (From AA similarity criterion)}$$

Since the corresponding sides of the similar triangle are in the same ratio, it becomes

$$\text{Therefore, } A'B/AB = BC'/BC = A'C'/AC$$

$$\text{So, it becomes } A'B/AB = BC'/BC = A'C'/AC = \frac{3}{4}$$

Hence, justified.

6. Draw a triangle ABC with side $BC = 7$ cm, $\angle B = 45^\circ$, $\angle A = 105^\circ$. Then, construct a triangle whose sides are $\frac{4}{3}$ times the corresponding sides of ΔABC .

To find $\angle C$:

Given:

$$\angle B = 45^\circ, \angle A = 105^\circ$$

We know that,

Sum of all interior angles in a triangle is 180° .

$$\angle A + \angle B + \angle C = 180^\circ$$

$$105^\circ + 45^\circ + \angle C = 180^\circ$$

$$\angle C = 180^\circ - 150^\circ$$

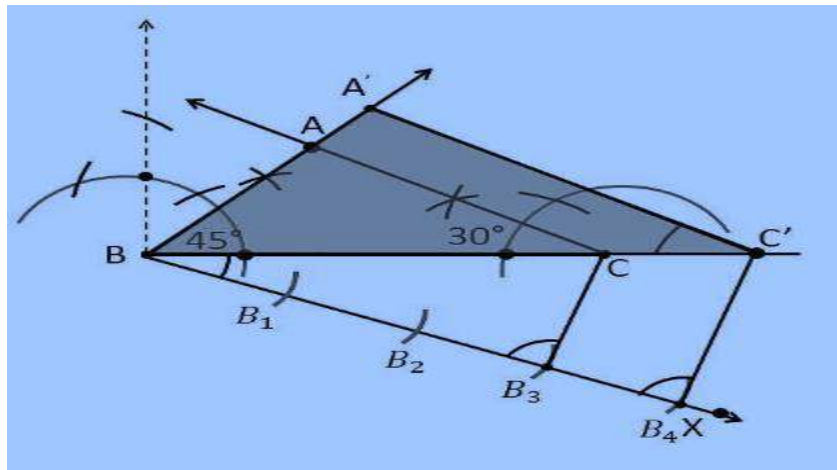
$$\angle C = 30^\circ$$

So, from the property of triangle, we get $\angle C = 30^\circ$

Construction Procedure:

The required triangle can be drawn as follows.

1. Draw a ΔABC with side measures of base $BC = 7$ cm, $\angle B = 45^\circ$, and $\angle C = 30^\circ$.
2. Draw a ray BX makes an acute angle with BC on the opposite side of vertex A .
3. Locate 4 points (as 4 is greater in 4 and 3), such as B_1, B_2, B_3, B_4 , on the ray BX .
4. Join the points B_3C .
5. Draw a line through B_4 parallel to B_3C which intersects the extended line BC at C' .
6. Through C' , draw a line parallel to the line AC that intersects the extended line segment at A' .
7. Therefore, $\Delta A'BC'$ is the required triangle.



Justification:

The construction of the given problem can be justified by proving that
Since the scale factor is $4/3$, we need to prove

$$A'B = (4/3)AB$$

$$BC' = (4/3)BC$$

$$A'C' = (4/3)AC$$

From the construction, we get $A'C' \parallel AC$

In $\Delta A'BC'$ and ΔABC ,

$$\therefore \angle A'C'B = \angle ACB \text{ (Corresponding angles)}$$

$$\angle B = \angle B \text{ (common)}$$

$$\therefore \Delta A'BC' \sim \Delta ABC \text{ (From AA similarity criterion)}$$

Since the corresponding sides of the similar triangle are in the same ratio, it becomes

$$\text{Therefore, } A'B/AB = BC'/BC = A'C'/AC$$

$$\text{So, it becomes } A'B/AB = BC'/BC = A'C'/AC = 4/3$$

Hence, justified.

7. Draw a right triangle in which the sides (other than hypotenuse) are of lengths 4 cm and 3 cm. Then construct another triangle whose sides are $5/3$ times the corresponding sides of the given triangle.

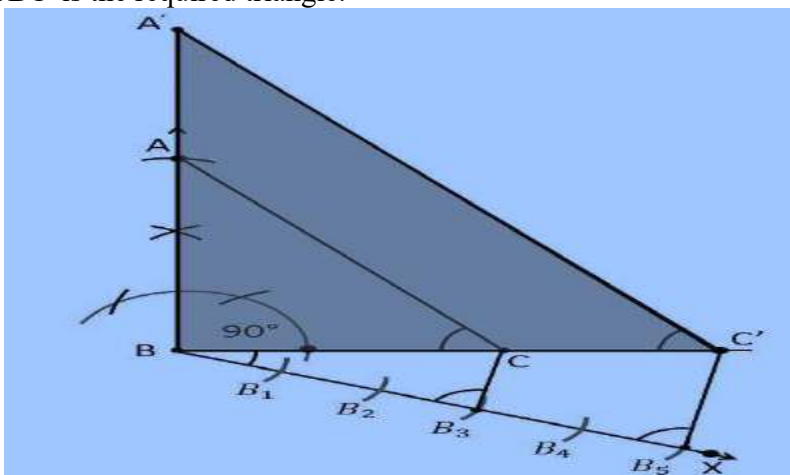
Given:

The sides other than hypotenuse are of lengths 4cm and 3cm. It defines that the sides are perpendicular to each other

Construction Procedure:

The required triangle can be drawn as follows.

1. Draw a line segment $BC = 3$ cm.
2. Now measure and draw $\angle = 90^\circ$
3. Take B as centre and draw an arc with the radius of 4 cm and intersects the ray at the point B.
4. Now, join the lines AC and the triangle ABC is the required triangle.
5. Draw a ray BX makes an acute angle with BC on the opposite side of vertex A.
6. Locate 5 such as $B_1, B_2, B_3, B_4,$ on the ray BX such that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5$
7. Join the points B_3C .
8. Draw a line through B_5 parallel to B_3C which intersects the extended line BC at C' .
9. Through C' , draw a line parallel to the line AC that intersects the extended line AB at A' .
10. Therefore, $\Delta A'BC'$ is the required triangle.



Justification:

The construction of the given problem can be justified by proving that

Since the scale factor is $5/3$, we need to prove

$$A'B = (5/3)AB$$

$$BC' = (5/3)BC$$

$$A'C' = (5/3)AC$$

From the construction, we get $A'C' \parallel AC$

In $\Delta A'BC'$ and ΔABC ,

$$\therefore \angle A'C'B = \angle ACB \text{ (Corresponding angles)}$$

$$\angle B = \angle B \text{ (common)}$$

$$\therefore \Delta A'BC' \sim \Delta ABC \text{ (From AA similarity criterion)}$$

Since the corresponding sides of the similar triangle are in the same ratio, it becomes

$$\text{Therefore, } A'B/AB = BC'/BC = A'C'/AC$$

$$\text{So, it becomes } A'B/AB = BC'/BC = A'C'/AC = 5/3$$

Hence, justified.