12. Construction of triangles

Exercise 12.1

1. Question

Construct a triangle ABC in which AB = 5 cm and BC = 4.6 cm and AC = 3.7 cm.

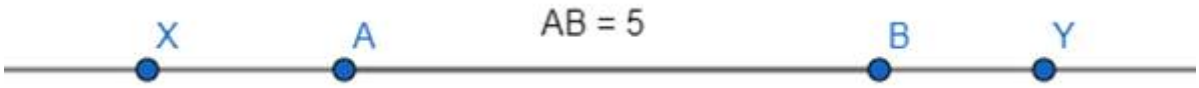
Answer

We follow several steps in construction to ensure a proper figure.

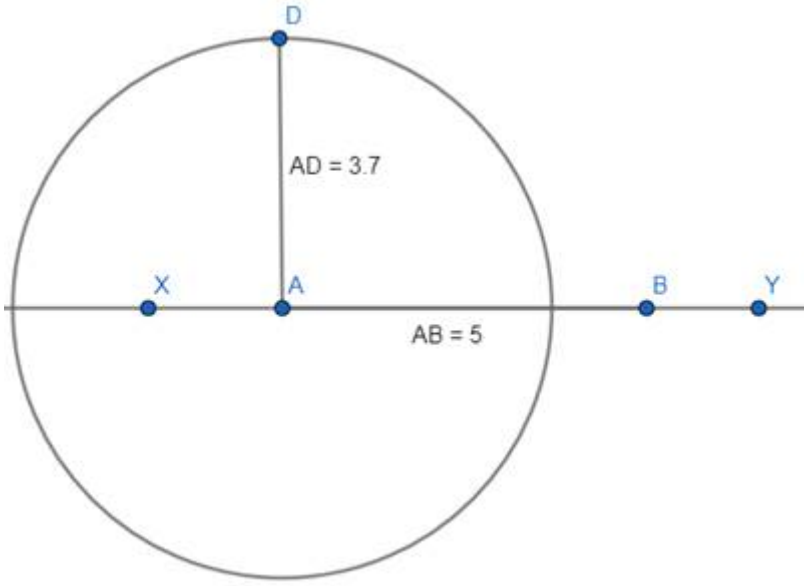
These are:

1. Draw a line segment sufficiently long using a ruler, name it XY (say).

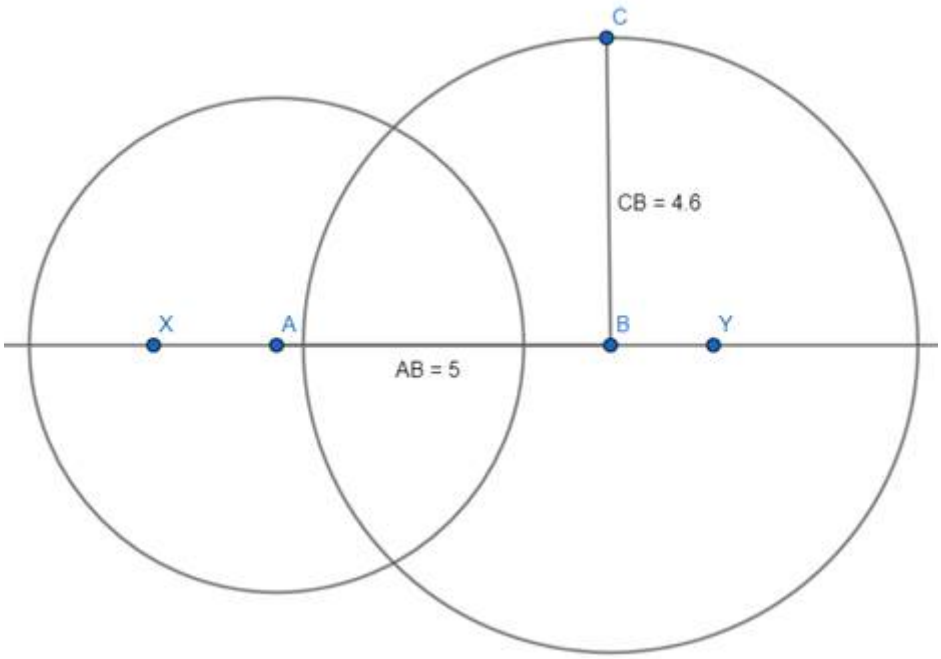
2. Locate points A and B such that AB = 5 cm on XY.



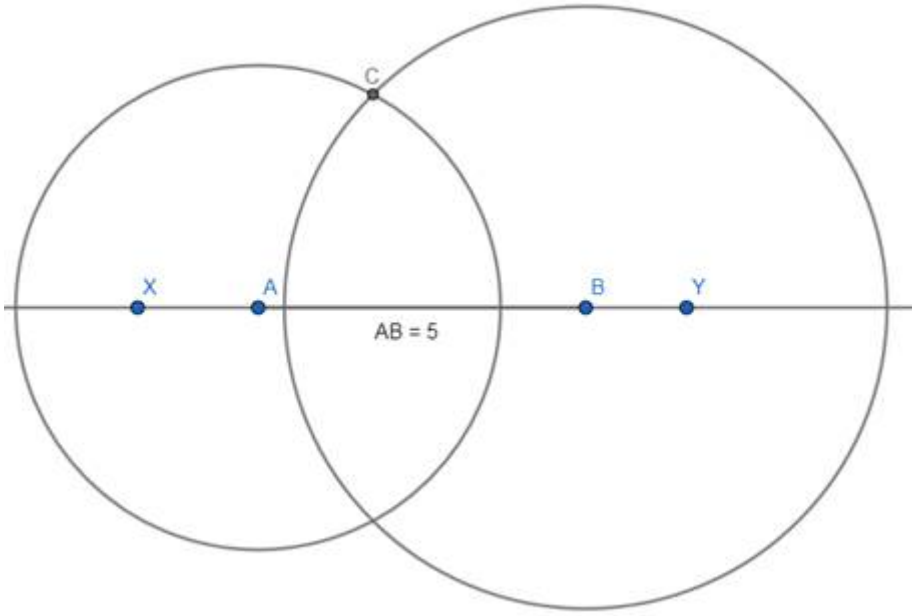
3. With A as centre and radius 3.7 cm, draw a circle or semicircle or arc (as drawn in the figure) using a compass.



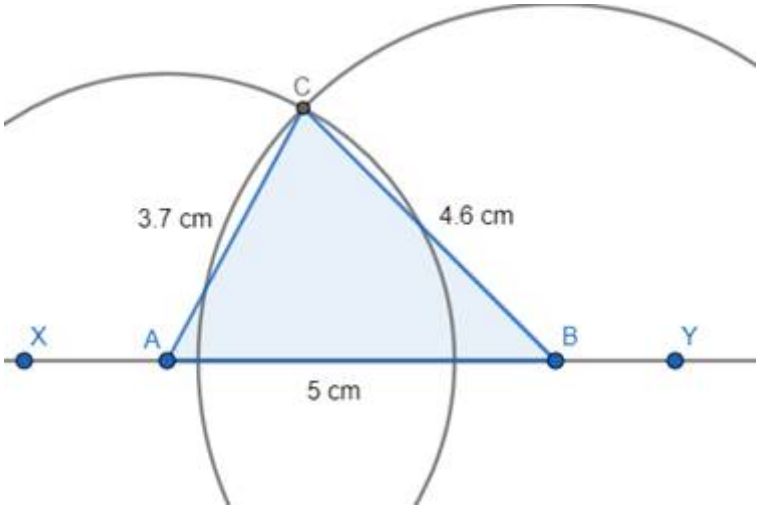
4. With B as centre and radius 4.6 cm, draw another circle or semicircle or arc using a compass.



5. These two circles or semicircles or arcs cut at a point, name it as C.



6. Join AC and BC to form the required triangle. X and Y points can be ignored or kept so.



Thus, ABC is the required triangle.

2. Question

Construct an equilateral triangle of side 4.8 cm.

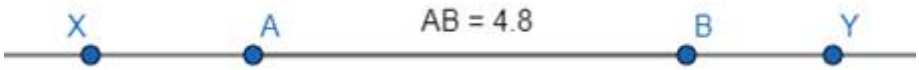
Answer

We follow several steps in construction to ensure a proper figure.

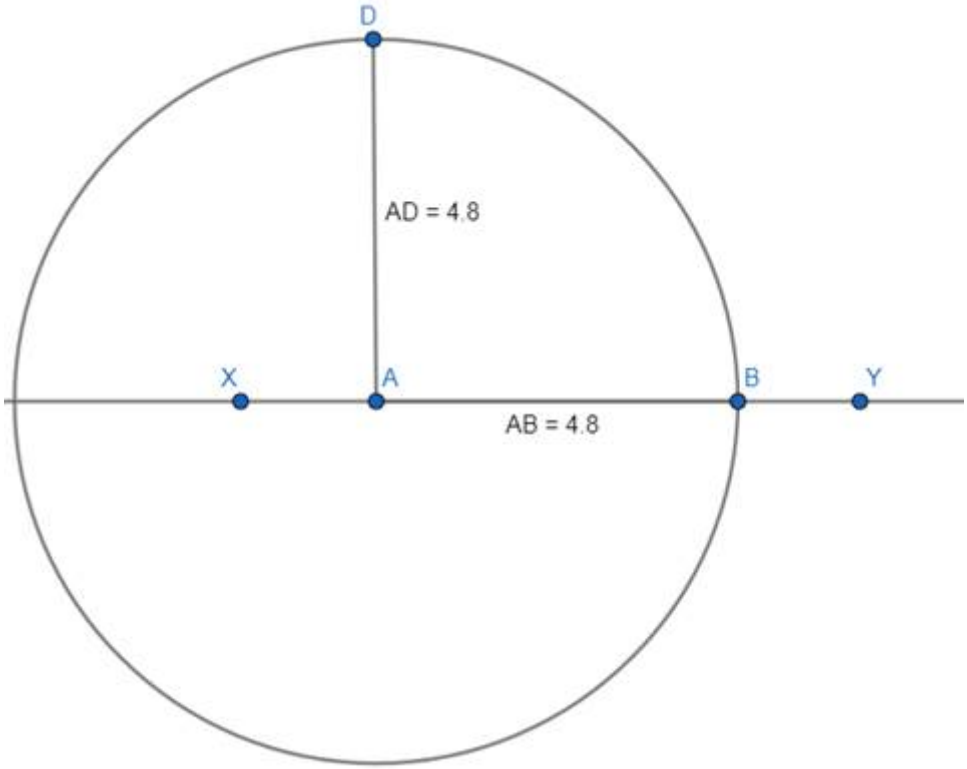
These are:

1. Draw a line segment sufficiently long using a ruler, name it XY (say).

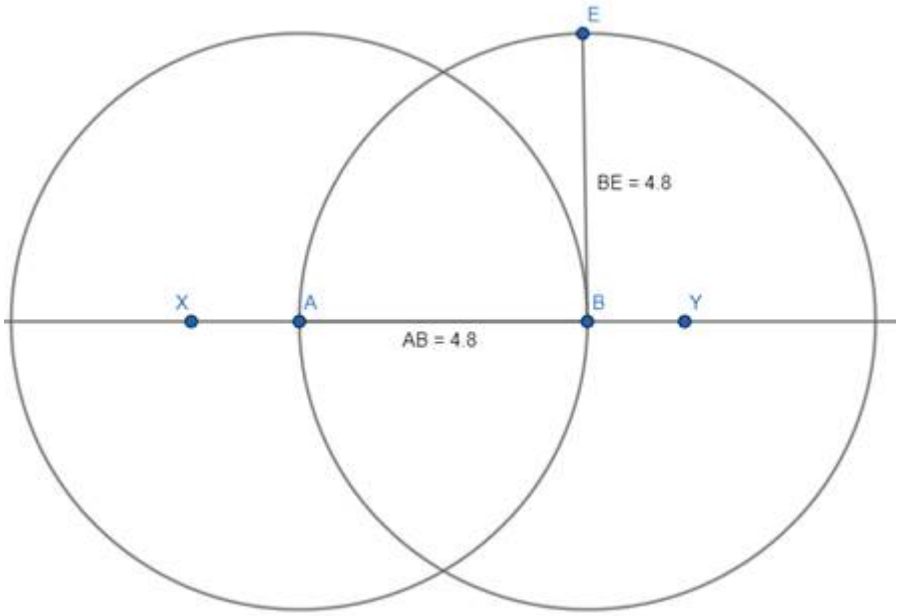
2. Locate points A and B such that AB = 4.8 cm on XY.



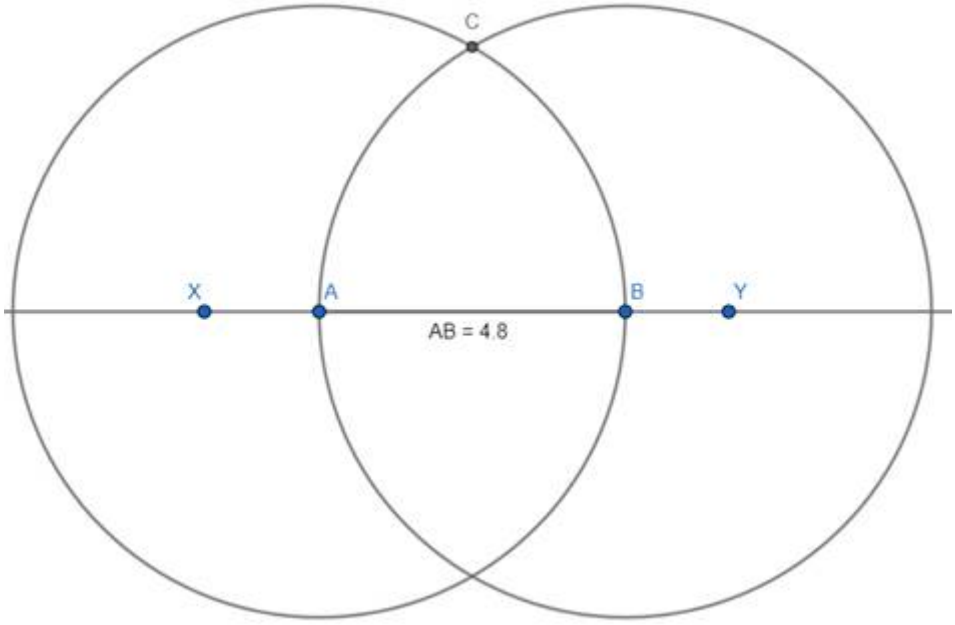
3. With A as centre and radius 4.8 cm, draw a circle or semicircle or arc (as drawn in the figure) using a compass.



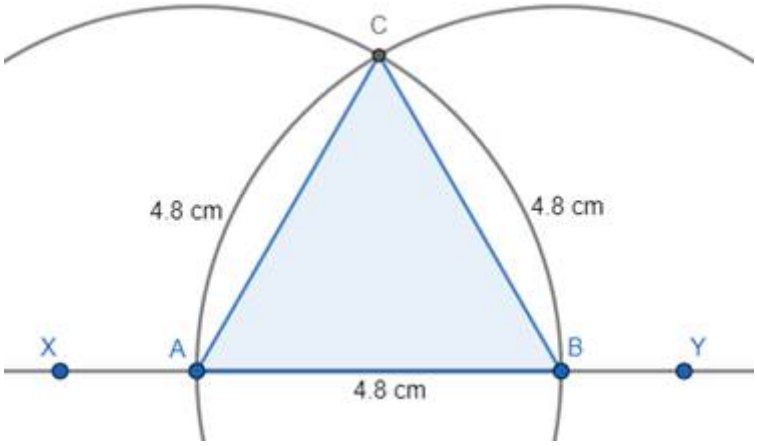
4. With B as centre and radius 4.8 cm, draw another circle or semicircle or arc.



5. These two circles or semicircles or arcs cut at a point, name it as C.



6. Join AC and BC.



Thus, ABC is the required triangle.

3. Question

Construct a triangle PQR, given that PQ = 5.6 cm, PR = 7 cm and QR = 4.5 cm.

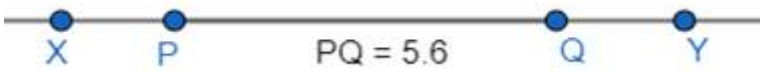
Answer

We follow several steps in construction to ensure a proper figure.

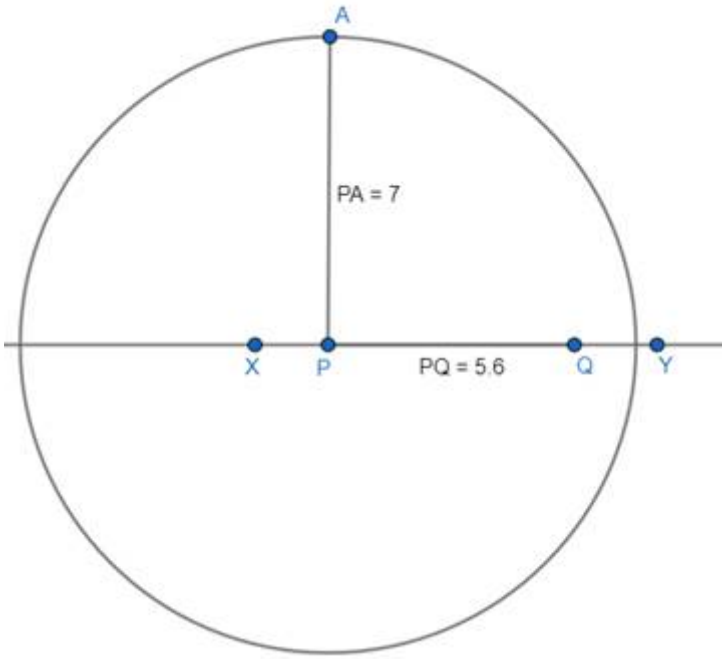
These are:

1. Draw a line segment sufficiently long using a ruler, name it XY (say).

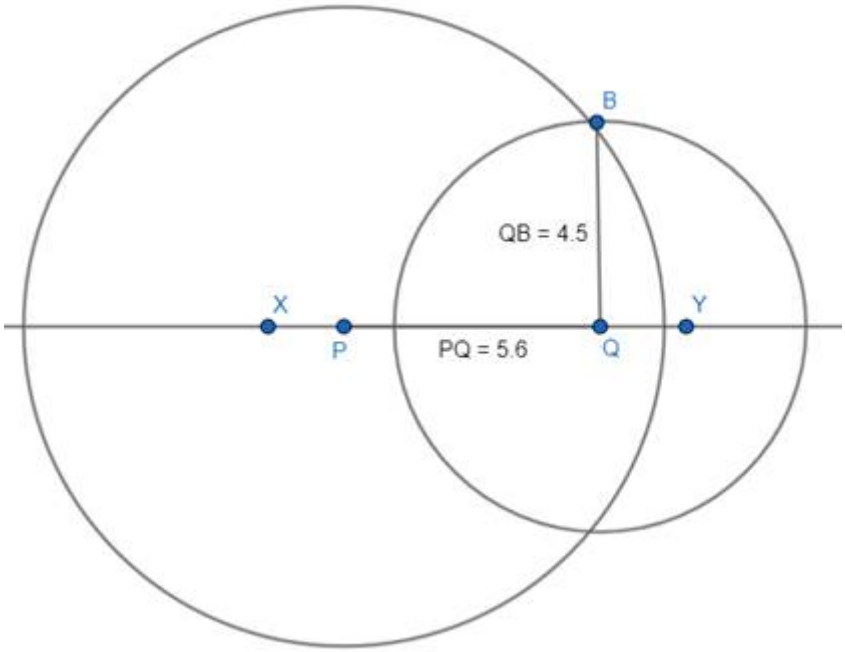
2. Locate points P and Q such that PQ = 5.6 cm on XY.



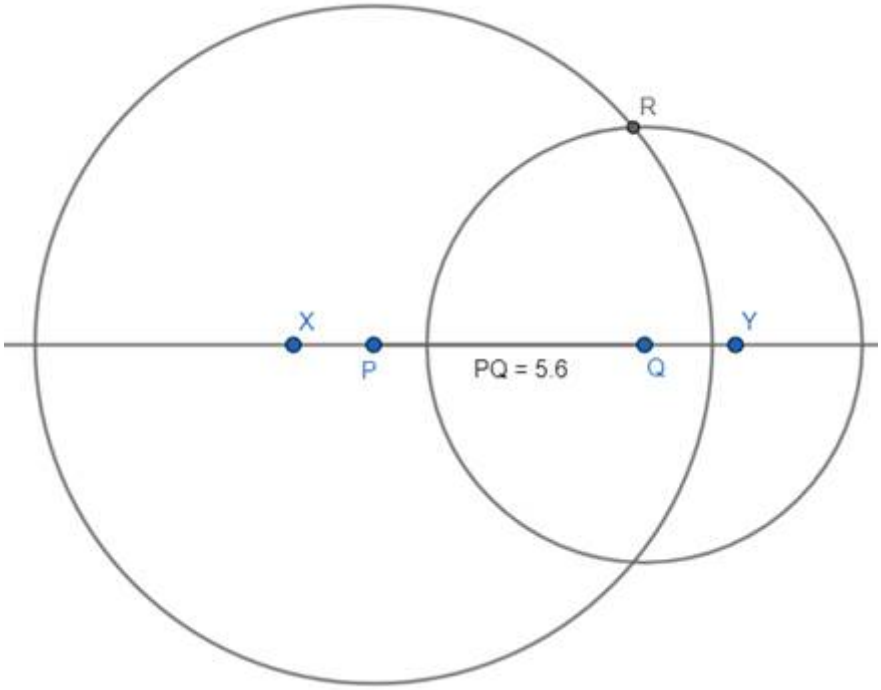
3. With P as centre and radius 7 cm, draw a circle or semicircle or an arc (as drawn in the figure) using a compass.



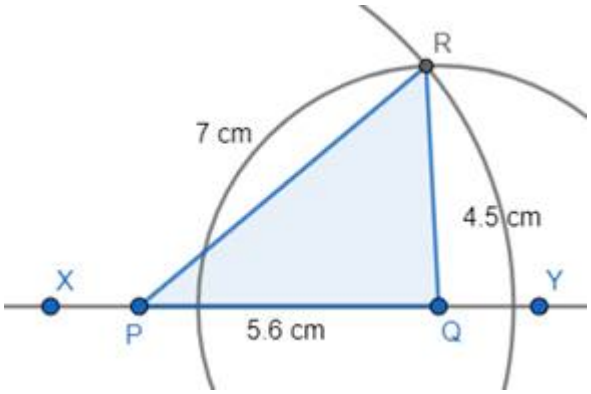
4. With Q as centre and radius 4.5 cm, draw another circle or semicircle or arc using a compass.



5. These two circles or semicircles or arcs cut at a point, name it as R.



6. Join PR and QR.



Thus, PQR is the required triangle.

4. Question

Construct a triangle XYZ in which XY = 7.8 cm, YZ = 4.5 cm and XZ = 9.5 cm.

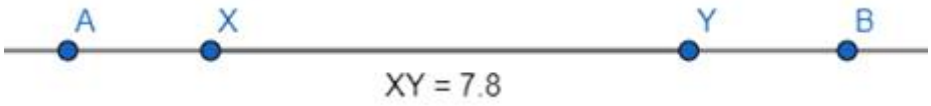
Answer

We follow several steps in construction to ensure a proper figure.

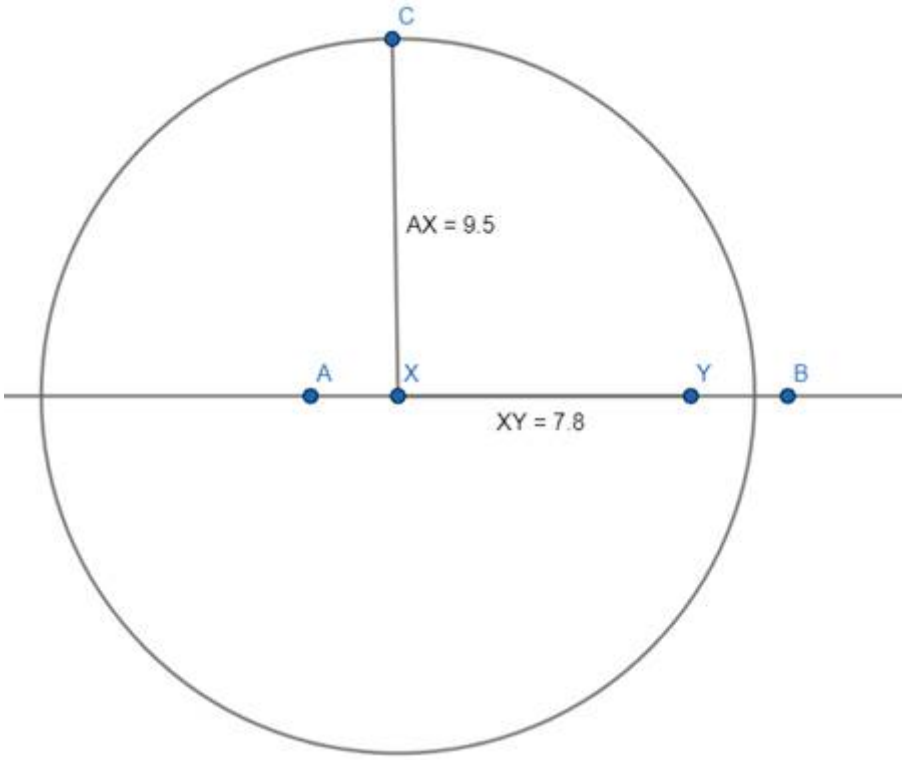
These are:

1. Draw a line segment sufficiently long using a ruler, name it as AB (say).

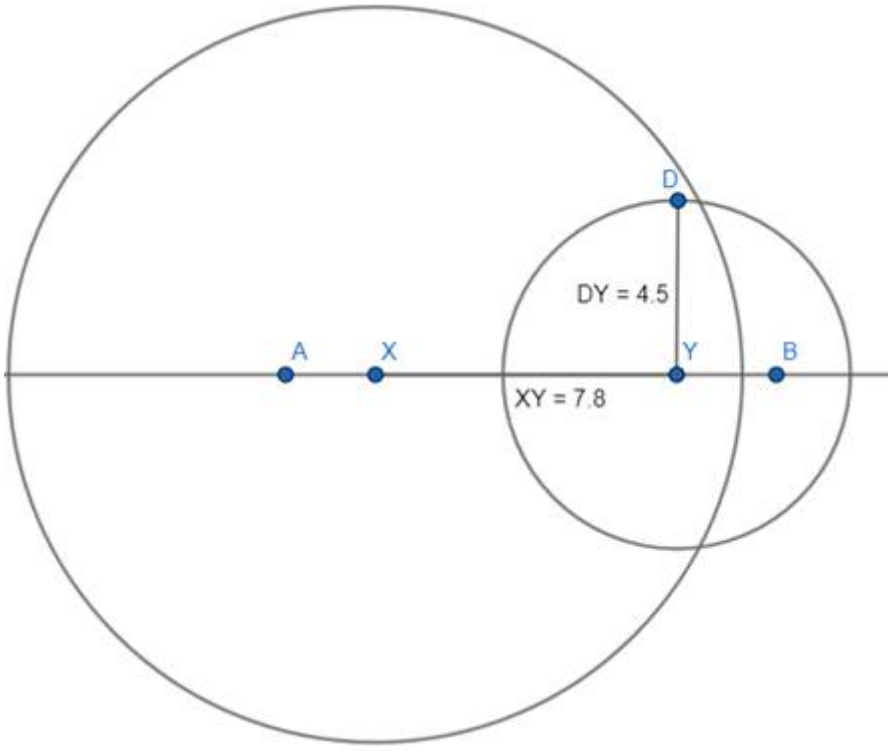
2. Locate points X and Y such that XY = 7.8 cm on AB.



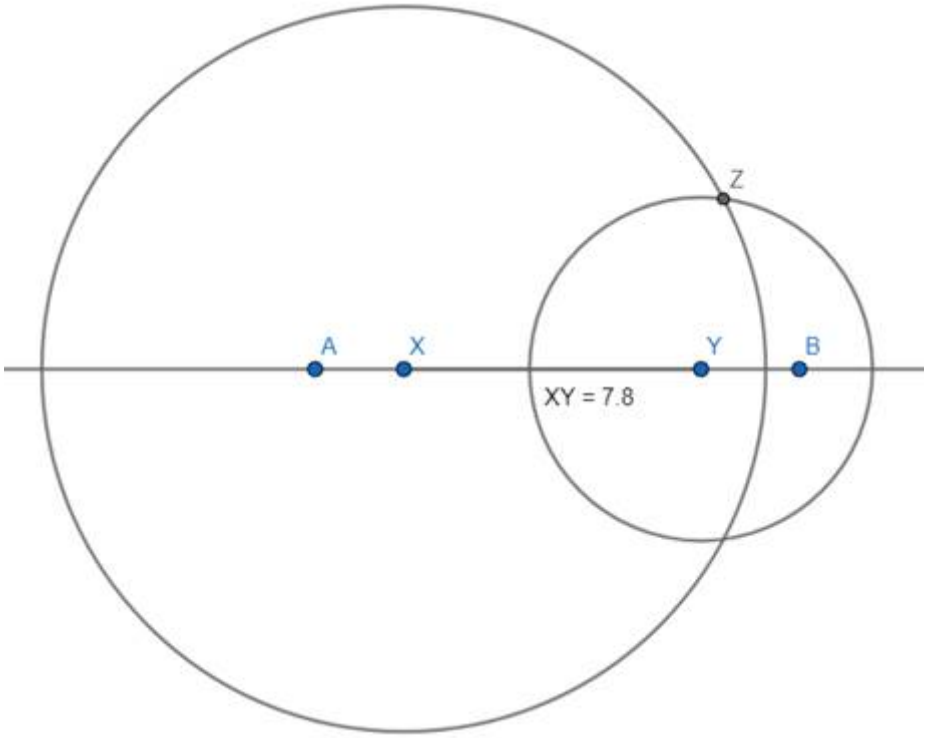
3. With X as centre and radius 9.5 cm, draw a circle or semicircle or an arc (as drawn in the figure) using a compass.



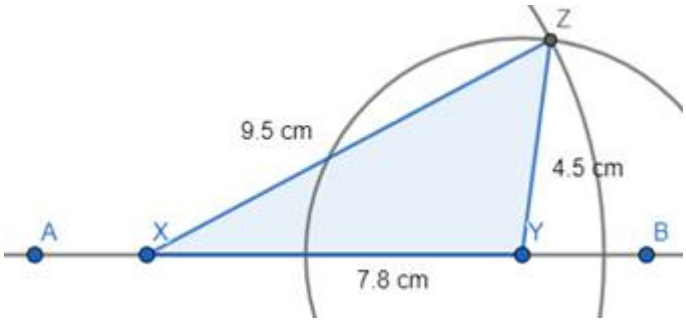
4. With Y as centre and radius 4.5 cm, draw another circle or semicircle or arc using a compass.



5. These two circles or semicircles or arcs cut at a point, name it as Z.



6. Join XZ and YZ.



Thus, XYZ is the required triangle.

5. Question

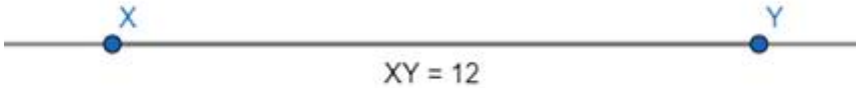
Construct a triangle whose perimeter is 12 cm and the ratio of their sides is 3:4:5.

Answer

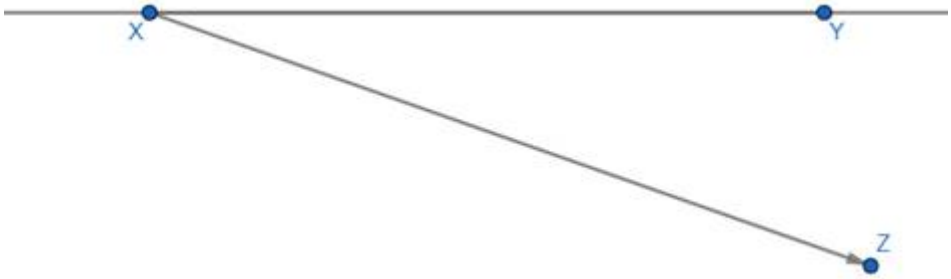
We are given with perimeter of triangle and ratio of its sides. We need to construct a triangle using the given information.

Steps of construction:

1. Draw a line segment using ruler and locate points X and Y such that XY = 12 cm.

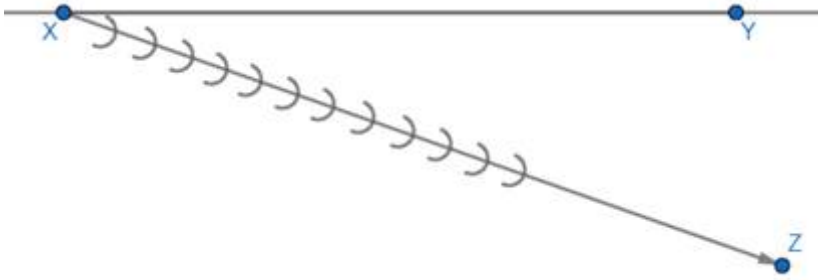


2. Draw a ray XZ, making an acute angle with XY and drawn in the downward direction. An acute angle is an angle smaller than a right angle (it is less than 90 degrees).

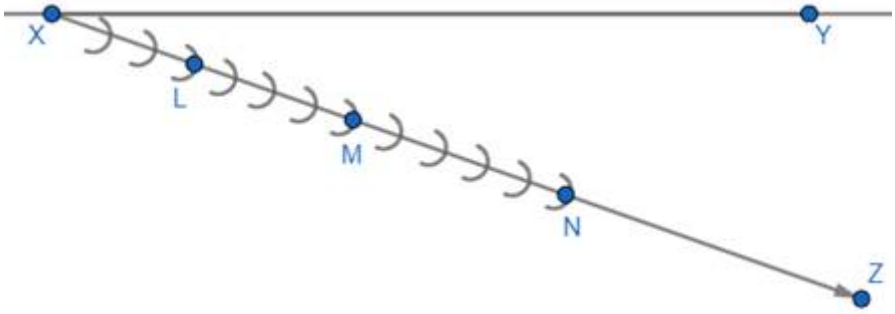


Clearly, the ∠YXZ < 90°.

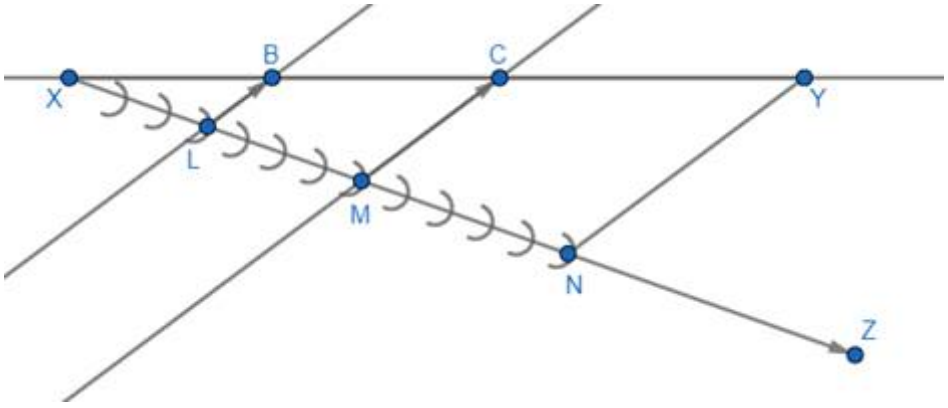
3. From X, locate (3 + 4 + 5) = 12 points at equal distances along XZ.



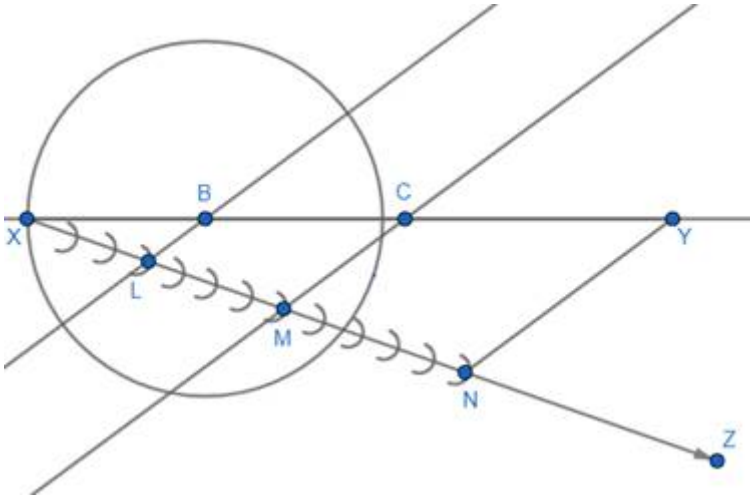
4. Mark points L, M, N on XZ such that XL = 3 parts, LM = 4 parts and MN = 5 parts.



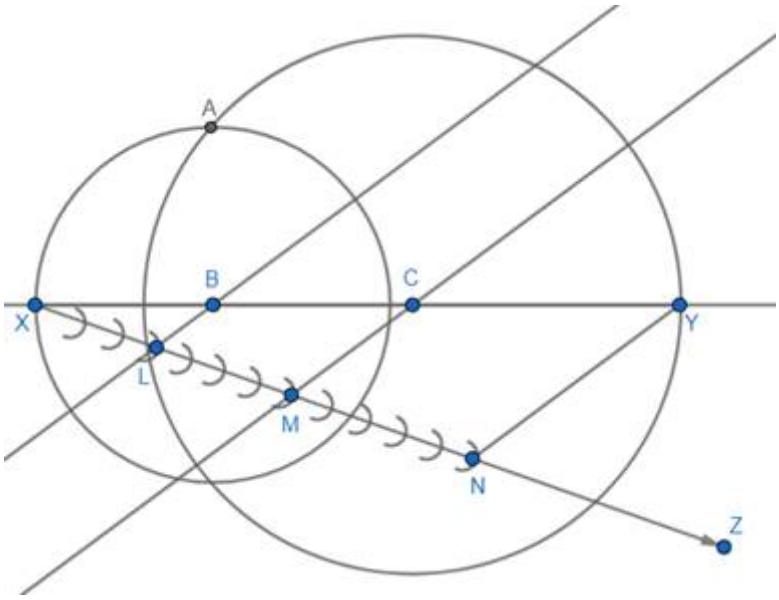
5. Now, join NY. Through L and M, draw LB ∥ NY and MC ∥ NY, intersecting XY at B and C respectively.



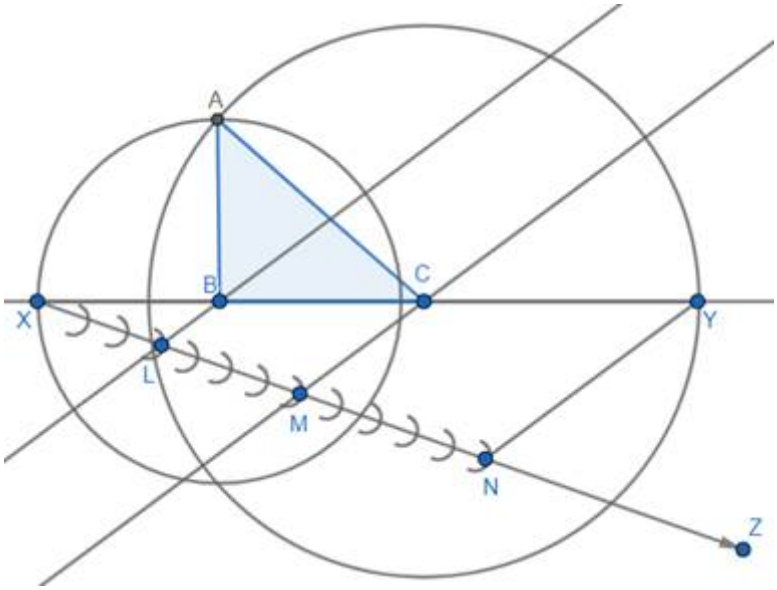
6. With B as centre and BX as radius, draw an arc. Keep one end of compass fixed at B, and then draw a fine circle or arc with it.



7. With C as centre and CY as radius, draw another arc cutting the previous arc at A. Keep one end of the compass at C and the other at Y, and then draw a fine circle or arc with it.



8. Finally, join AB and AC.



Thus, ABC is the required triangle.

Exercise 12.2

1. Question

Construct a triangle ABC, in which AB = 4.5 cm, AC = 5.5 cm and ∠BAC = 75°.

Answer

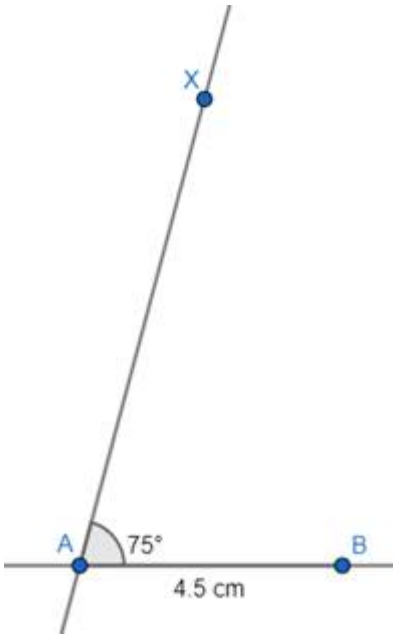
We have been given two sides and one angle of triangle ABC.

Steps of construction for this case would be:

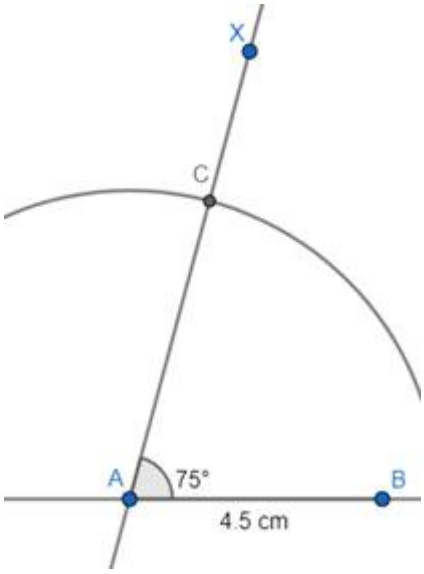
1. Draw a line segment sufficiently long using a ruler.

2. Locate points A and B such that AB = 4.5 cm on the line segment so formed in the previous step.

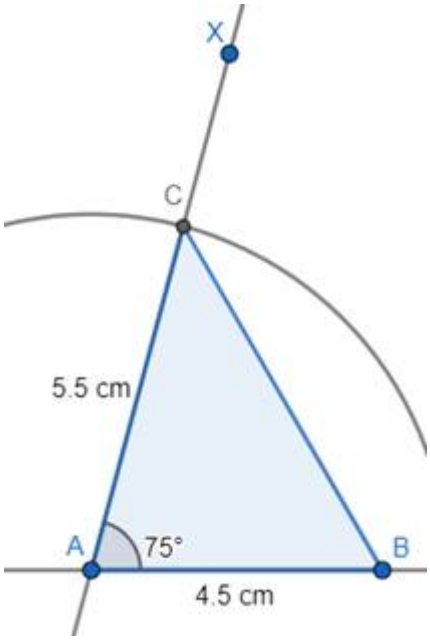
3. At A, construct a line segment AX, sufficiently large, such that ∠XAB = 75°; use protractor to measure the angle 75°.



4. With A as centre and radius 5.5 cm, draw a circle or semicircle or an arc cutting the line segment AX at C using a compass and a ruler.



5. Join BC using a ruler.



Thus, ABC is the required triangle.

2. Question

Construct a triangle PQR in which PQ = 5.4 cm, QR = 5.5 cm and ∠PQR = 55°.

Answer

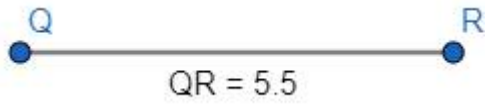
We have been given two sides and one angle of triangle PQR.

Steps of construction for this case would be:

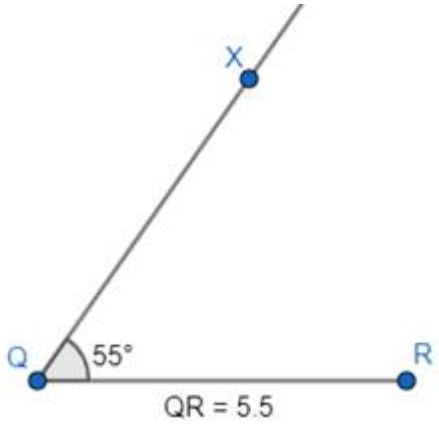
1. Draw a line segment sufficiently long using a ruler.

---

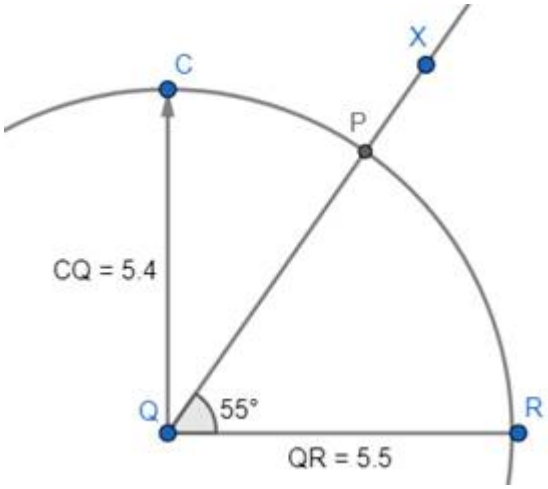
2. Locate points Q and R such that QR = 5.5 cm, on the line segment so formed in step 1 and you can even erase the unnecessary line.



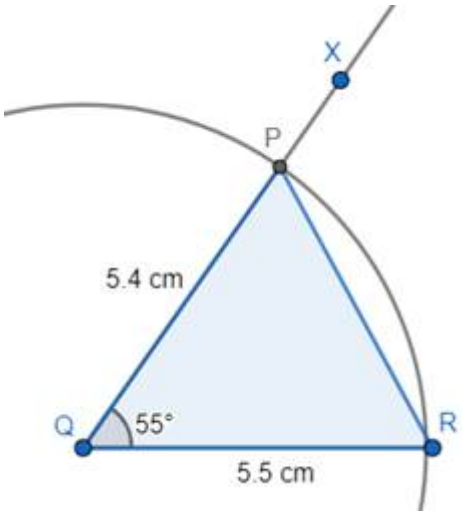
3. At Q, construct a line segment QX, sufficiently large, such that ∠XQR = 55°; use protractor to measure the angle 55°.



4. With Q as centre and radius 5.4 cm, draw a circle or semicircle or an arc cutting the line segment QX at P using a compass and a protractor.



5. Join PR.



Thus, PQR is the required triangle.

3. Question

Construct a triangle XYZ in which XY = 5 cm, YZ = 5.5 cm and ∠XYZ = 100°.

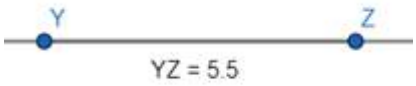
Answer

We have been given two sides and one angle of triangle XYZ.

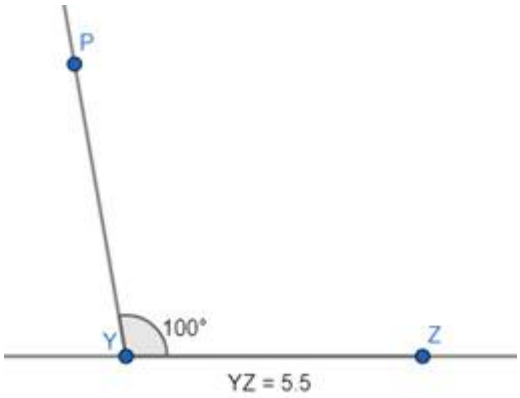
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

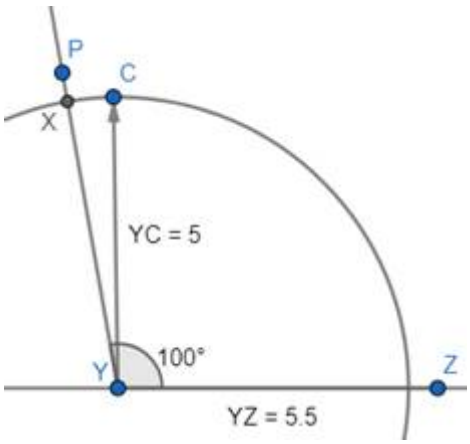
2. Locate points Y and Z such that YZ = 5.5 cm on the previously drawn line segment using a ruler.



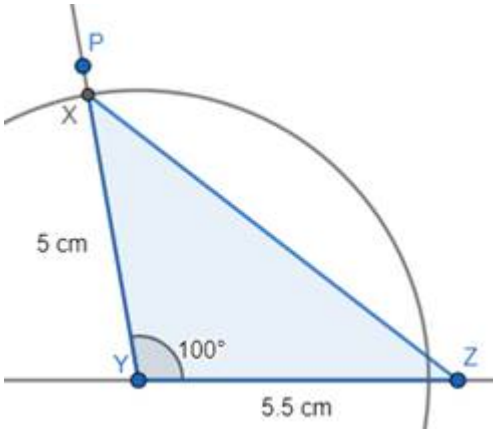
3. At Y, construct a line segment YP, sufficiently large, such that ∠PYZ = 100°; use protractor to measure the angle 100°.



4. With Y as centre and radius 5 cm, draw a circle or a semicircle or an arc cutting the line segment YP at X using a compass and a protractor.



5. Join ZX.



Thus, XYZ is the required triangle.

4. Question

Construct a triangle LMN in which LM = 7.8 cm, MN = 6.3 cm and ∠LMN = 45°.

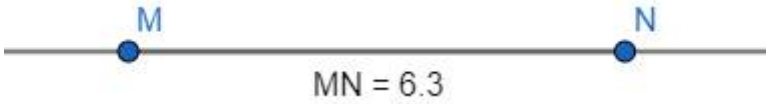
Answer

We have been given two sides and one angle of triangle LMN.

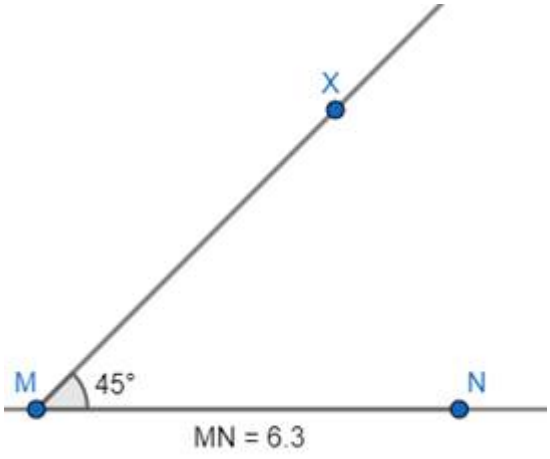
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

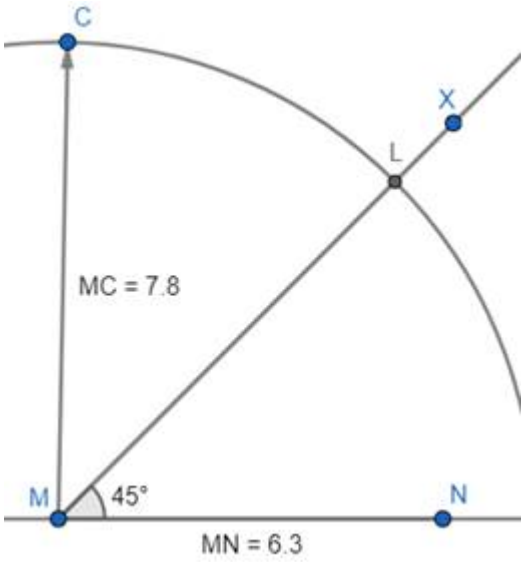
2. Locate points M and N such that MN = 6.3 cm.



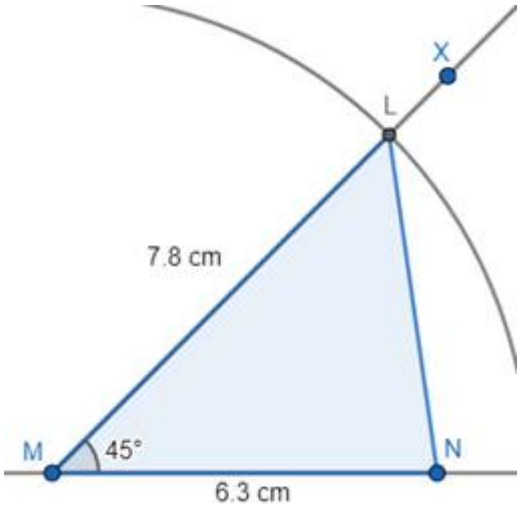
3. At M, construct a line segment MX, sufficiently large, such that ∠XMN = 45°; use protractor to measure the angle 45°.



4. With M as centre and radius 7.8 cm, draw a circle or a semicircle or an arc cutting the line segment MX at L using a compass.



5. Join LN.



Thus, LMN is the required triangle.

Exercise 12.3

1. Question

Construct a triangle ABC in which AB = 6.5 cm, ∠A = 45° and ∠B = 60°.

Answer

We have been given two angles and one side of triangle ABC.

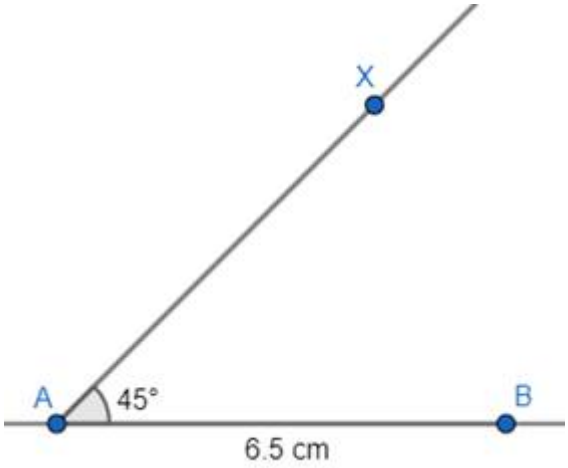
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

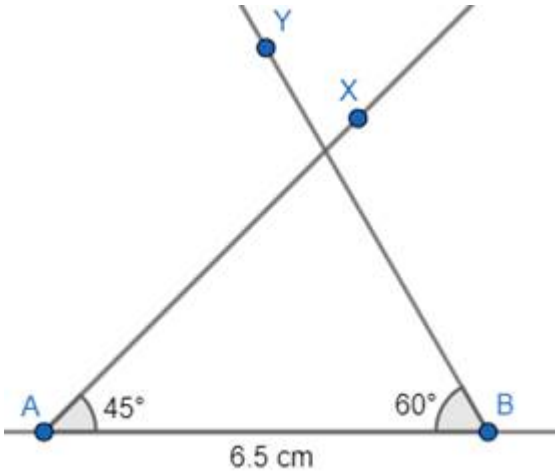
---

2. Locate points A and B such that AB = 6.5 cm, on the previously drawn line segment using a ruler.

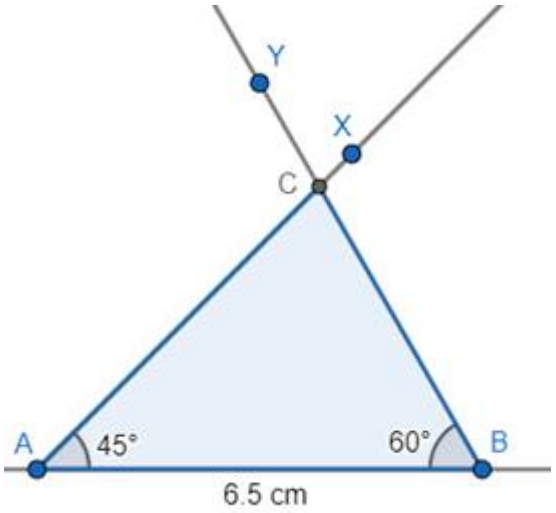
3. Construct a line segment AX such that ∠XAB = 45° using a compass; use protractor to measure 45°.



4. Construct another line segment BY such that ∠YBA = 60° using a compass; use protractor to measure 60°.



5. Use these extended line segments AX and BY to intersect at point C.



Thus, ABC is the required triangle.

2. Question

Construct a triangle PQR in which QR = 4.8 cm, ∠Q = 45° and ∠R = 55°.

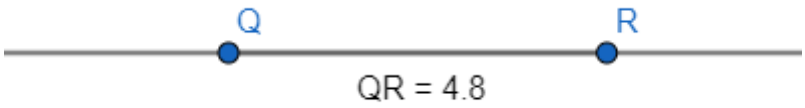
Answer

We have been given two angles and one side of triangle ABC.

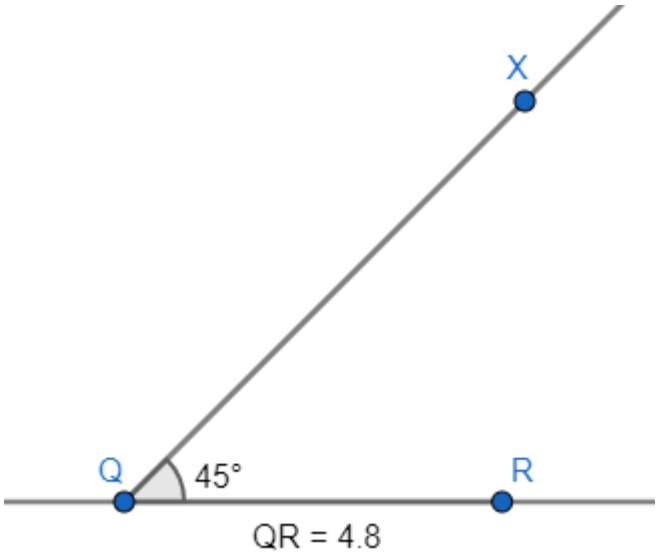
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

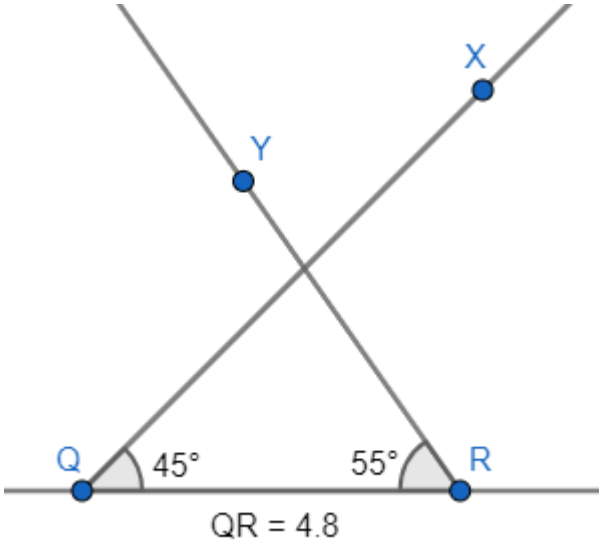
2. Locate points Q and R such that QR = 4.8 cm, on the previously drawn line segment using a ruler.



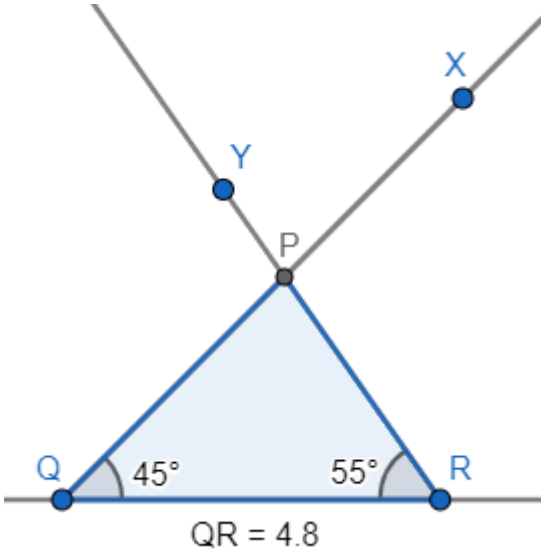
3. Construct a line segment QX such that ∠XQR = 45° using a compass; use protractor to measure 45°.



4. Construct another line segment RY such that ∠YRQ = 55° using a compass; use protractor to measure 55°.



5. Use these extended line segments QX and RY to intersect at point P.



Thus, PQR is the required triangle.

3. Question

Construct a triangle ABC in which BC = 5.2 cm, ∠B = 35° and ∠C = 80°.

Answer

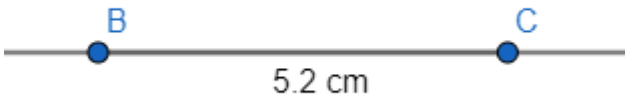
We have been given two angles and one side of triangle ABC.

Steps of construction for this case would be:

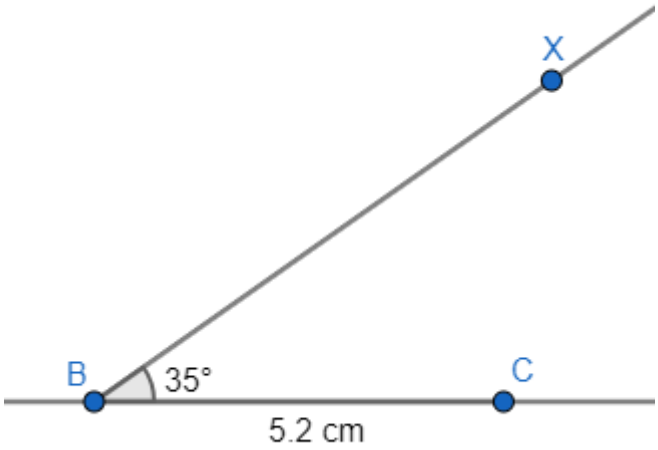
1. Draw a line segment sufficiently long using a ruler.

---

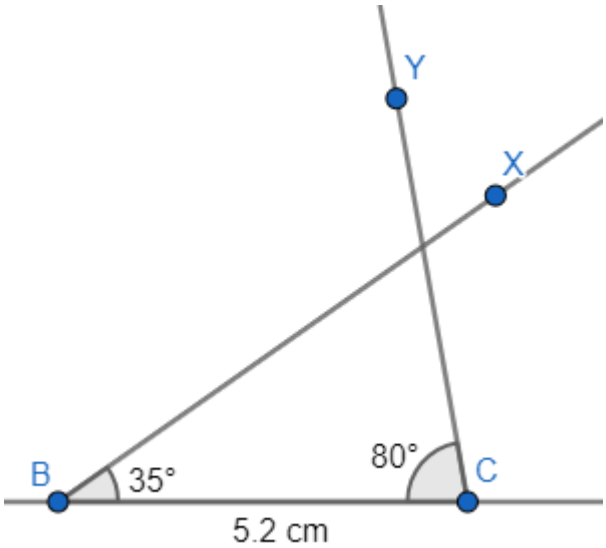
2. Locate points B and C such that BC = 5.2 cm, on the previously drawn line segment using a ruler.



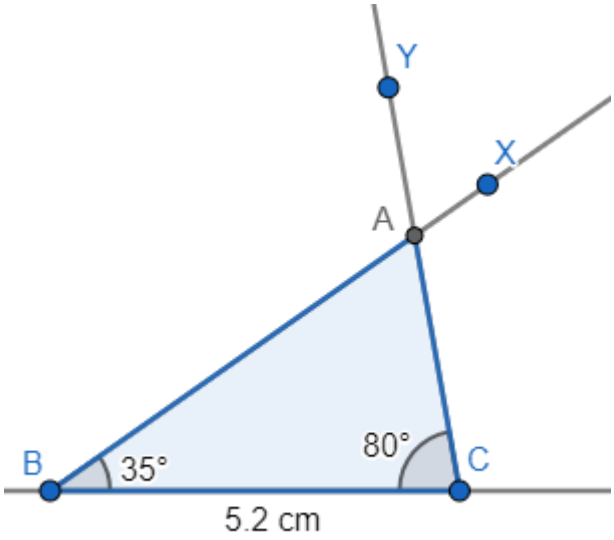
3. Construct a line segment BX such that ∠XBC = 35° using a compass; use protractor to measure 35°.



4. Construct another line segment CY such that ∠YCB = 80° using a compass; use protractor to measure 80°.



5. Use these extended line segments BX and CY to intersect at point A.



Thus, ABC is the required triangle.

4. Question

Construct a triangle ABC in which BC = 6 cm, ∠B = 30° and ∠C = 125°.

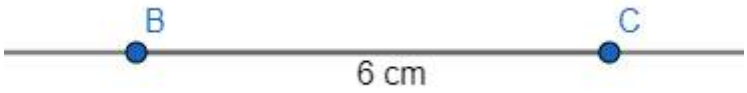
Answer

We have been given two angles and one side of triangle ABC.

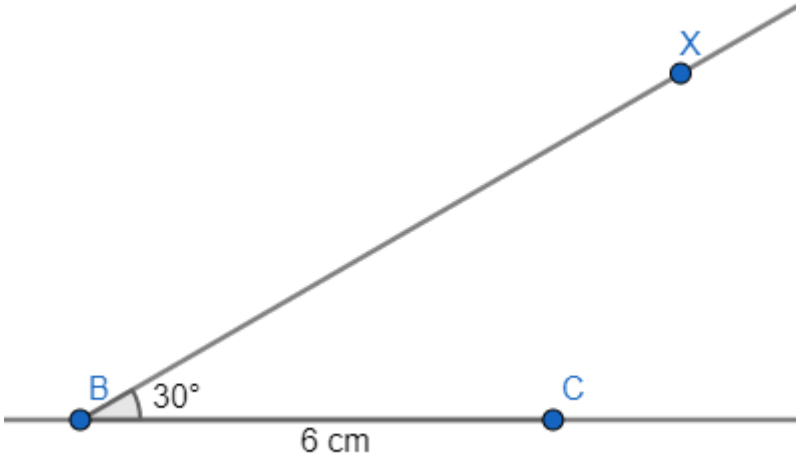
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

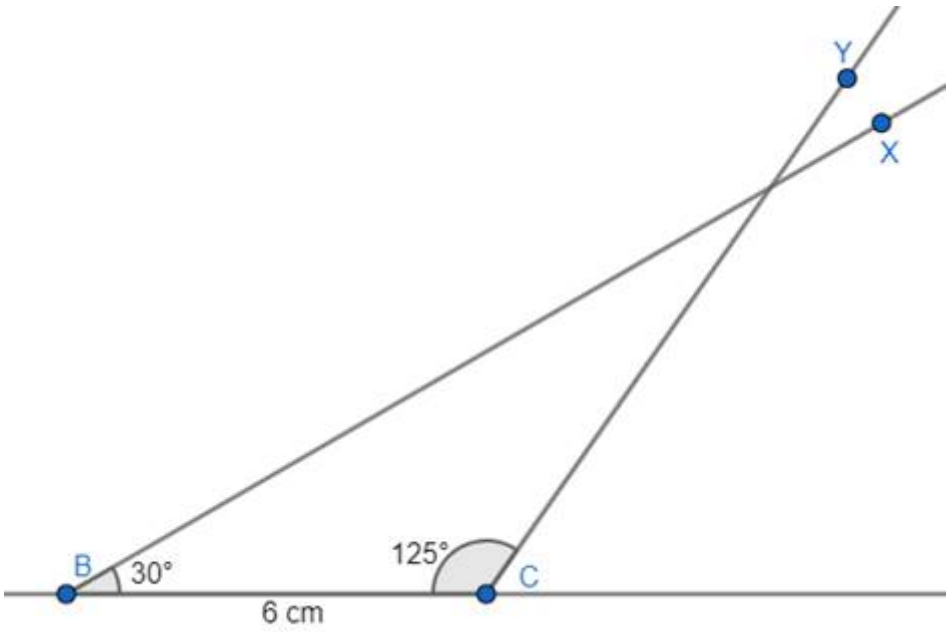
2. Locate points B and C such that BC = 6 cm, on the line segment in step 1 using a ruler.



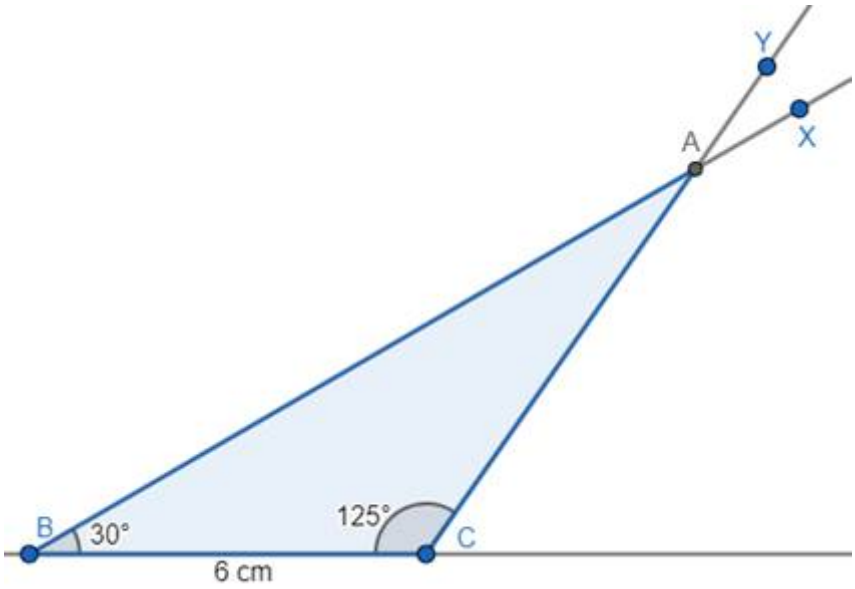
3. Construct a line segment BX such that ∠XBC = 30° using a compass; use protractor to measure 30°.



4. Construct another line segment CY such that ∠YCB = 125° using a compass; use protractor to measure 125°.



5. Use these extended line segments BX and CY to intersect at point A.



Thus, ABC is the required triangle.

Exercise 12.4

1. Question

Construct a right angle triangle ABC in which ∠B =90°, AB = 5 cm and AC = 7 cm.

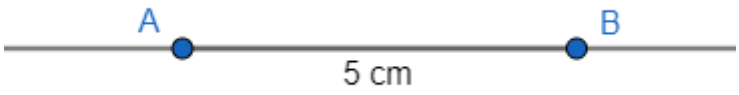
Answer

We have been given two sides and one angle of right angled triangle ABC.

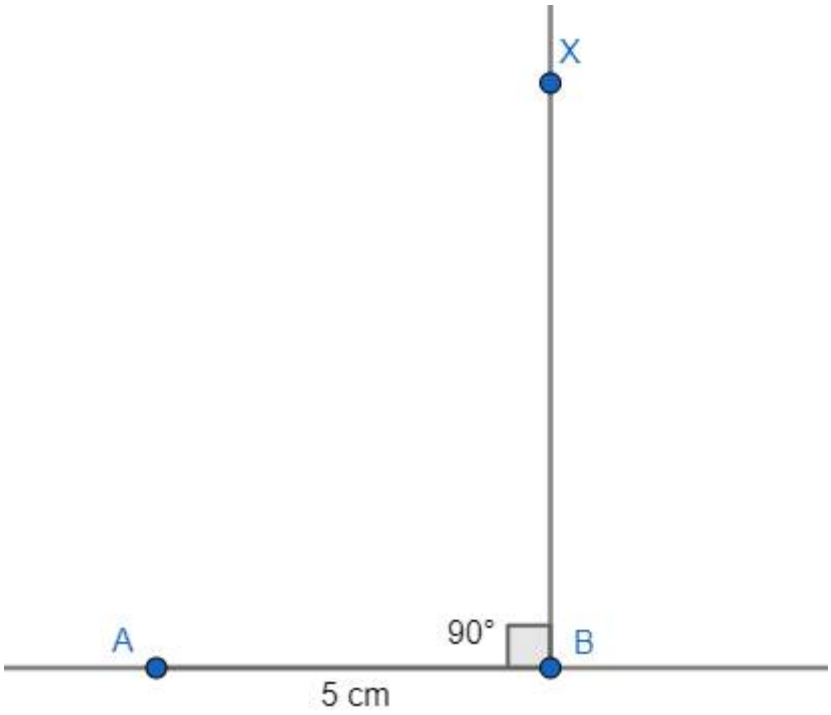
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

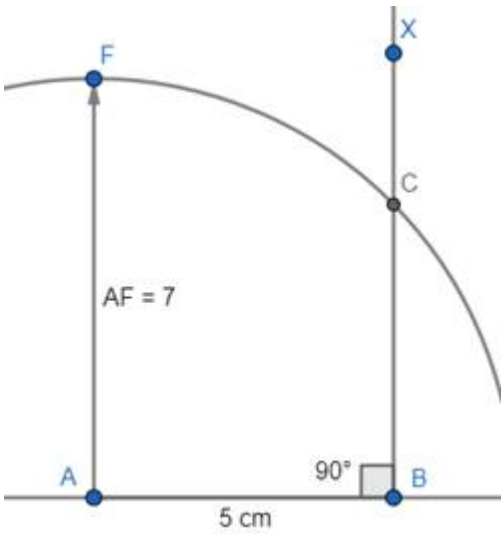
2. Locate points A and B such that AB = 5 cm, on the previous drawn line segment using a ruler.



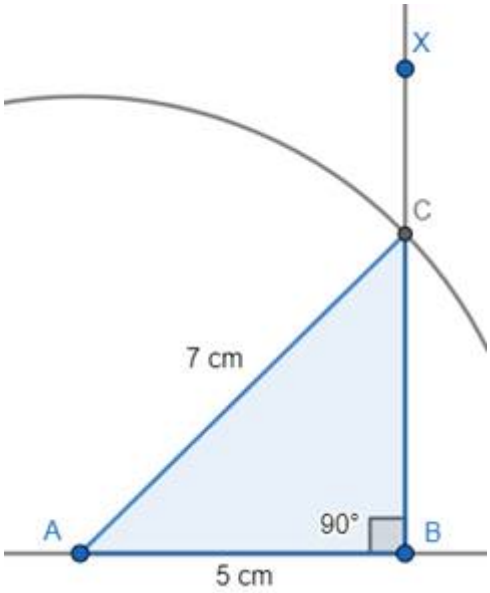
3. At B, construct a line segment BX, sufficiently large, such that ∠XBA = 90° using a compass; use protractor to measure the angle 90°.



4. With A as centre and radius 7 cm, draw a circle or a semicircle or an arc cutting the line segment BX at C.



5. Join AC.



Thus, ABC is the required triangle.

2. Question

Construct a right angle triangle PQR in which ∠R = 90°, PQ = 4 cm and QR – 3 cm.

Answer

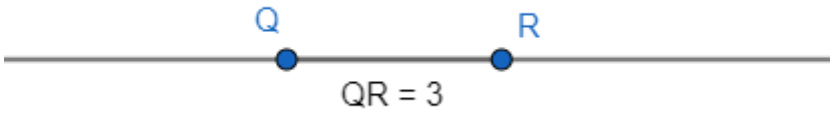
We have been given two sides and one angle of right angled triangle ABC.

Steps of construction for this case would be:

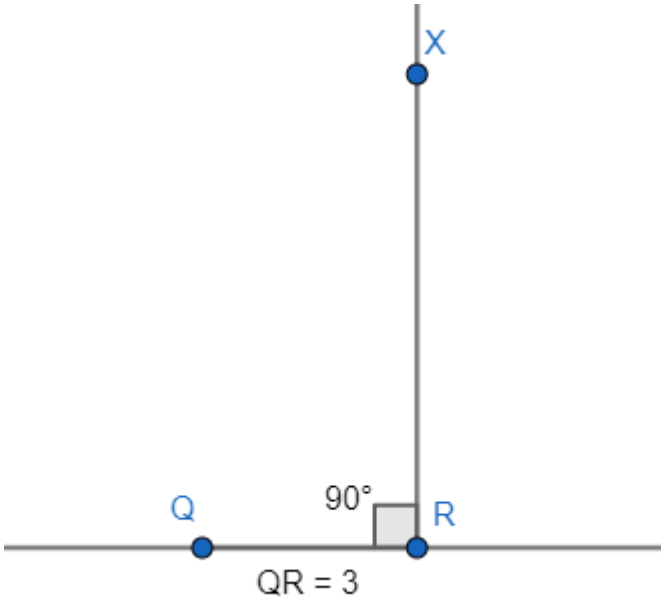
1. Draw a line segment sufficiently long using a ruler.

---

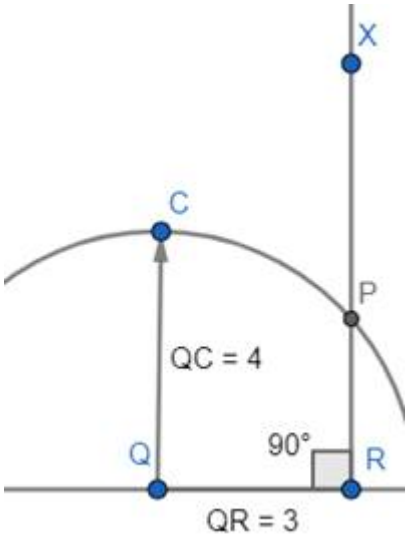
2. Locate points Q and R such that QR = 3 cm, on the previously drawn line segment using a ruler.



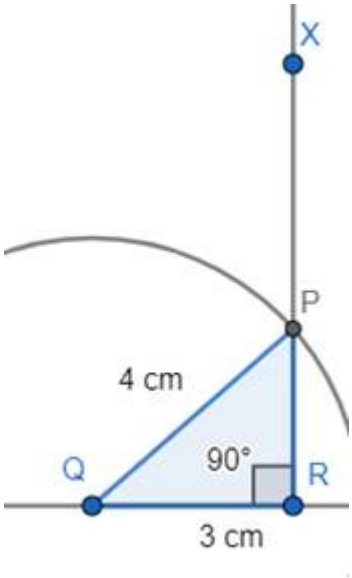
3. At R, construct a line segment RX, sufficiently large, such that ∠XRQ = 90° using a compass; use protractor to measure the angle 90°.



4. With Q as centre and radius 4 cm, draw a circle or a semicircle or an arc cutting the line segment RX at P.



5. Join QP.



Thus, PQR is the required triangle.

3. Question

Construct a right angle triangle ABC in which ∠B = 90°, BC = 4 cm and AC = 5 cm.

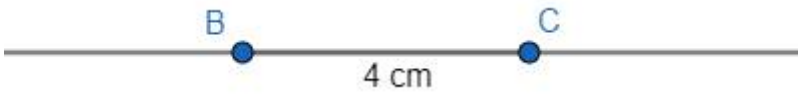
Answer

We have been given two sides and one angle of right angled triangle ABC.

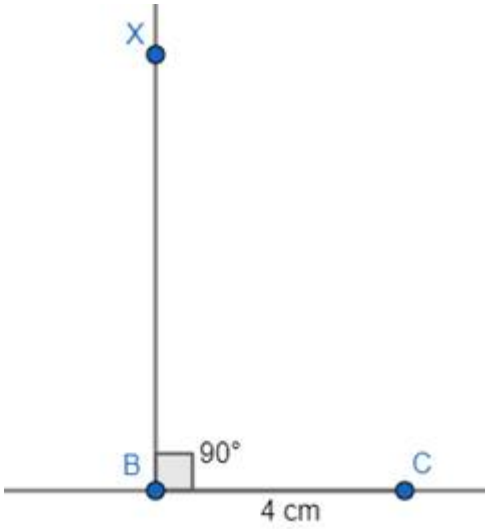
Steps of construction for this case would be:

1. Draw a line segment sufficiently long using a ruler.

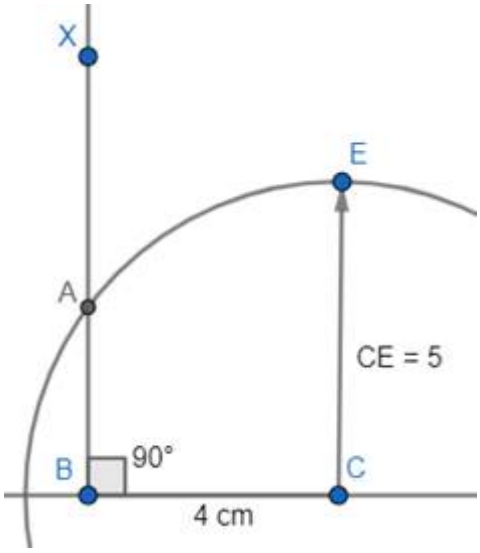
2. Locate points B and C such that BC = 4 cm, on the previously drawn line segment using a ruler.



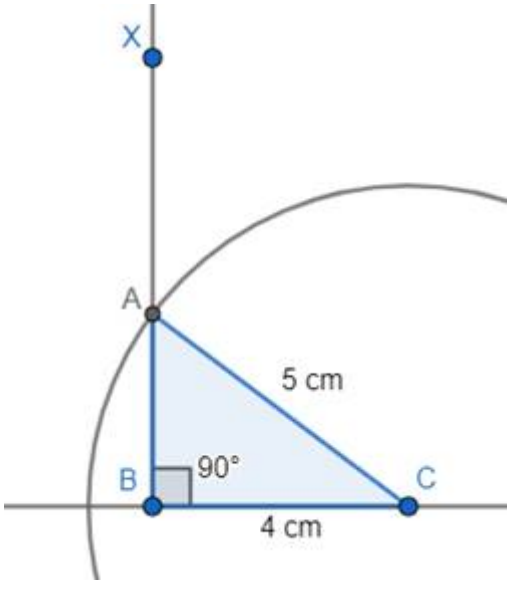
3. At B, construct a line segment BX, sufficiently large, such that ∠XBC = 90° using a compass; use protractor to measure the angle 90°.



4. With C as centre and radius 5 cm using a compass, draw an arc cutting the line segment BX at A.



5. Join AC.



Thus, ABC is the required triangle.

Exercise 12.5

1. Question

Construct an isosceles triangle ABC in which base BC = 6.5 cm and altitude from A on BC is 4 cm.

Answer

Here, we are supposed to construct an isosceles triangle ABC, with base BC and altitude from A on BC given.

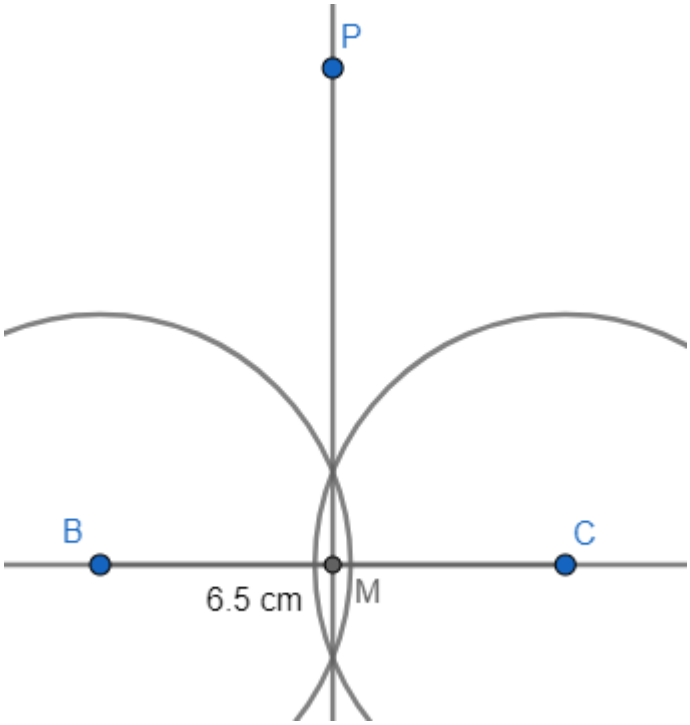
Steps of construction will be:

1. Draw a line segment sufficiently long using a ruler.

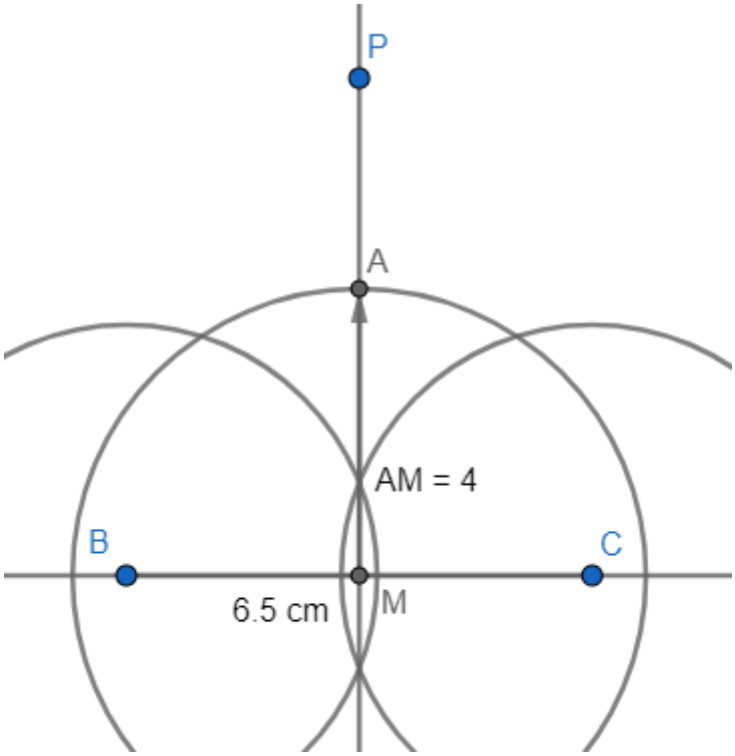
2. Locate points B and C such that BC = 6.5 cm, on the previously drawn line segment using a ruler.

3. Draw a perpendicular bisector of BC.

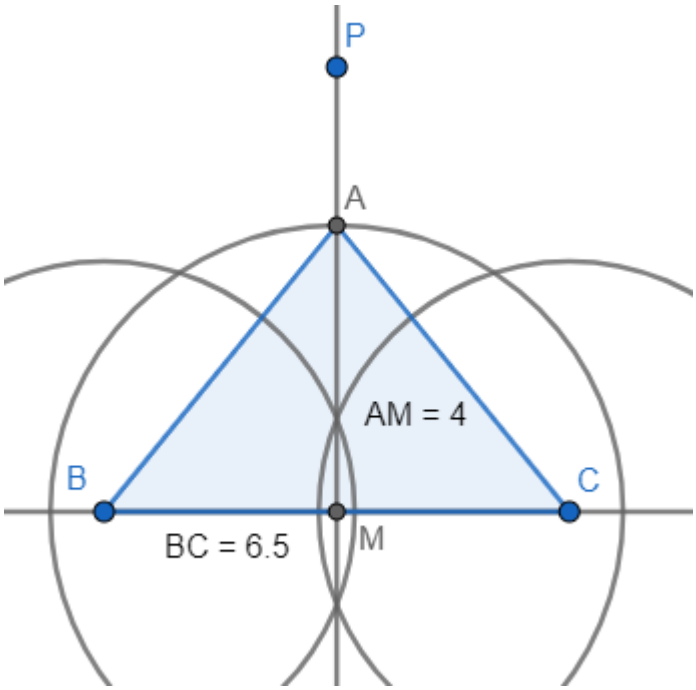
For this, fix your compass at approximately more than the length of BC and make two circle or semicircle, or two arcs taking B as centre on either sides of the line, then similarly make two more arcs taking C as centre cutting the previous arcs. Join the two intersections and call it MP with M on BC.



4. With M as centre and radius 4 cm, draw a circle or a semicircle or an arc cutting MP at A using a compass.



5. Join AB and AC.



Thus, ABC is the required isosceles triangle.

2. Question

Construct an isosceles triangle XYZ in which base YZ = 5.8 cm and altitude from X on YZ is 3.8 cm.

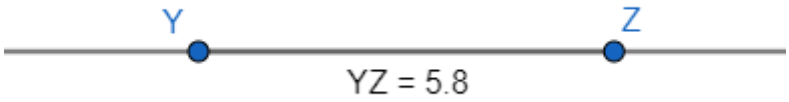
Answer

Here, we are supposed to construct an isosceles triangle XYZ, with base YZ and altitude from X on YZ given.

Steps of construction will be:

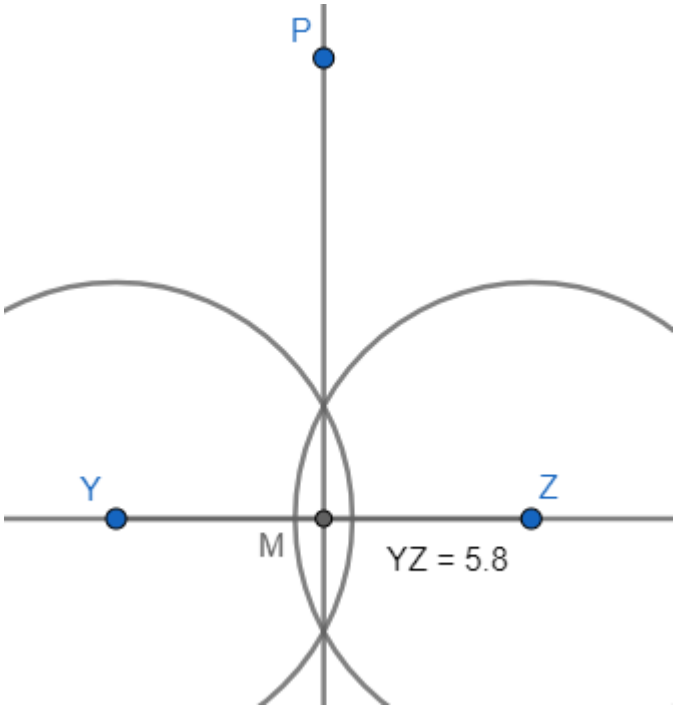
1. Draw a line segment sufficiently long using a ruler.

2. Locate points Y and Z on the line such that YZ = 5.8 cm.

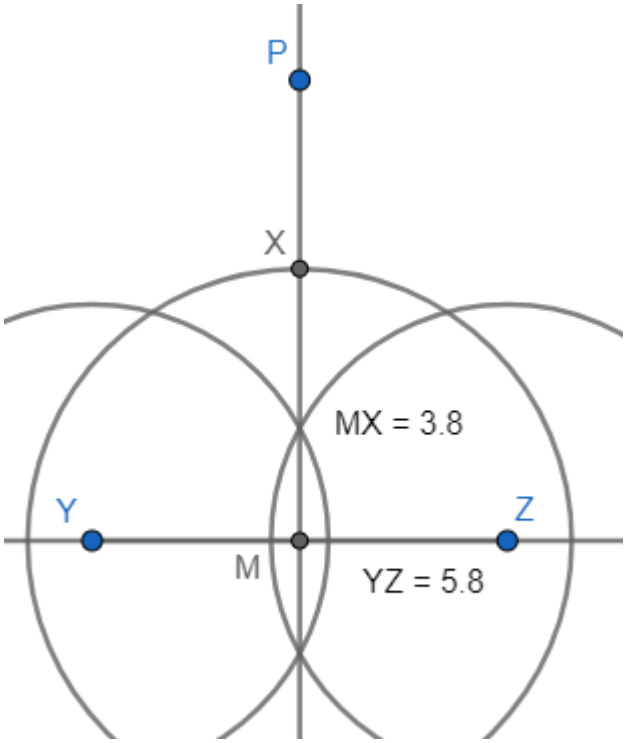


3. Draw a perpendicular bisector of YZ.

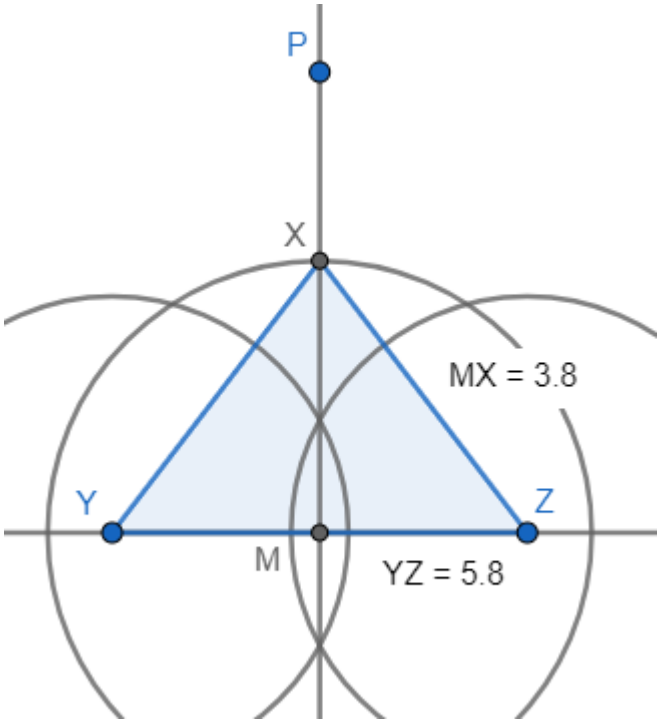
For this, fix your compass at approximately more than the length of YZ and make a circle or semicircle, or two arcs taking Y as centre on either sides of the line YZ, then similarly make two more arcs taking Z as centre cutting the previous arcs. Join the two intersections and call it MP with M on YZ.



4. With M as centre and radius 3.8 cm, draw an arc cutting MP at X using a compass.



5. Join XY and XZ.



Thus, XYZ is the required triangle.

3. Question

Construct an isosceles triangle PQR in which base PQ = 7.2 cm and altitude from R on PQ is 5 cm.

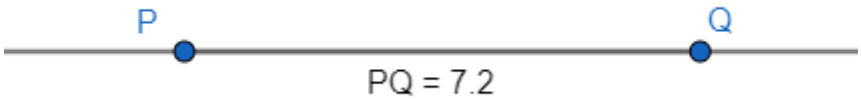
Answer

Here, we are supposed to construct an isosceles triangle PQR, with base PQ and altitude from R on PQ given.

Steps of construction will be:

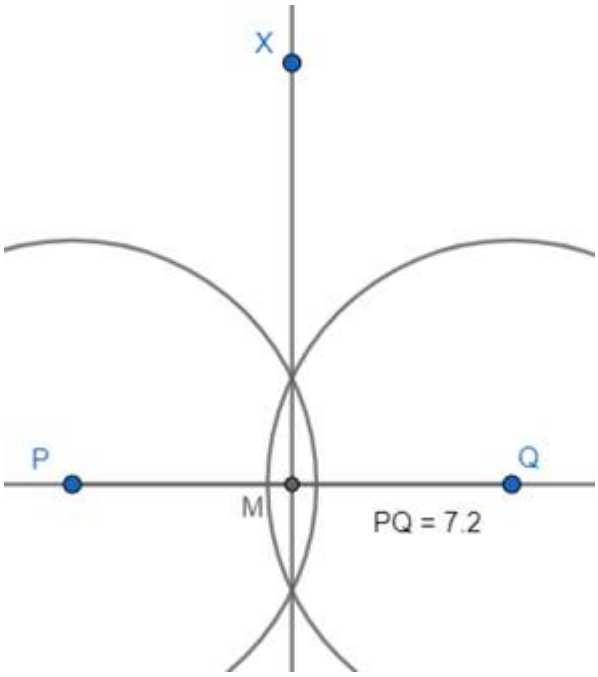
1. Draw a line segment sufficiently long using a ruler.

2. Locate points P and Q on the line such that PQ = 7.2 cm on the previously drawn line segment using a ruler.

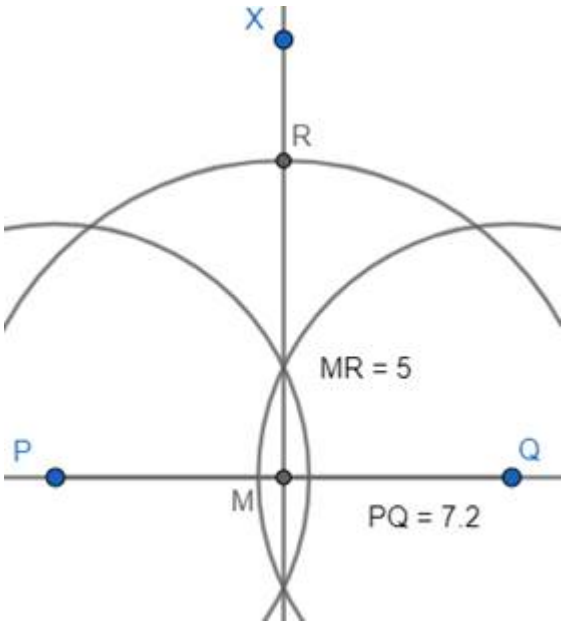


3. Draw a perpendicular bisector of PQ.

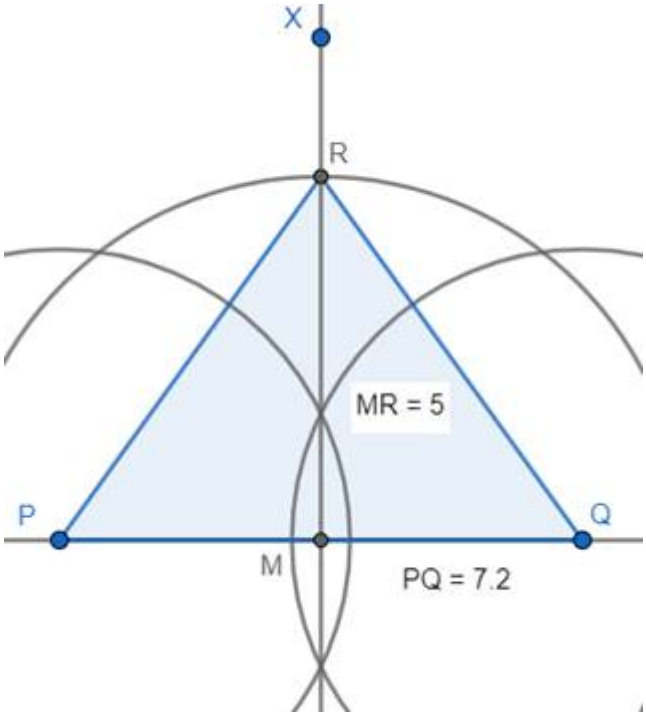
For this, fix your compass at approximately more than the length of PQ and make a circle or semicircle, or two arcs taking P as centre on either sides of the line segment PQ, then similarly make two more arcs taking Q as centre cutting the previous arcs. Join the two intersections and call it MX with M on PQ.



4. With M as centre and radius 5 cm, draw an arc cutting MX at R using a compass.



5. Join PR and QR.



Thus, PQR is the required triangle.

Exercise 12.6

1. Question

Construct an isosceles triangle whose altitude is 4.5 cm and vertex angle is 70°.

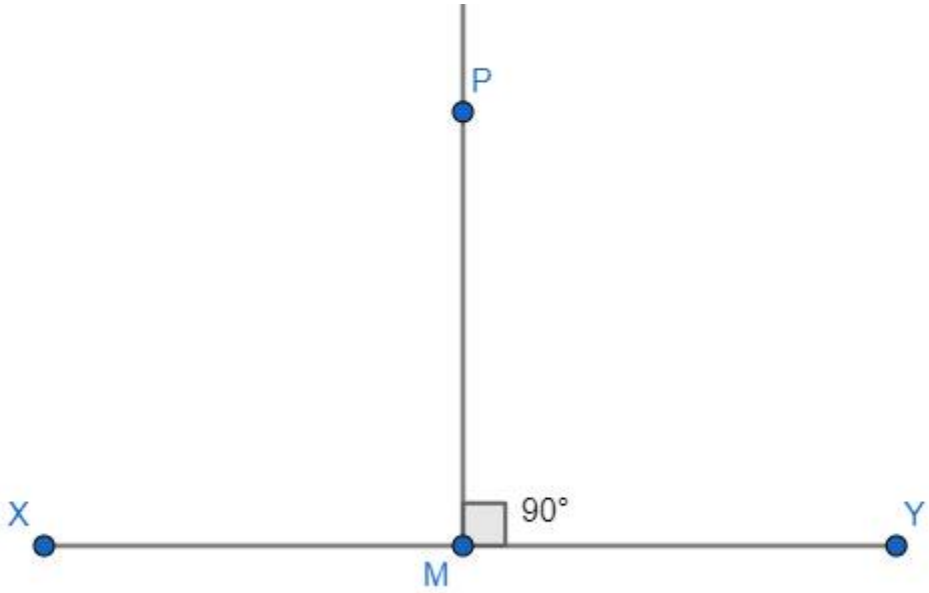
Answer

Here, we are given with altitude of triangle, that is, 4.5 cm and vertex angle equals to 70°. Let us construct an isosceles triangle using the following steps of construction.

Steps of construction:

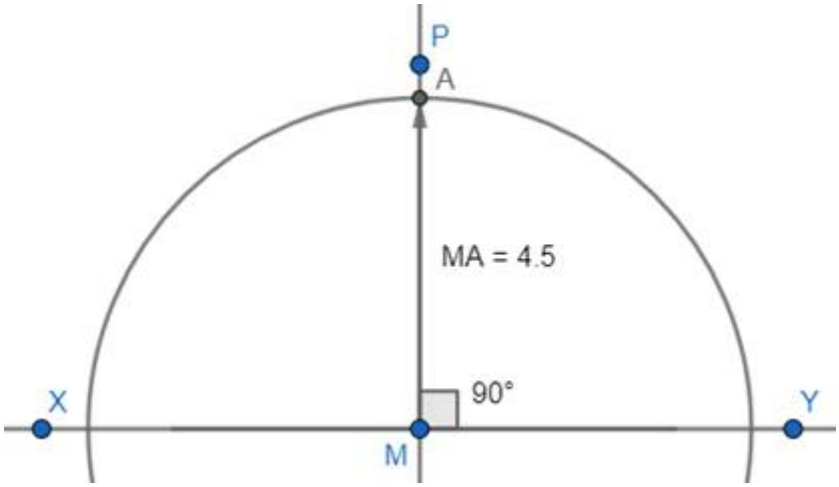
1. Draw a line segment XY using a ruler of any length.

2. Take a point M on line XY and draw a perpendicular line MP such that MP ⊥ XY; use protractor to measure the angle 90°.



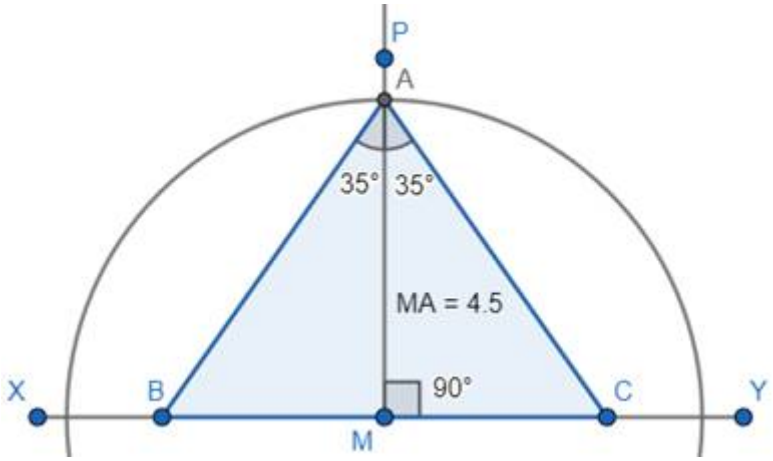
3. Now, with M as centre draw a circle or semicircle or an arc of radius 4.5 cm cutting MP at A using a compass and a ruler.

4.



on XY such that, ∠MAB = 35° ($\frac{70°}{2} = 35°$) and ∠MAC = 35° ($\frac{70°}{2} = 35°$).

Measure the angles using a protractor.



Thus, ABC is the required isosceles triangle.

2. Question

Construct an isosceles triangle whose altitude is 6.6 cm and vertex angle is 60°.

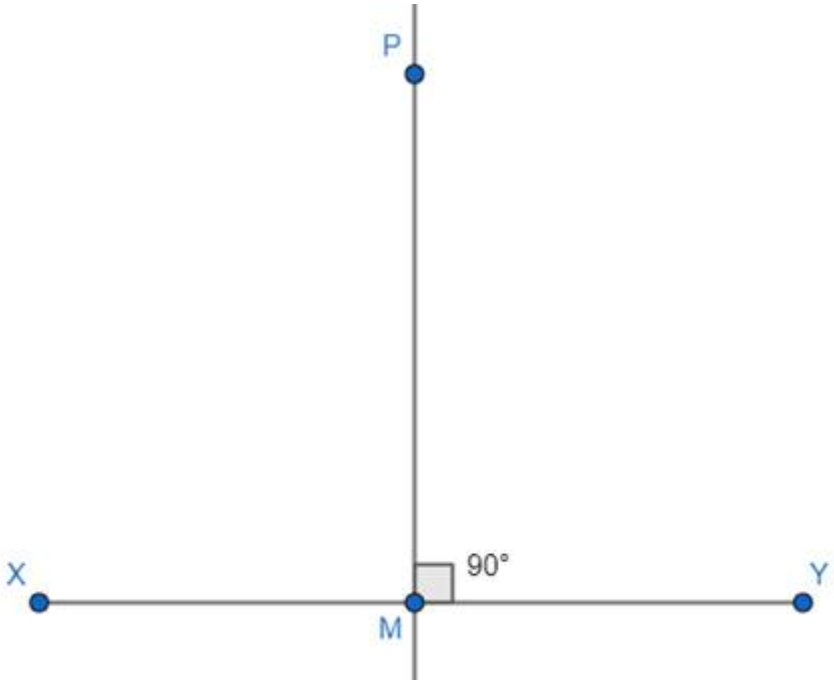
Answer

Here, we are given with altitude of triangle, that is, 6.6 cm and vertex angle equals to 60°. Let us construct an isosceles triangle using the following steps of construction.

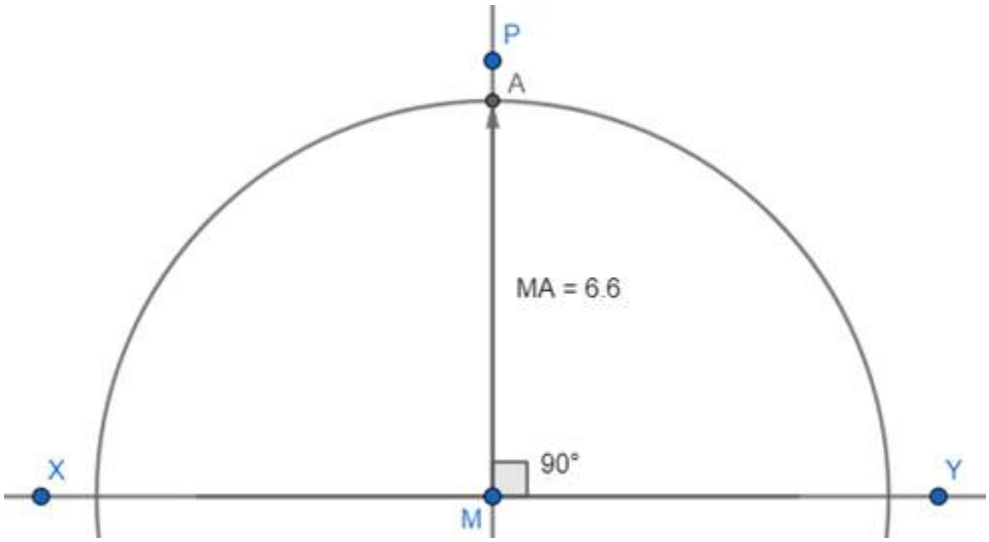
Steps of construction:

1. Draw a line segment XY using a ruler of any length.

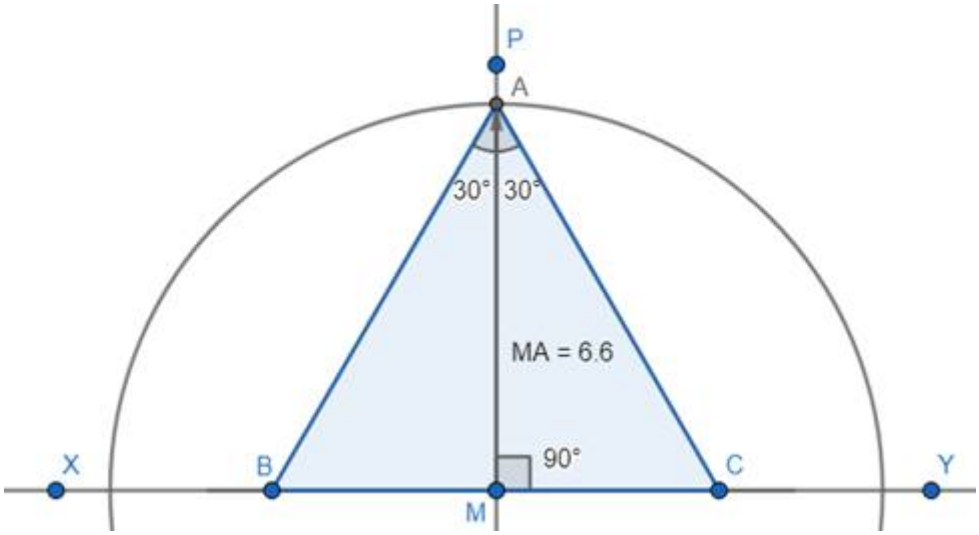
2. Take a point M on line XY and draw a perpendicular line MP such that MP ⊥ XY; use protractor to measure the angle 90°.



3. Now, with M as centre draw an arc of radius 6.6 cm cutting MP at A, using a protractor and a ruler.



4. Construct B and C on XY such that, ∠MAB = 30° $(\frac{60°}{2} = 30°)$ and ∠MAC = 30° $(\frac{60°}{2} = 30°)$. Measure the angles using a protractor.



Thus, ABC is required triangle.

3. Question

Construct an isosceles triangle whose altitude is 5 cm and vertex angle is 90°.

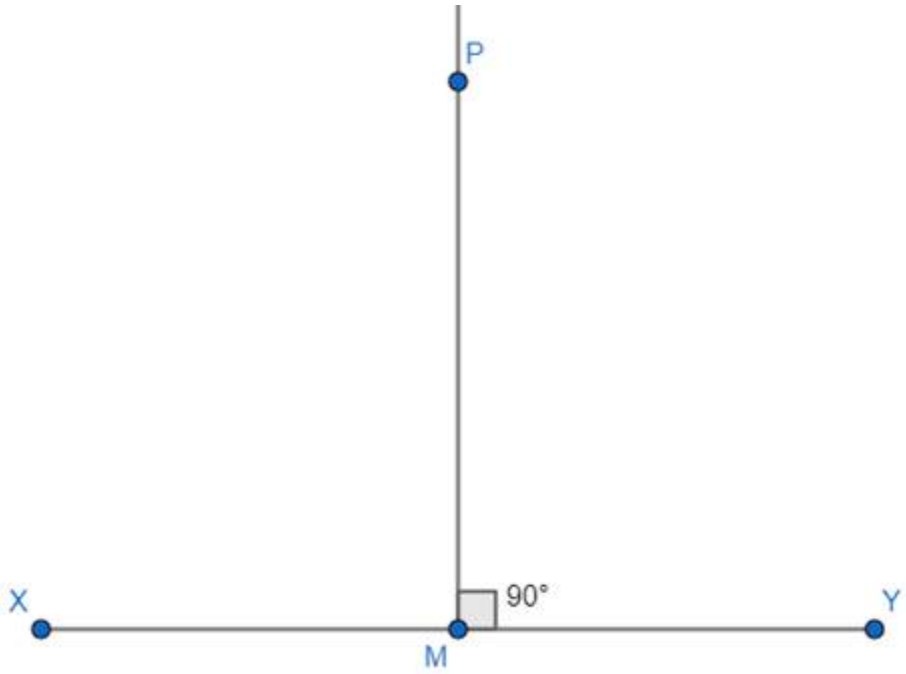
Answer

Here, we are given with altitude of triangle, that is, 5 cm and vertex angle equals to 90°. Let us construct an isosceles triangle using the following steps of construction.

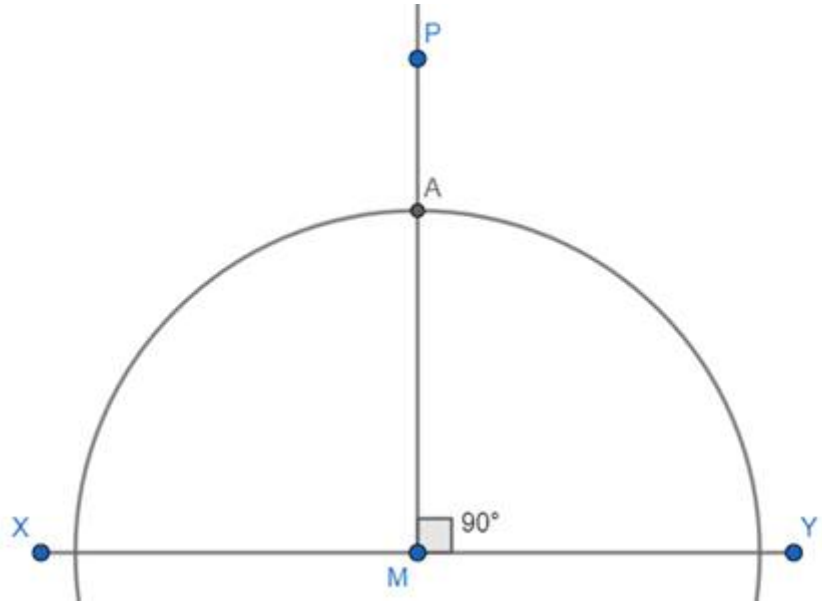
Steps of construction:

1. Draw a line segment XY using a ruler of any length.

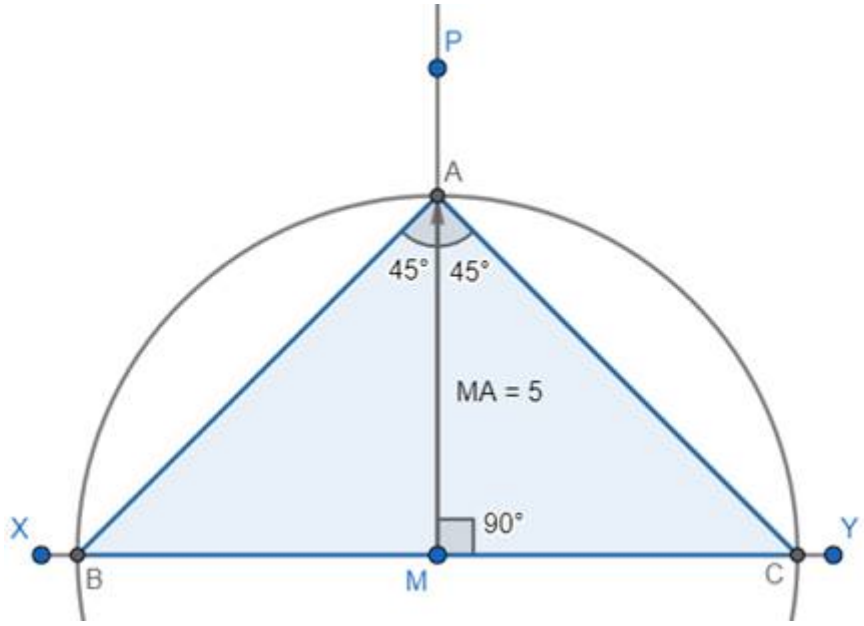
2. Take a point M on line XY and draw a perpendicular line MP such that MP ⊥ XY; use protractor to measure angle 90°.



3. Now, with M as centre draw a circle or semicircle or an arc of radius 5 cm cutting MP at A using a compass and a ruler.



4. Construct B and C on XY such that, ∠MAB = 45° $(\frac{90°}{2} = 45°)$ and ∠MAC = 45° $(\frac{90°}{2} = 45°)$. Measure the angles using a protractor.



Thus, ABC is the required triangle.

Exercise 12.7

1. Question

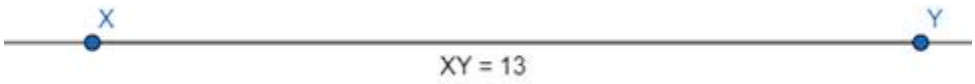
Construct a triangle ABC, whose perimeter is 13 cm and whose sides are in the ratio 3:4:5.

Answer

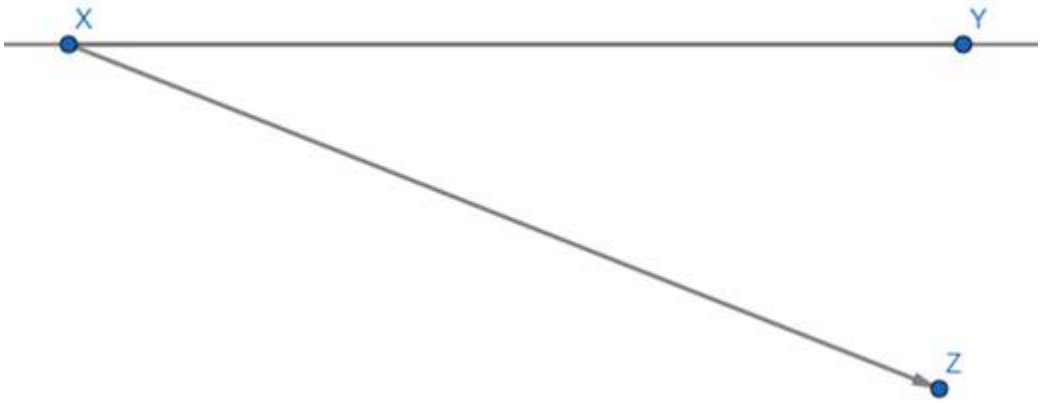
We are given with perimeter of triangle and ratio of its sides. We need to construct a triangle using the given information.

Steps of construction:

1. Draw a line segment using ruler and locate points X and Y such that XY = 13 cm.

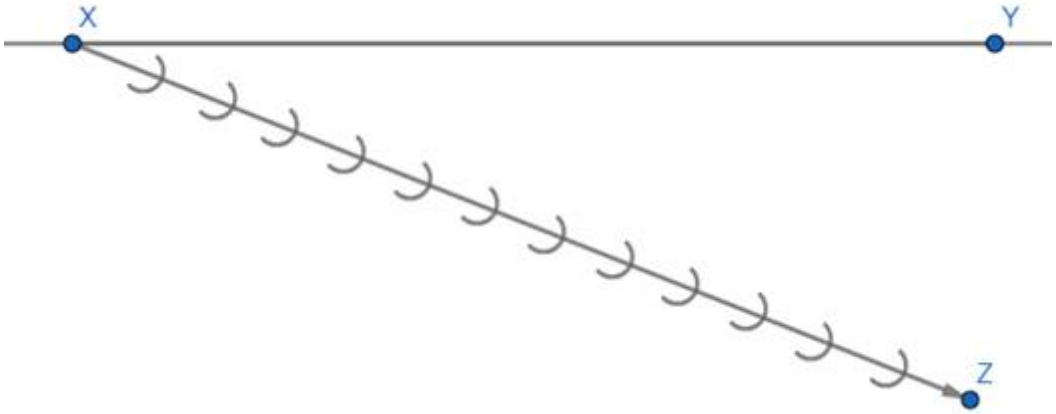


2. Draw a ray XZ, making an acute angle with XY and drawn in the downward direction. An acute angle is an angle less than right angle (less than 90°). Use the protractor to measure the acute angle.

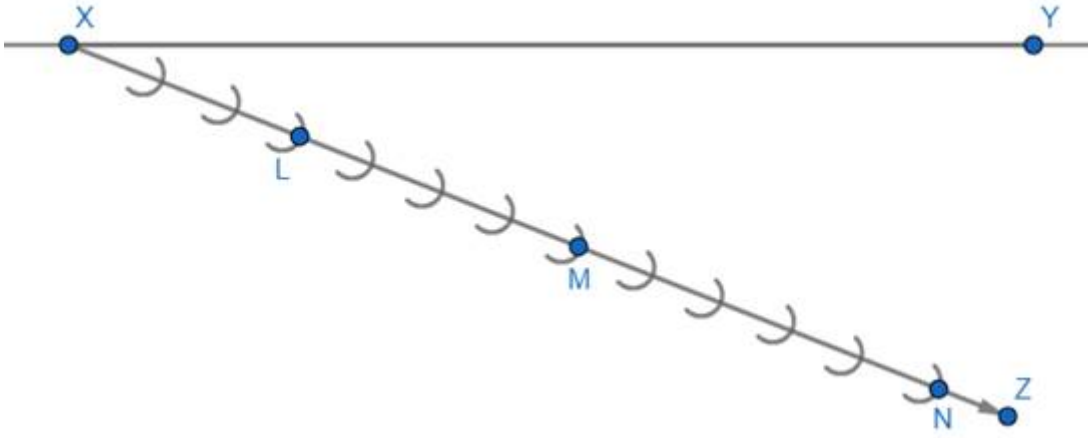


Here, ∠YXZ < 90° obviously.

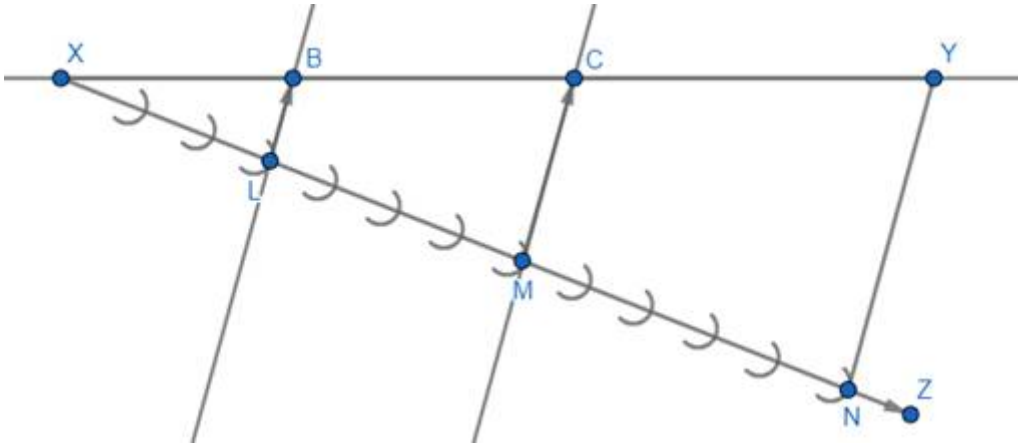
3. From X, locate (3 + 4 + 5) = 12 points at equal distances along XZ.



4. Mark points L, M, N on XZ such that XL = 3 parts, LM = 4 parts and MN = 5 parts.

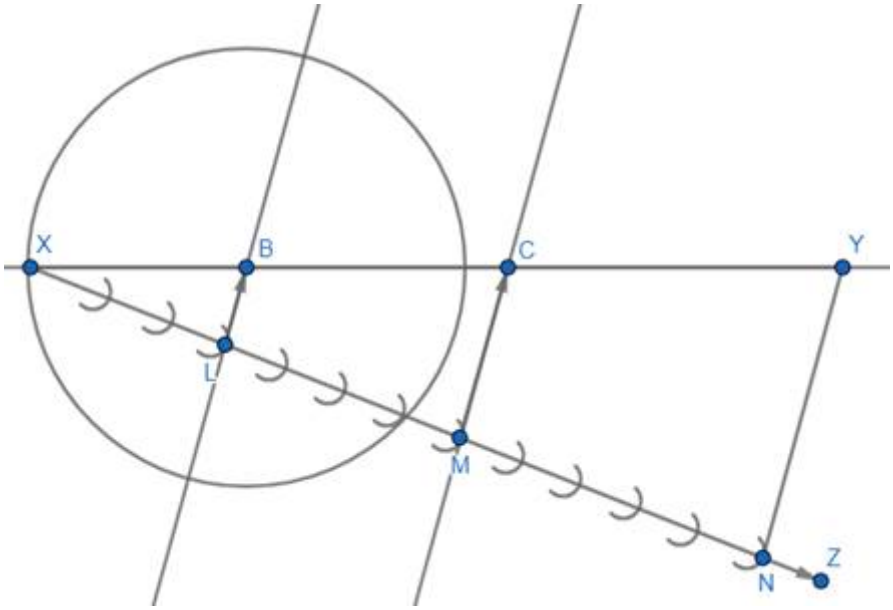


5. Now, join NY. Through L and M, draw LB ∥ NY and MC ∥ NY, intersecting XY at B and C respectively.



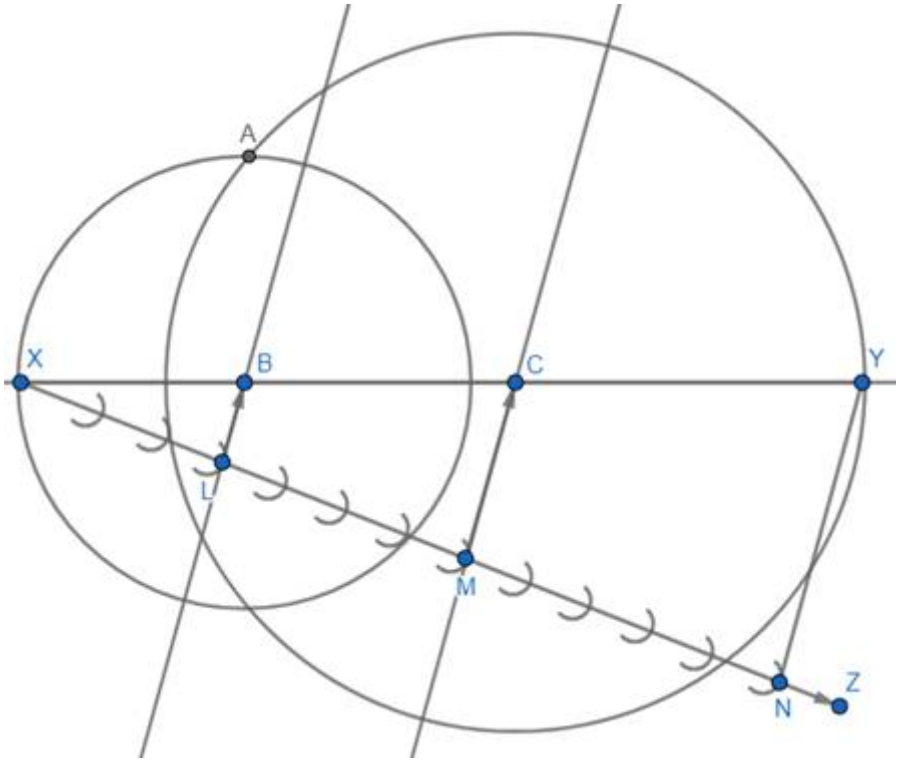
6. With B as centre and BX as radius, draw a circle or semicircle or an arc.

Keep one end of compass fixed at B and then draw a fine circle or arc with it.

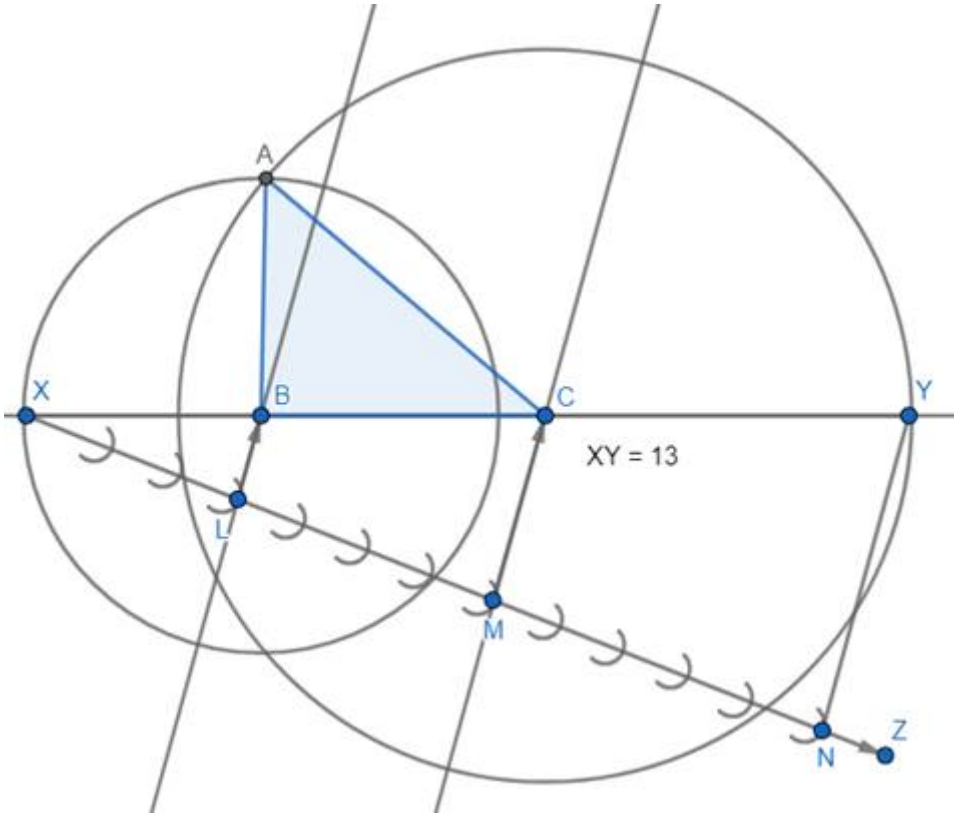


7. With C as centre and CY as radius, draw another circle or semicircle or arc cutting the previous arc at A.

Keep one end of the compass fixed at C, and then draw a fine circle or arc with it.



8. Finally, join AB and AC.



Thus, ABC is the required triangle.

2. Question

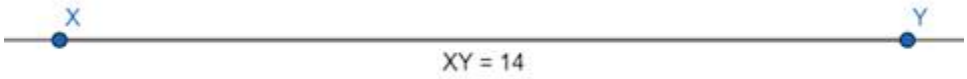
Construct a triangle PQR, whose perimeter is 14 cm and whose sides are in the ratio 2:4:5.

Answer

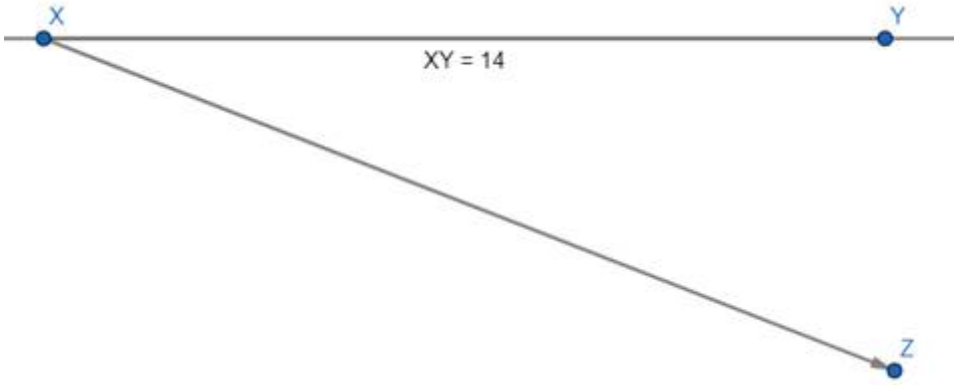
We are given with perimeter of triangle and ratio of its sides. We need to construct a triangle using the given information.

Steps of construction:

1. Draw a line segment using ruler and locate points X and Y such that XY = 14 cm.

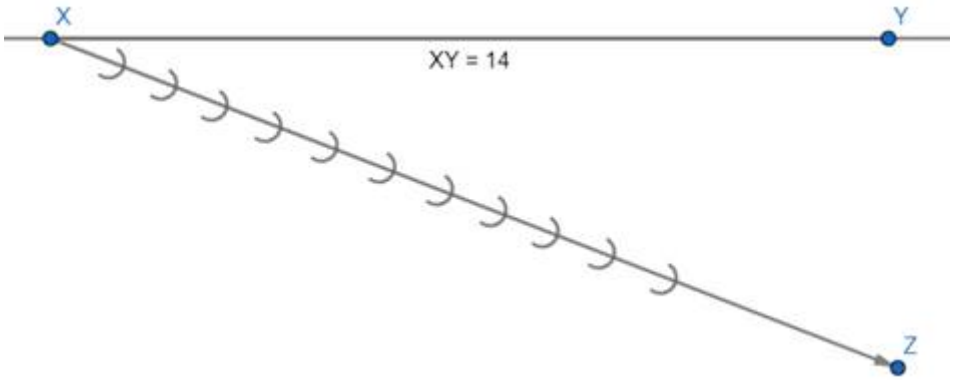


2. Draw a ray XZ, making an acute angle with XY and drawn in the downward direction.

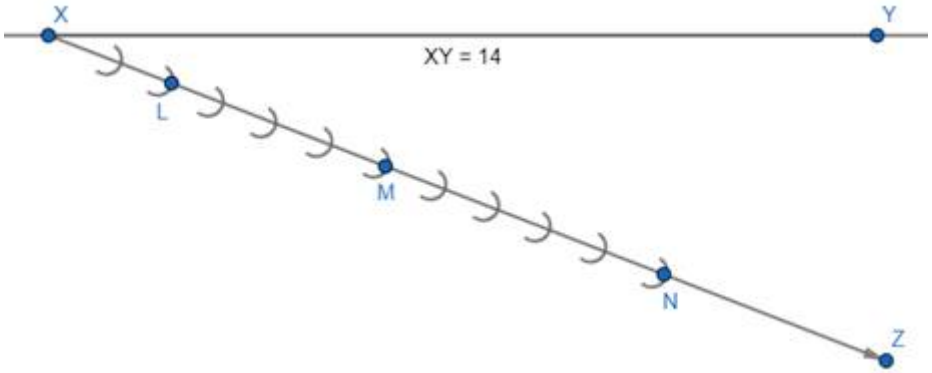


Here, ∠YXZ < 90° obviously.

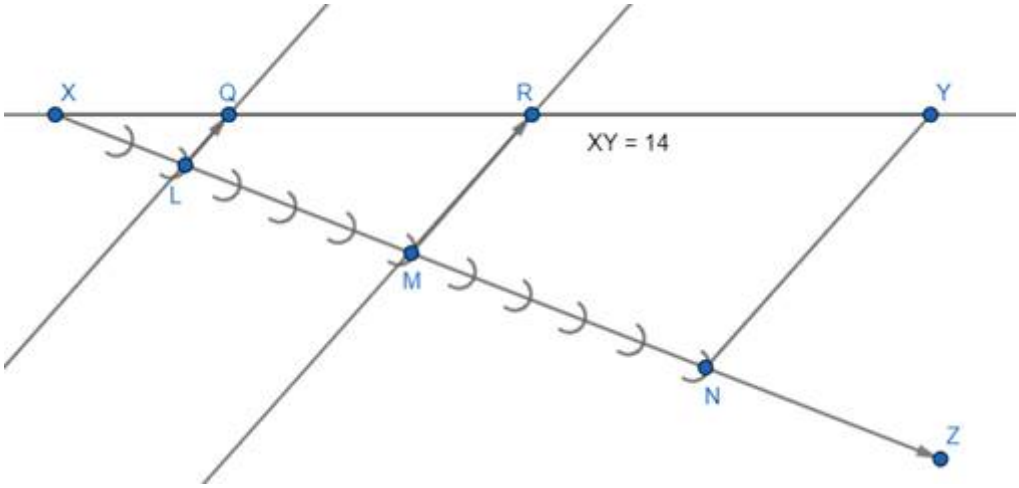
3. From X, locate (2 + 4 + 5) = 11 points at equal distances along XZ.



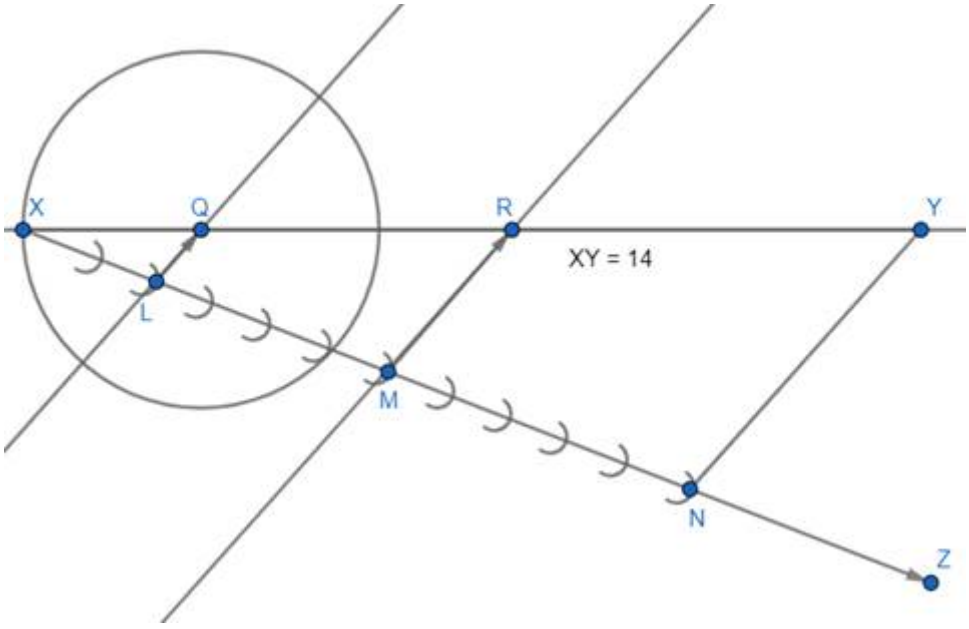
4. Mark points L, M, N on XZ such that XL = 2 parts, LM = 4 parts and MN = 5 parts.



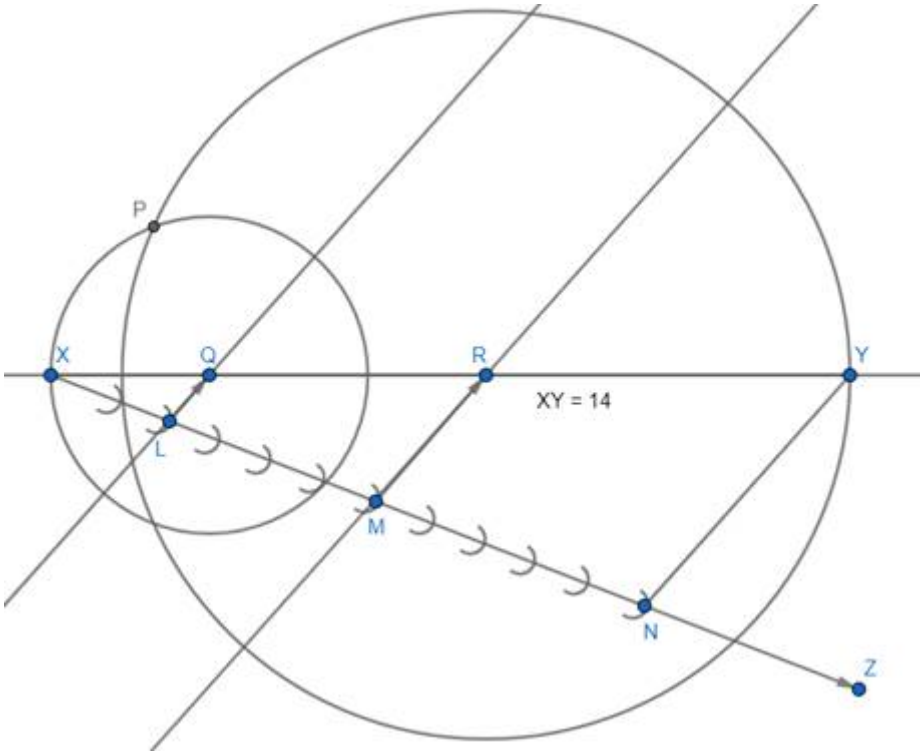
5. Now, join NY. Through L and M, draw LQ ‖ NY and MR ‖ NY, intersecting XY at Q and R respectively.



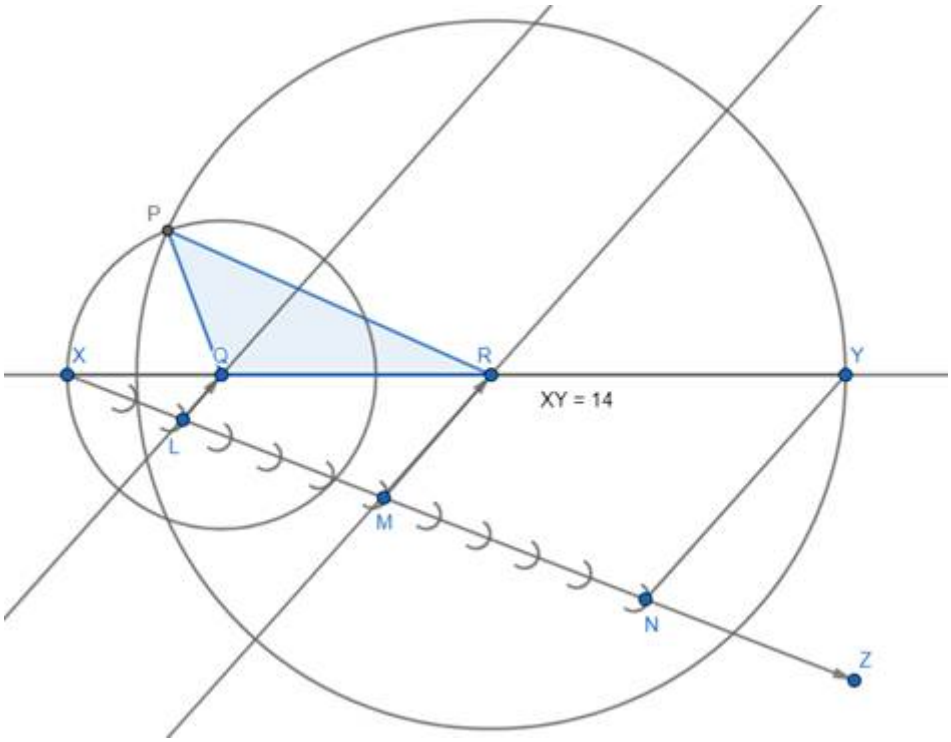
6. With Q as centre and QX as radius, draw a circle or a semicircle or an arc. Keep one end of compass fixed at Q, and then draw a fine circle or arc with it.



7. With R as centre and RY as radius, draw another circle or semicircle or arc cutting the previous arc at P. Keep one end of the compass fixed at R, and then draw a fine circle or arc with it.



8. Finally, join PQ and PR.



Thus, PQR is the required triangle.

3. Question

Construct a triangle MNP, whose perimeter is 15 cm and whose sides are in the ratio 2:3:4.

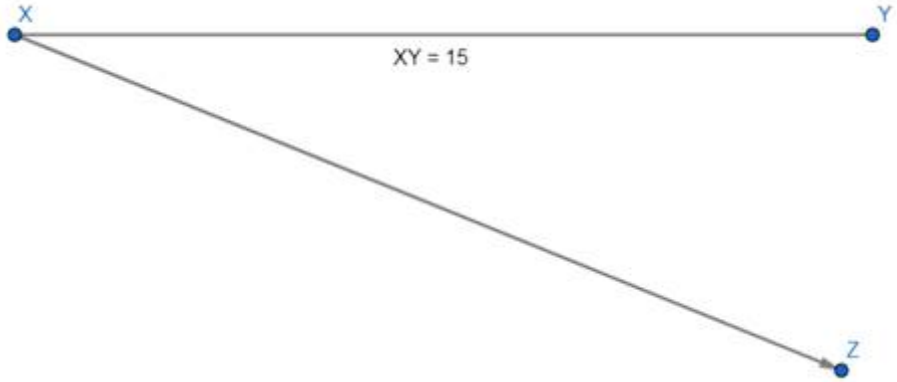
Answer

We are given with perimeter of triangle and ratio of its sides. We need to construct a triangle using the given information.

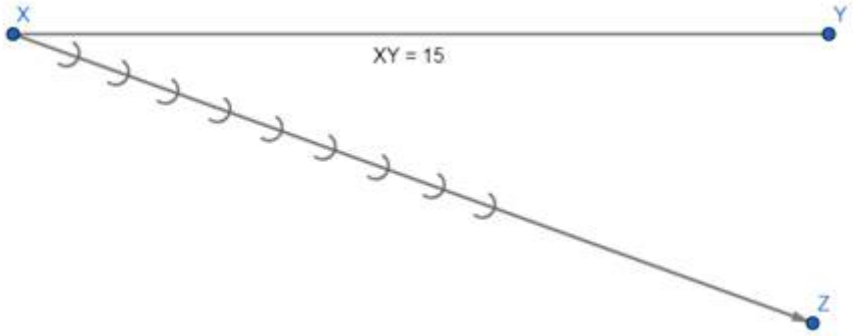
Steps of construction:

1. Draw a line segment using ruler and locate points X and Y such that XY = 15 cm.

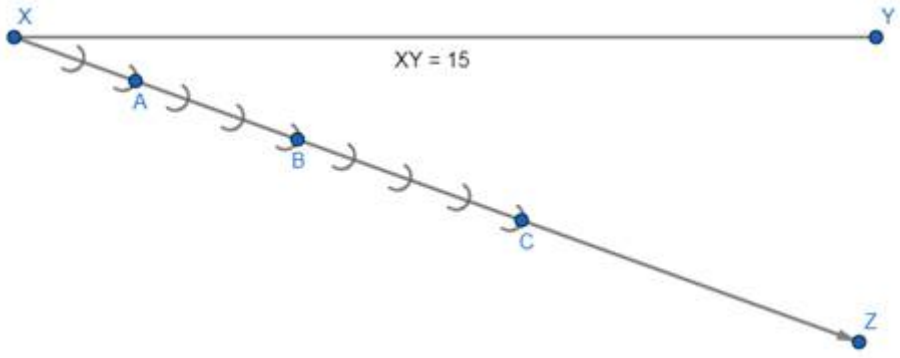
2. Draw a ray XZ, making an acute angle with XY and drawn in the downward direction.



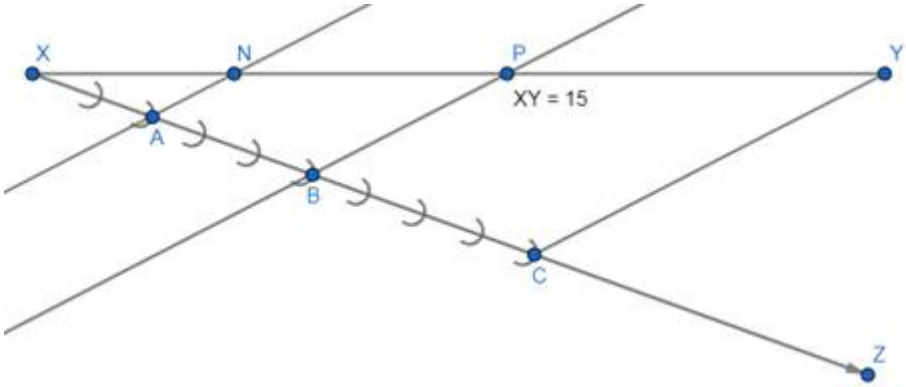
3. From X, locate (2 + 3 + 4) = 9 points at equal distances along XZ.



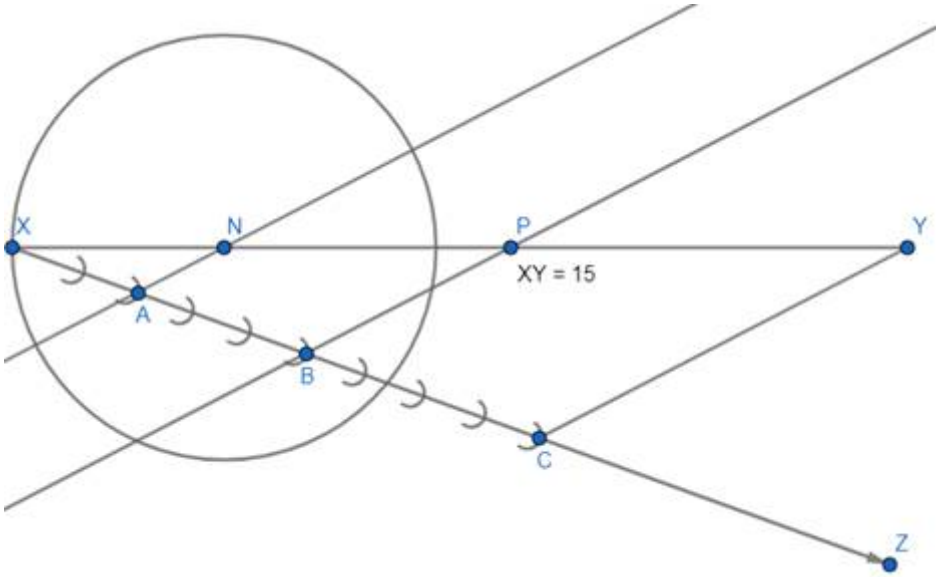
4. Mark points A, B, C on XZ such that XA = 2 parts, AB = 3 parts and BC = 4 parts.



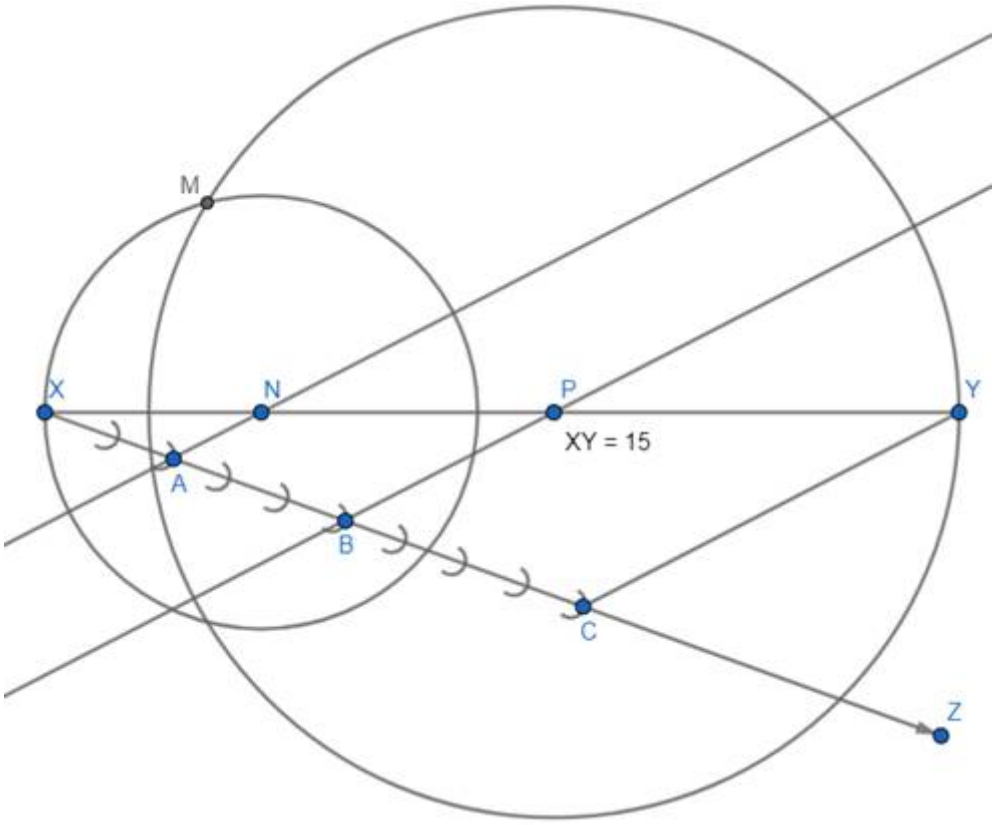
5. Now, join CY. Through A and B, draw AN ‖ CY and BP ‖ CY, intersecting XY at N and P respectively.



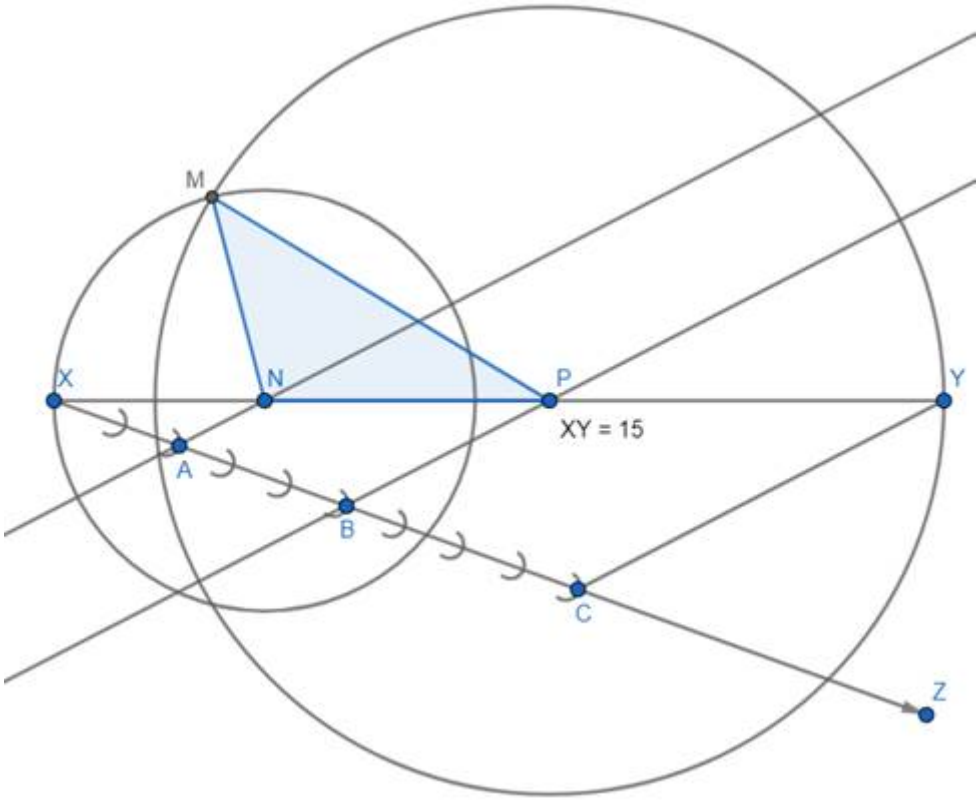
6. With N as centre and NX as radius, draw a circle or semicircle or an arc. Keep one end of the compass fixed at N, and then draw a fine circle or arc with it.



7. With P as centre and PY as radius, draw another circle or arc cutting the previous arc at M. Keep one end of the compass fixed at P, and then draw a fine circle or arc with it.



8. Finally, join MN and MP.



Thus, MNP is the required triangle.

Exercise 12.8

1. Question

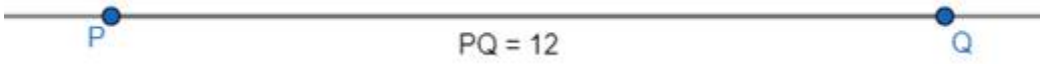
Construct a triangle ABC whose perimeter 12 cm and whose base angles are 50° and 80°.

Answer

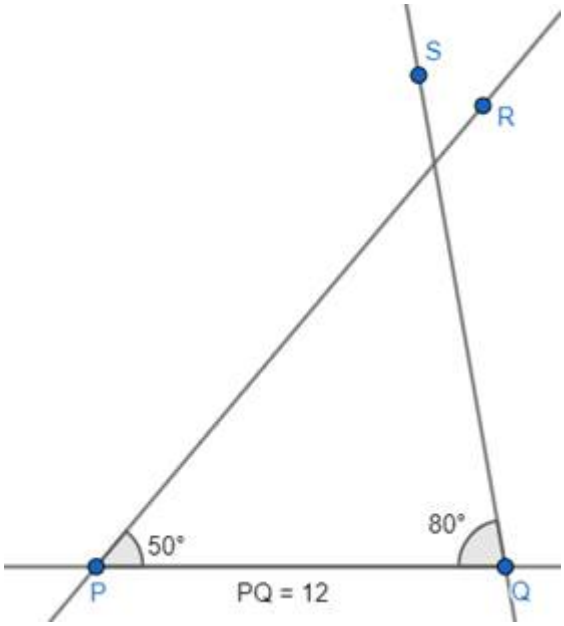
Here, we have been given the perimeter and base angles of the triangle.

Steps of construction are:

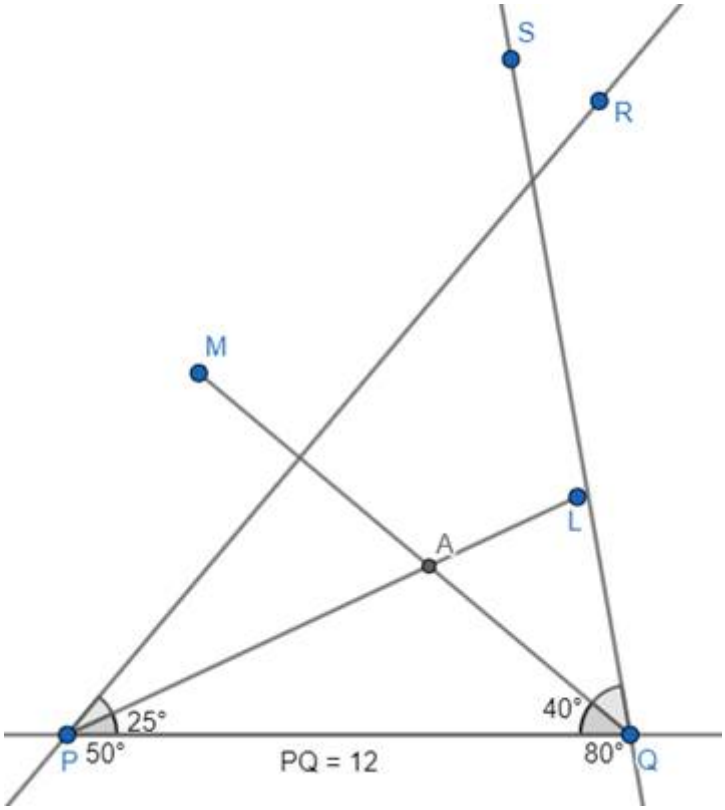
1. Draw a line segment using a ruler; locate points P and Q such that PQ = 12 cm.



2. Construct rays PR such that ∠QPR = 50° and QS such that ∠PQS = 80° using compass and then measure it with protractor.

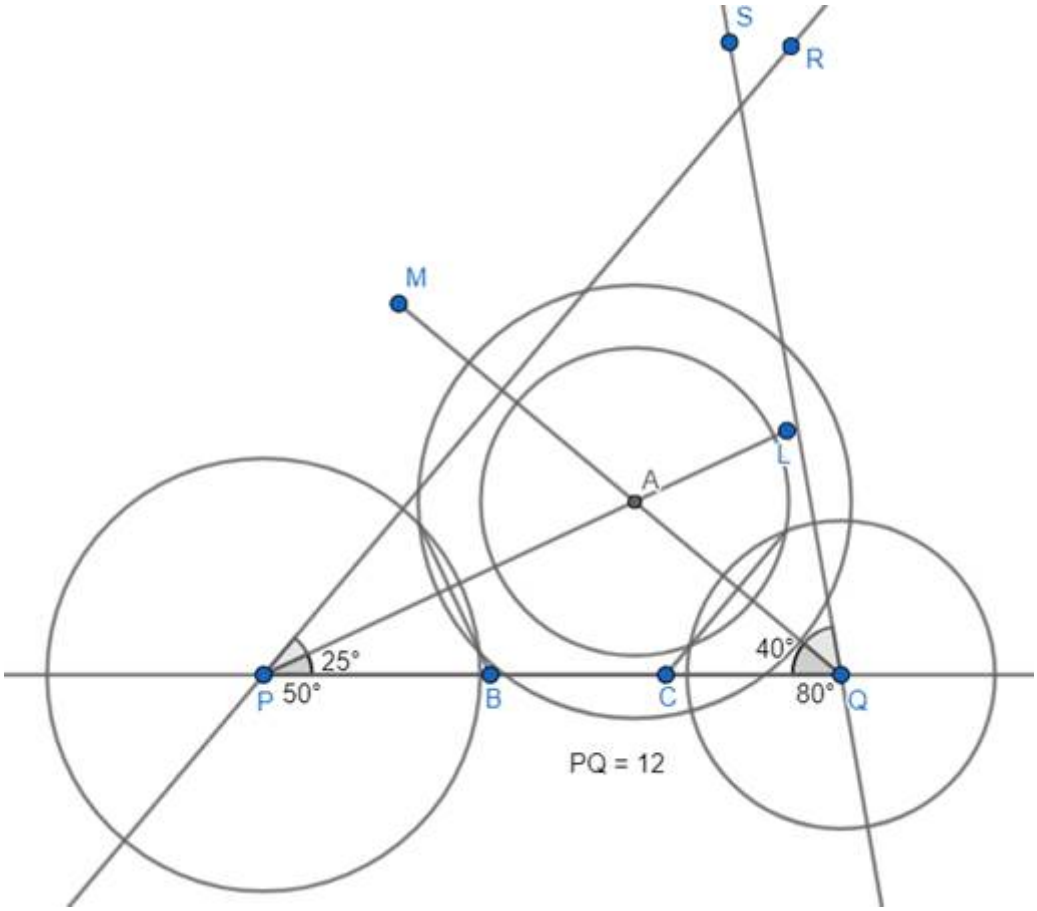


3. Draw the bisectors PL and QM of ∠QPR and ∠PQS respectively using a protractor and a ruler. Let it intersect it at A.

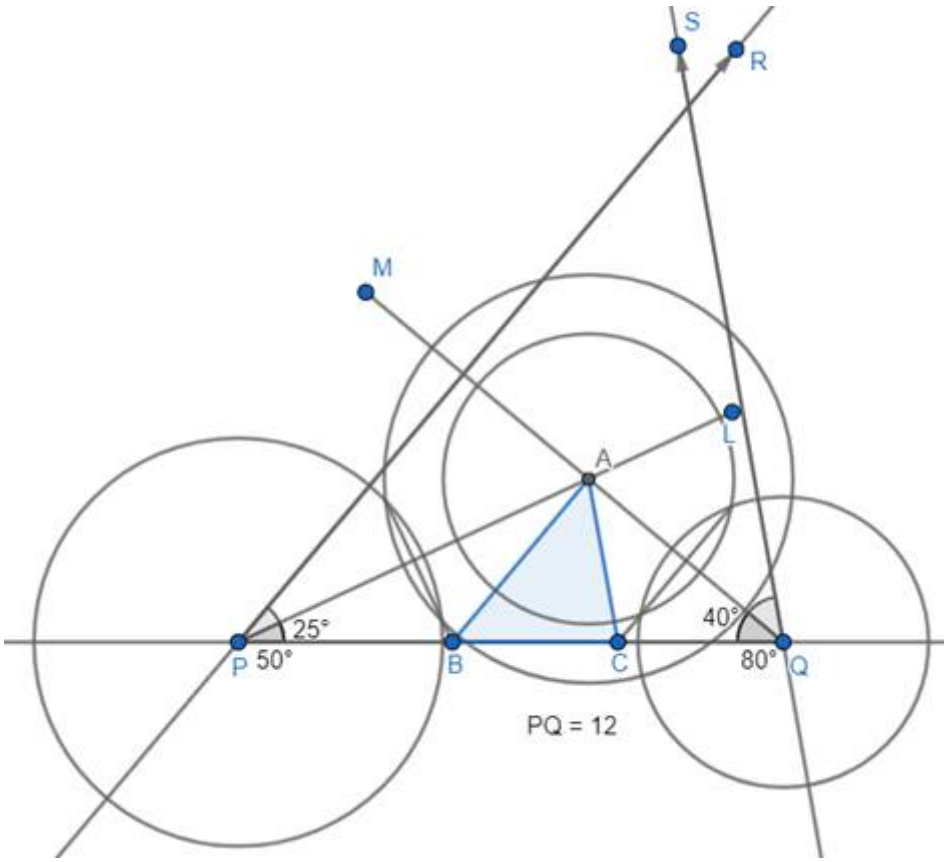


4. Draw the perpendicular bisector of AP and AQ and let these intersect PQ at B and C respectively.

In order to draw perpendicular bisector of AP, fix one end of the compass at P at more than half of the length of AP and make a complete circle or arcs on both sides of line AP, and the other end of compass at A and intersect with the previous arcs. Do similar with the line segment AQ. Here, we've made complete circles.



5. Join AB and AC.



Thus, ABC is the required triangle.

2. Question

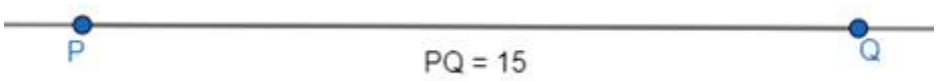
Construct a triangle XYZ whose perimeter 15 cm and whose base angles are 60° and 70°.

Answer

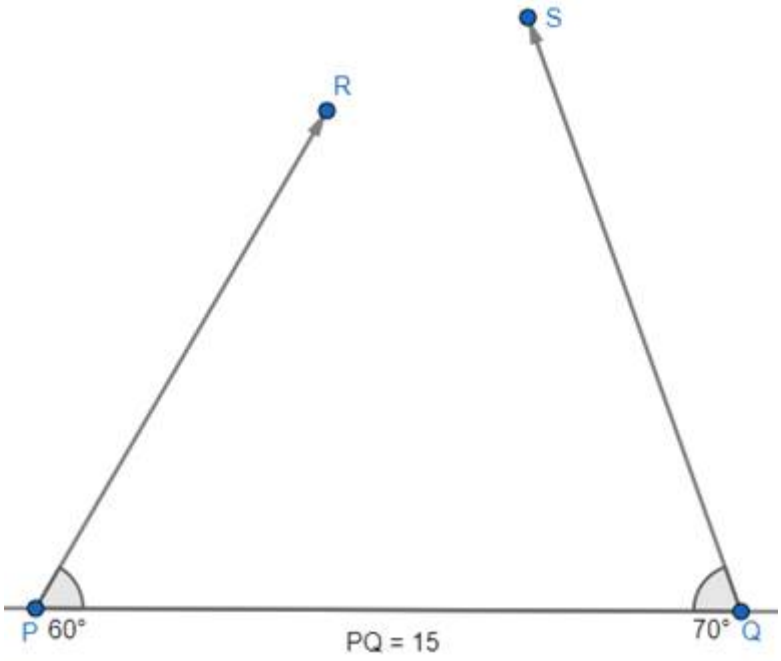
Here, we have been given the perimeter and base angles of the triangle.

Steps of construction are:

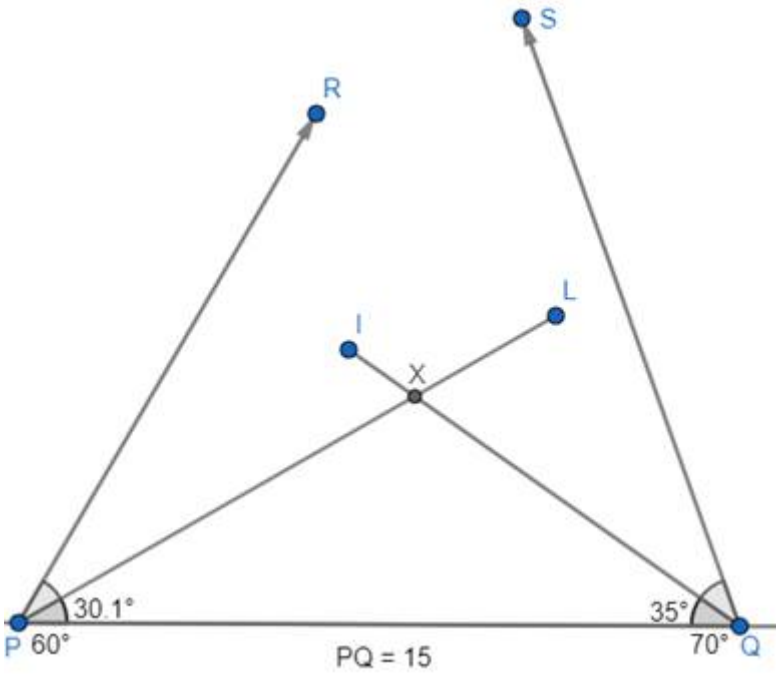
1. Draw a line segment using a ruler; locate points P and Q such that PQ = 15 cm.



2. Construct rays PR such that ∠QPR = 60° and QS such that ∠PQS = 70° using compass and then measure it with protractor.

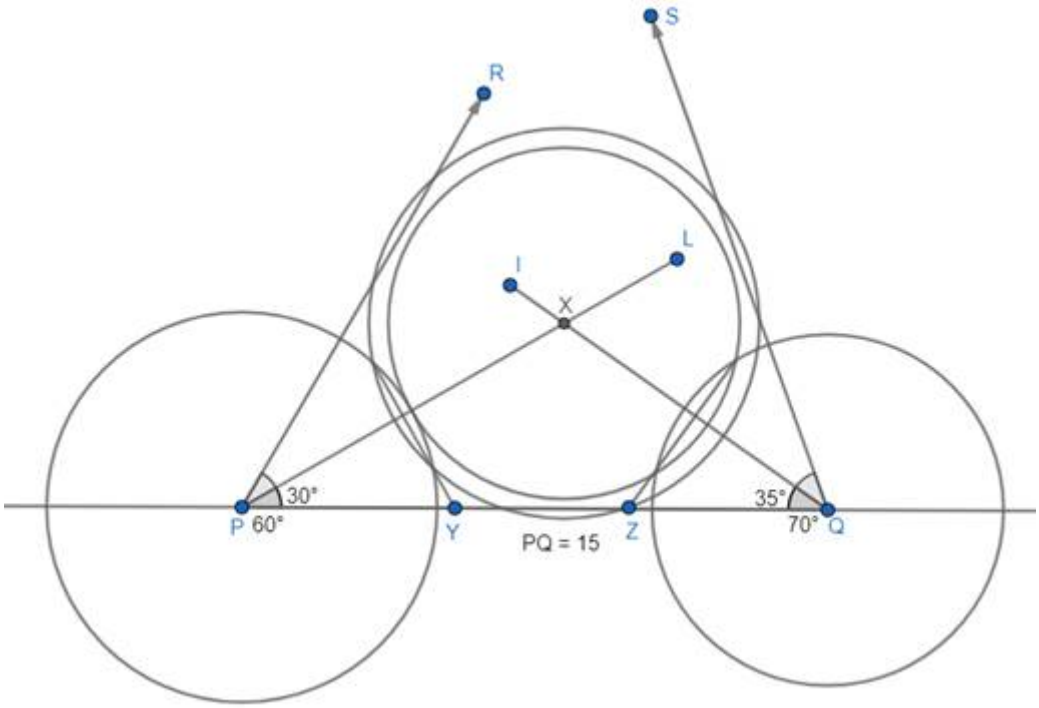


3. Draw the bisectors PL and QM of ∠QPR and ∠PQS respectively. Let it intersect it at X.

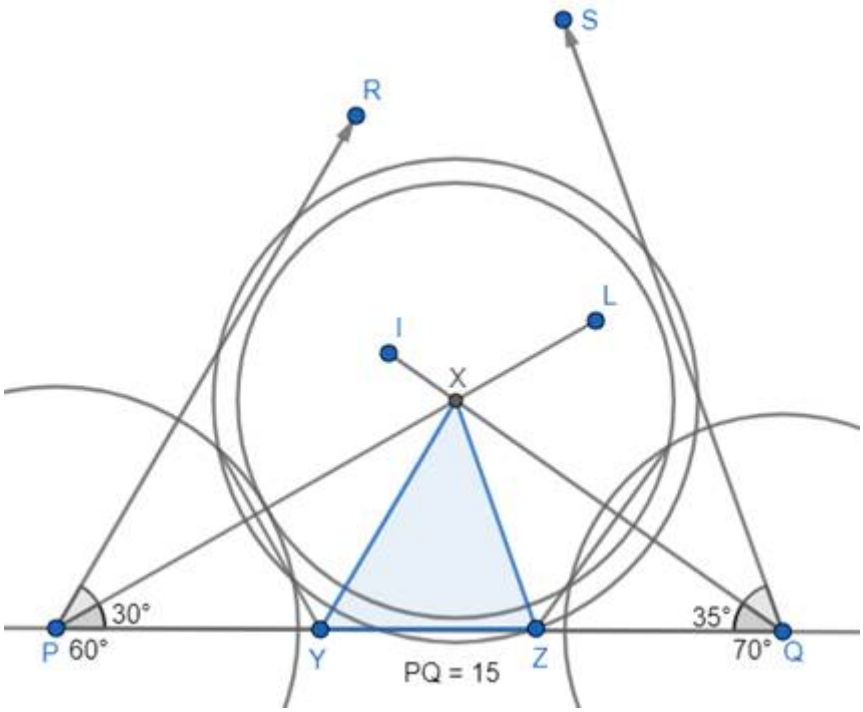


4. Draw the perpendicular bisector of XP and XQ and let these intersect PQ at Y and Z respectively.

In order to draw perpendicular bisector of XP, fix one end of the compass at P at more than half of the length of XP and make a complete circle or arcs on both sides of line XP, and the other end of compass at X and intersect with the previous arcs. Do similar with the line segment XQ. Here, we've made complete circles.



5. Join XY and XZ.



Thus, XYZ is the required triangle.

3. Question

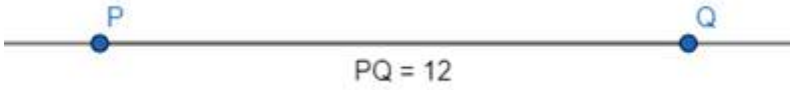
Construct a triangle ABC whose perimeter 12 cm and whose base angles are 65° and 85°.

Answer

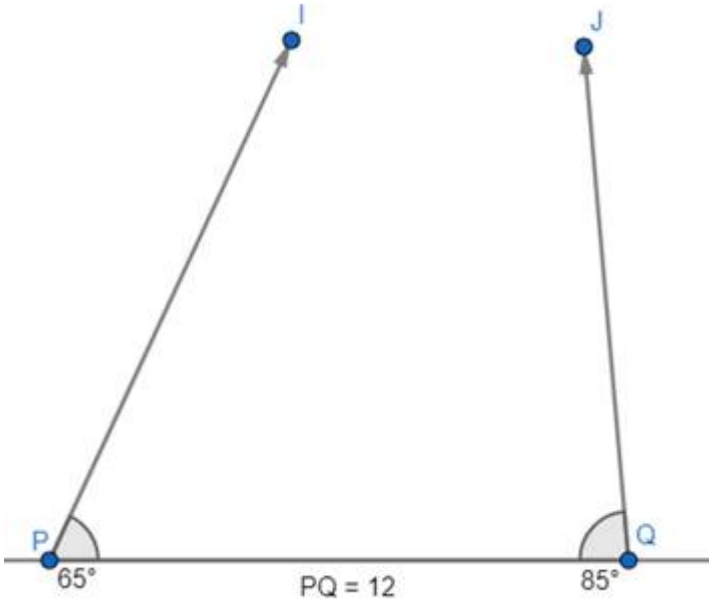
Here, we have been given the perimeter and base angles of the triangle.

Steps of construction are:

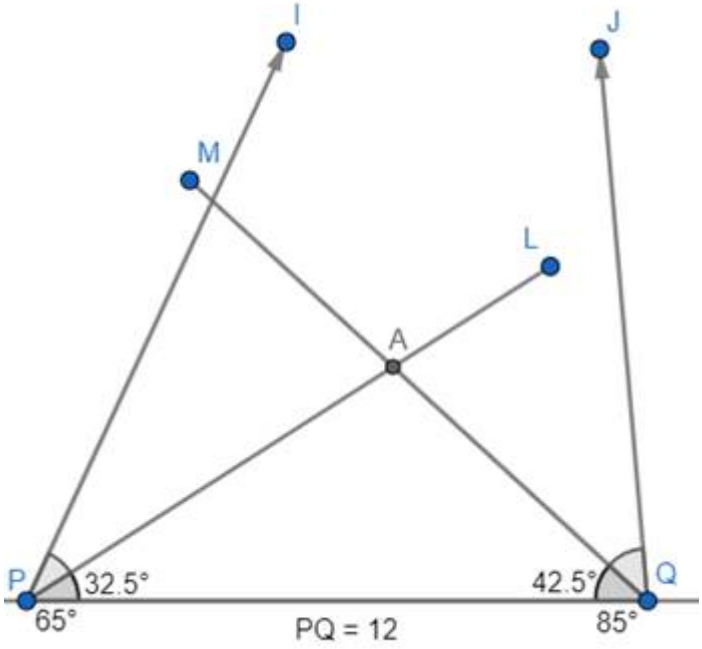
1. Draw a line segment using a ruler; locate points P and Q such that PQ = 12 cm.



2. Construct rays PR such that ∠QPR = 65° and QS such that ∠PQS = 85° using compass and then measure it with protractor.

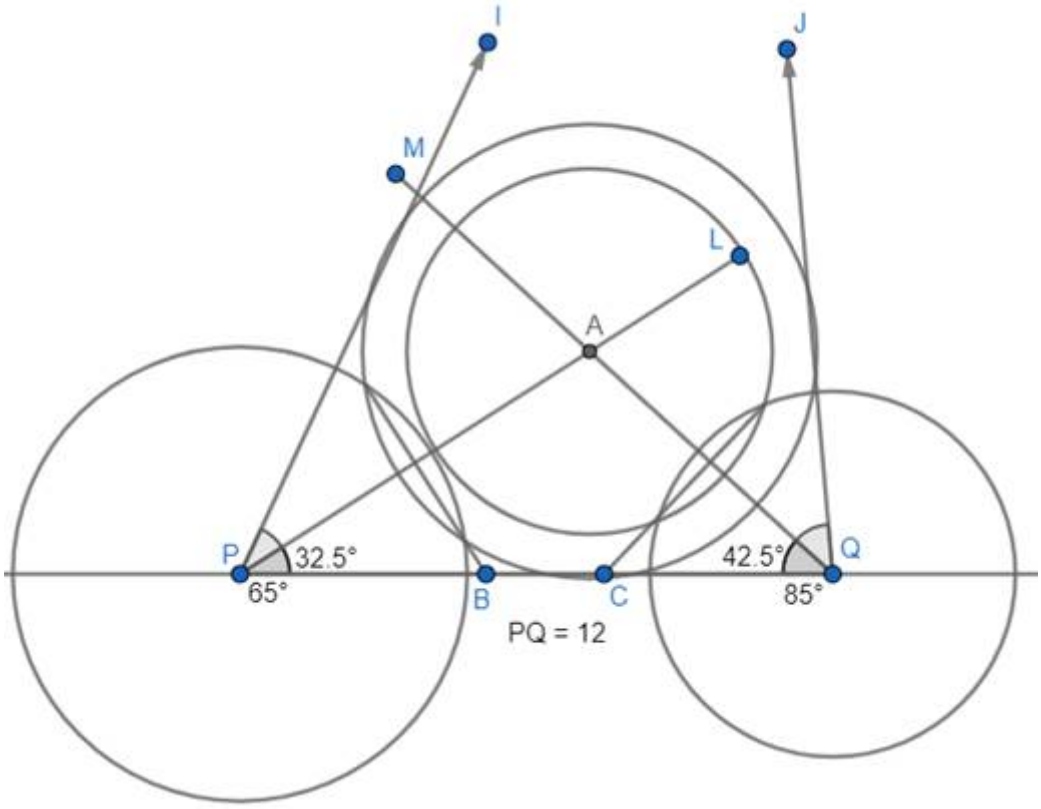


3. Draw the bisectors PL and QM of ∠QPR and ∠PQS respectively. Let it intersect it at A.

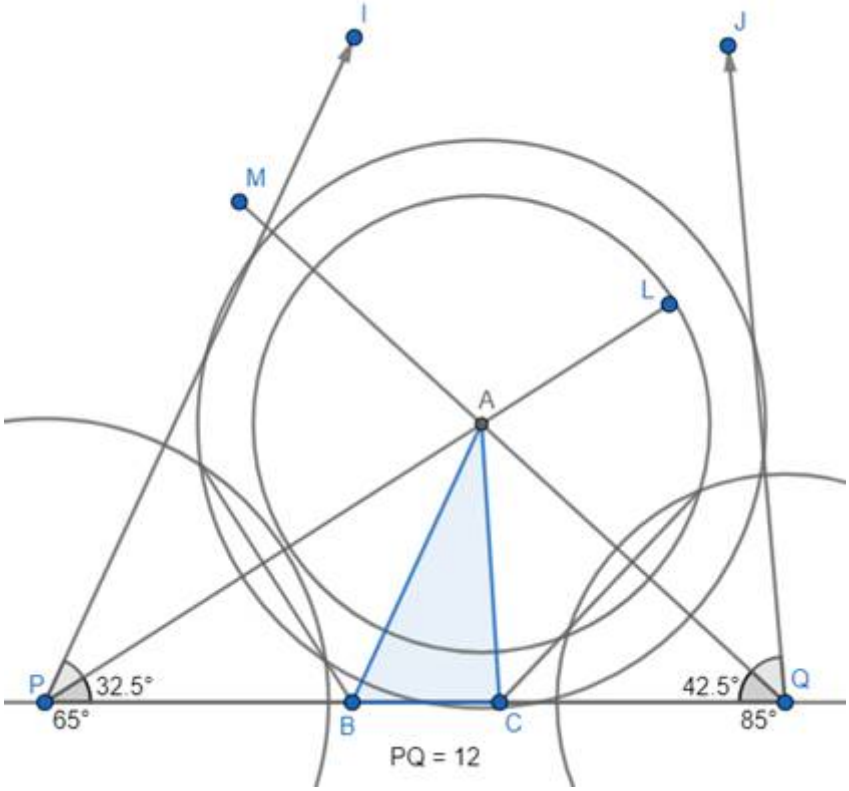


4. Draw the perpendicular bisector of AP and AQ and let these intersect PQ at B and C respectively.

In order to draw perpendicular bisector of AP, fix one end of the compass at P at more than half of the length of AP and make a complete circle or arcs on both sides of line AP, and the other end of compass at A and intersect with the previous arcs. Do similar with the line segment AQ. Here, we've made complete circles.



5. Join AB and AC.



Thus, ABC is the required triangle.

Exercise 12.9

1. Question

Construct an equilateral triangle of height 4.5 cm. Measure approximate length of the its side.

Answer

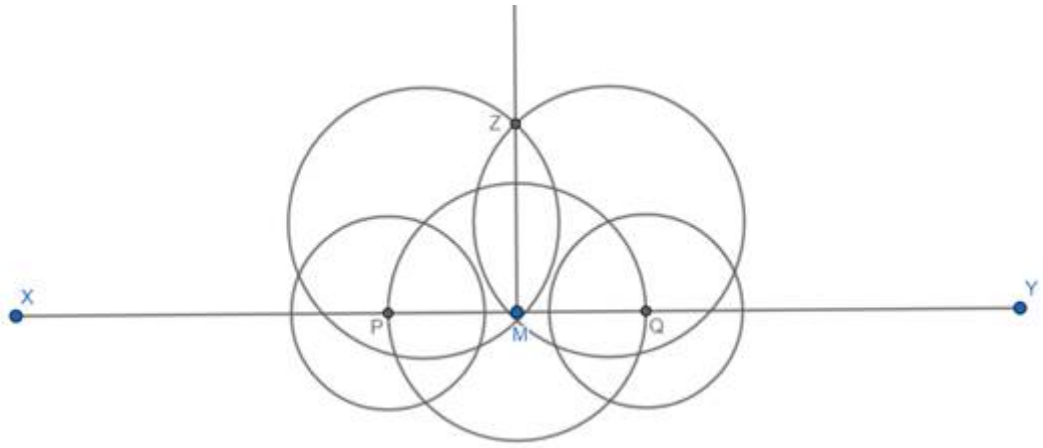
An equilateral triangle has three equal sides and each angle measuring 60°. To make an equilateral triangle, we have been given height of the triangle and we already know the sides are all equal.

Steps of construction:

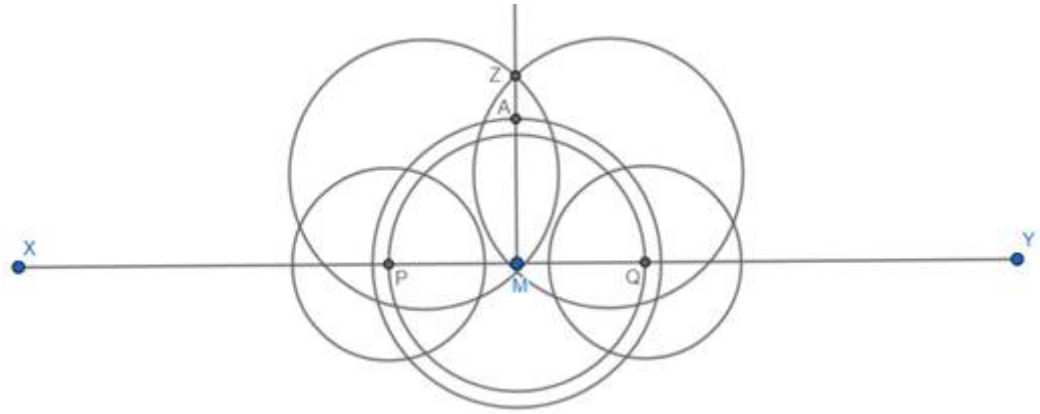
1. Draw a line segment XY, large enough using a ruler.

2. Take any point M on line segment XY. Draw ZM ⊥ XY using a compass and ruler.

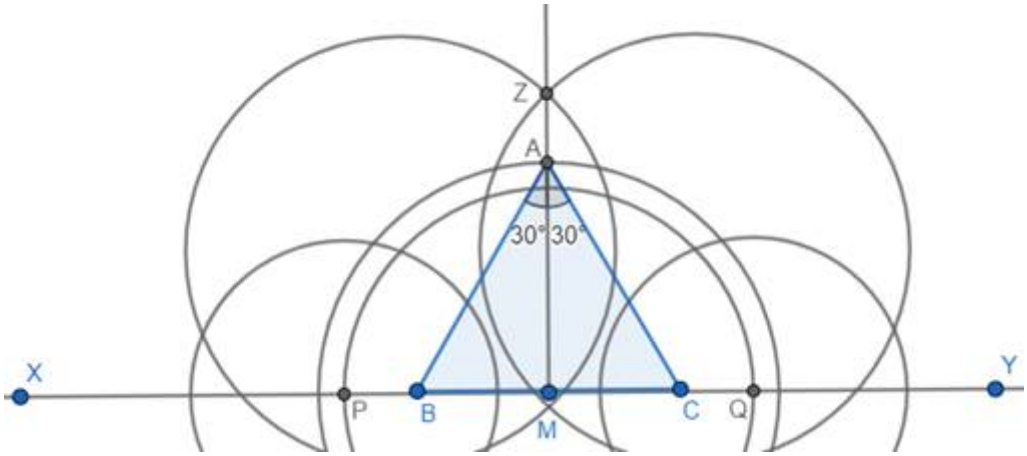
To draw perpendicular ZM: With M as centre, draw a circle/semicircle of radius say 4 cm cutting the line XY at P and Q on XY. Taking each P and Q as centre, draw an arc or circle of radius 3 cm (say). These arcs or circle should intersect the circle of centre M. The points at which they intersect, draw two more arcs or circles of radius 4.2 cm. Let the point at which these arcs or circles intersect be Z. Join MZ.



3. With M as centre and radius 4.5 cm, draw an arc/circle/semicircle cutting MZ at A using a compass.

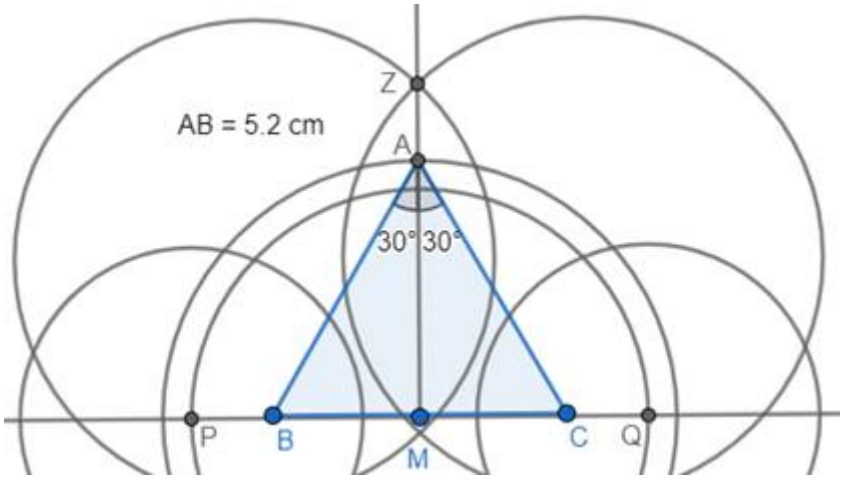


4. Construct ∠MAB = 30° and ∠MAC = 30°, with B and C on XY using a compass.



To measure the length of sides of the equilateral triangle, use a ruler and measure the length of one of the sides of the triangle so constructed.

Here, the length has come out to be 5.2 cm.



Thus, ABC is the required equilateral triangle and the length of its sides is 5.2 cm.

2. Question

Construct an equilateral triangle of height 5.2 cm. Measure approximate length of the its side.

Answer

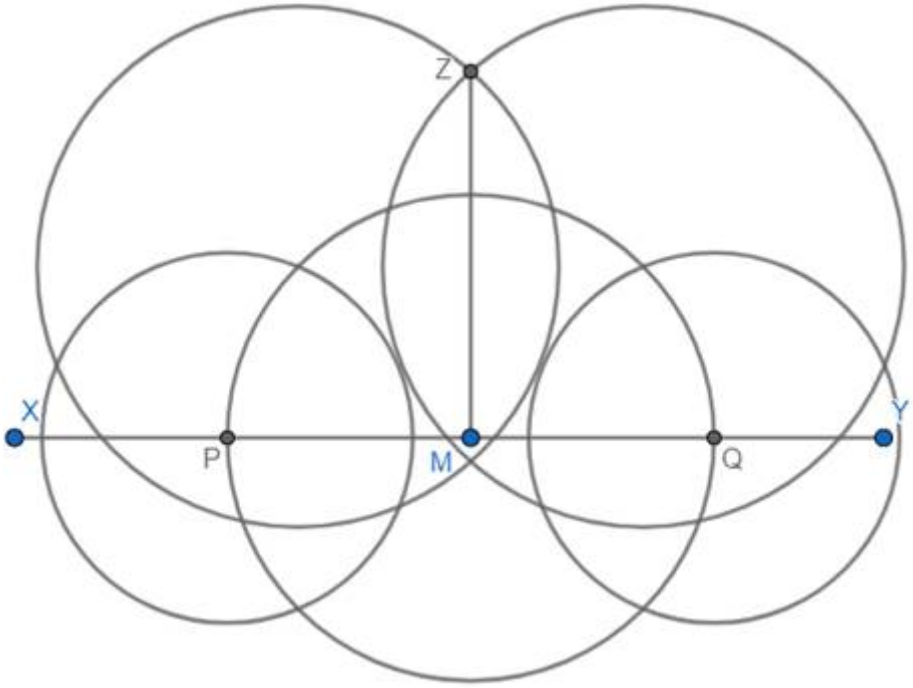
An equilateral triangle has three equal sides and each angle measuring 60°. To make an equilateral triangle, we have been given height of the triangle and we already know the sides are all equal.

Steps of construction:

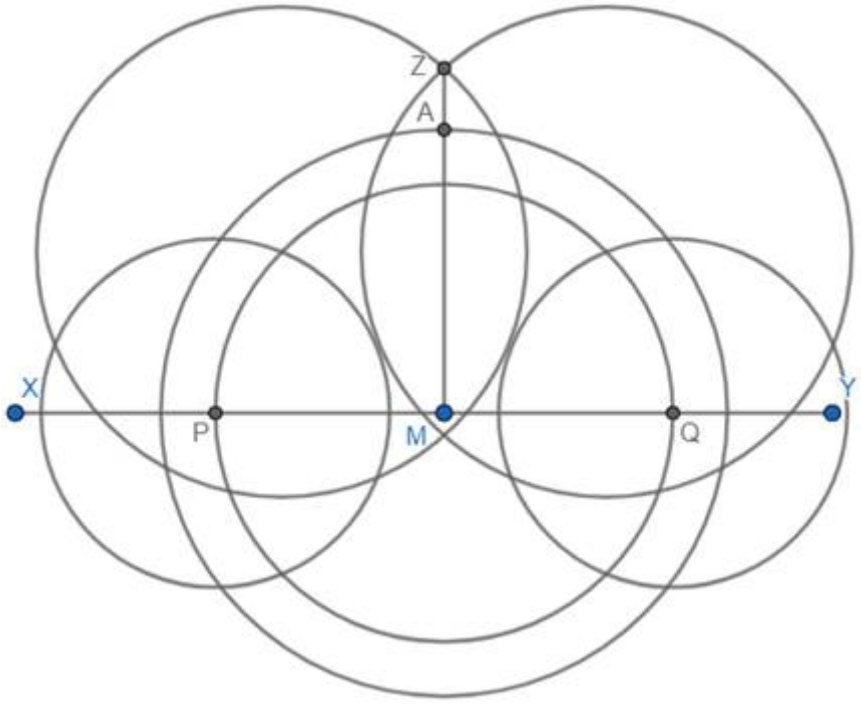
1. Draw a line segment XY, large enough using a ruler.

2. Take any point M on line segment XY. Draw ZM ⊥ XY using a compass and ruler.

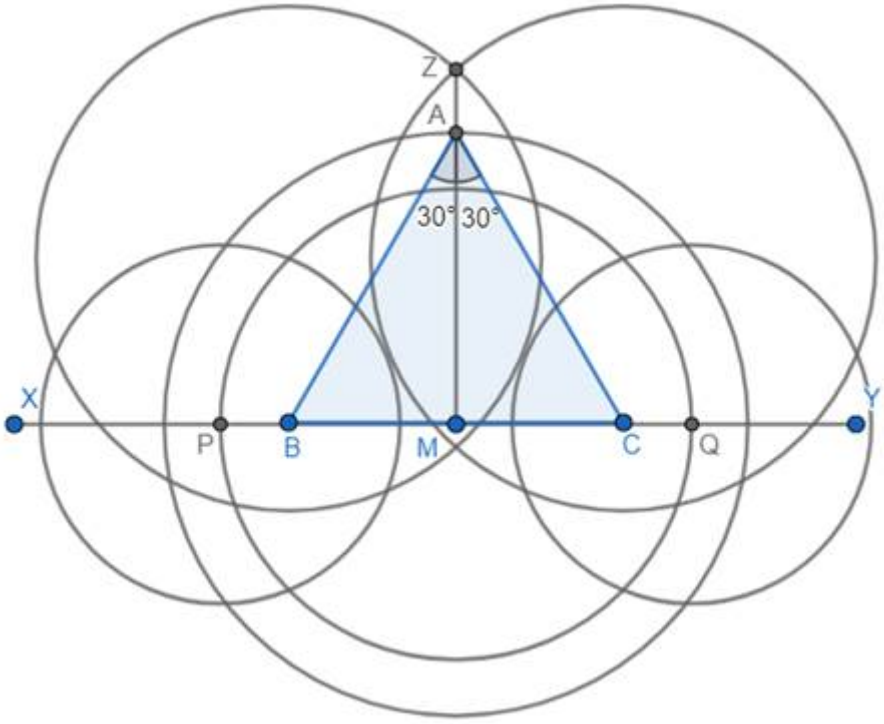
To draw perpendicular ZM: With M as centre, draw a circle/semicircle of radius say 4.2 cm cutting the line XY at P and Q on XY. Taking each P and Q as centre one by one, draw an arc or circle of radius 3.2 cm (say). These arcs or circle should intersect the circle of centre M. The points at which they intersect, draw two more arcs or circles of radius 4.5 cm. Let the point at which these arcs or circles intersect be Z. Join MZ.



3. With M as centre and radius 5.2 cm, draw an arc/circle/semicircle cutting MZ at A using a compass.

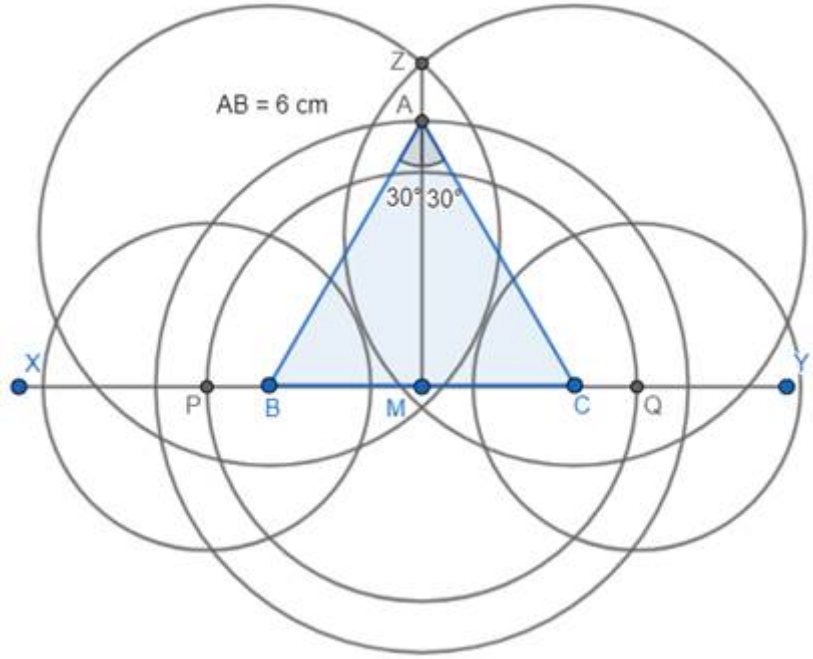


4. Construct ∠MAB = 30° and ∠MAC = 30°, with B and C on XY using a compass.



To measure the length of sides of the equilateral triangle, use a ruler and measure the length of one of the sides of the triangle so constructed.

Here, the length has come out to be 6 cm.



Thus, ABC is the required triangle and the length of its side is 6 cm.

3. Question

Construct an equilateral triangle of height 6 cm. Measure approximate length of the its side.

Answer

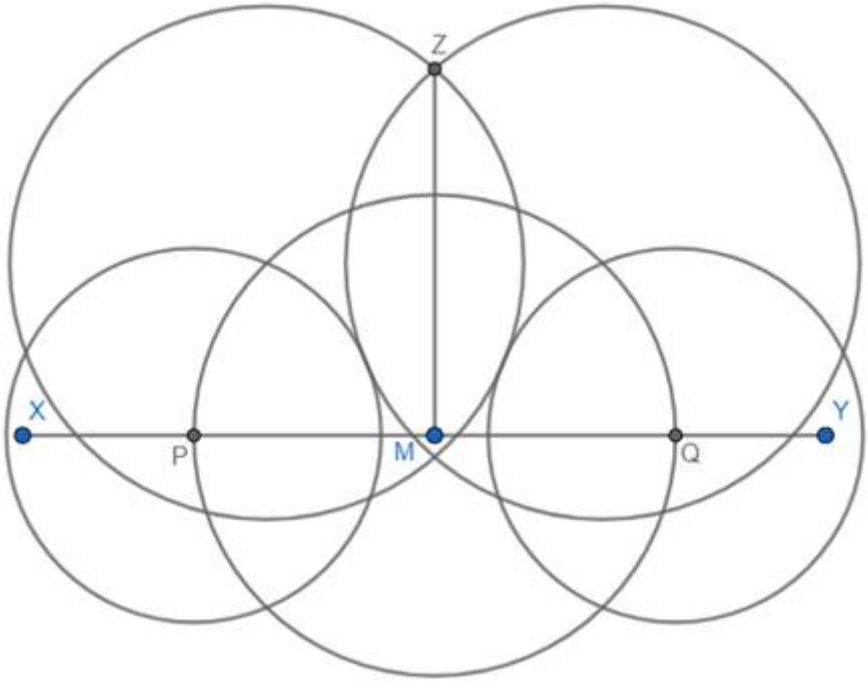
An equilateral triangle has three equal sides and each angle measuring 60°. To make an equilateral triangle, we have been given height of the triangle and we already know the sides are all equal.

Steps of construction:

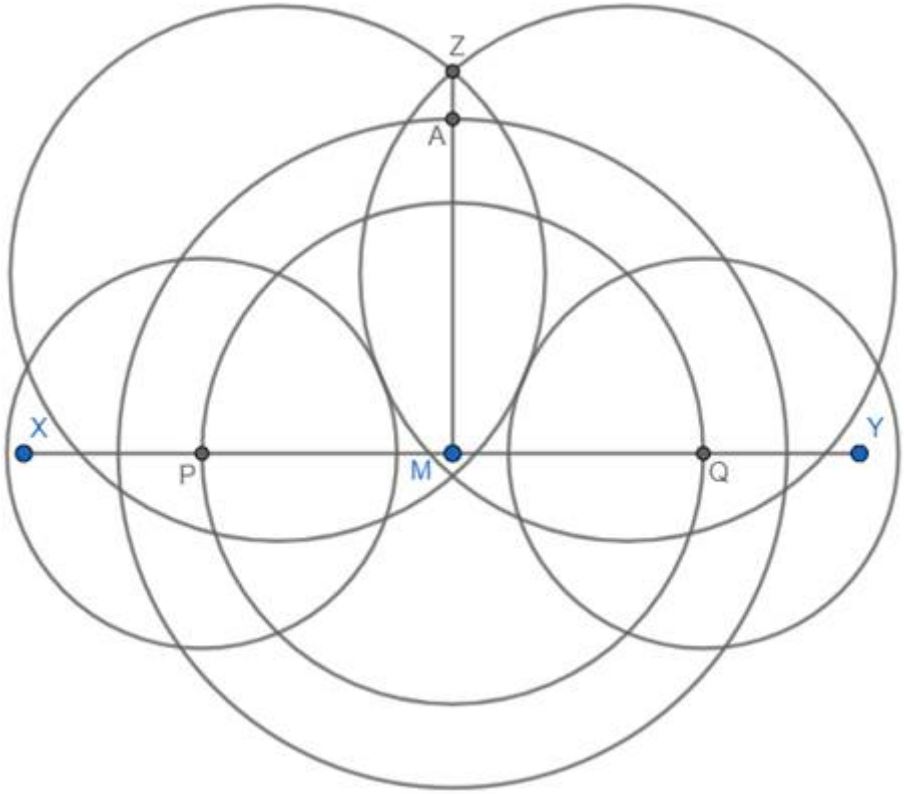
1. Draw a line segment XY, large enough using a ruler.

2. Take any point M on line segment XY. Draw ZM ⊥ XY using a compass and ruler.

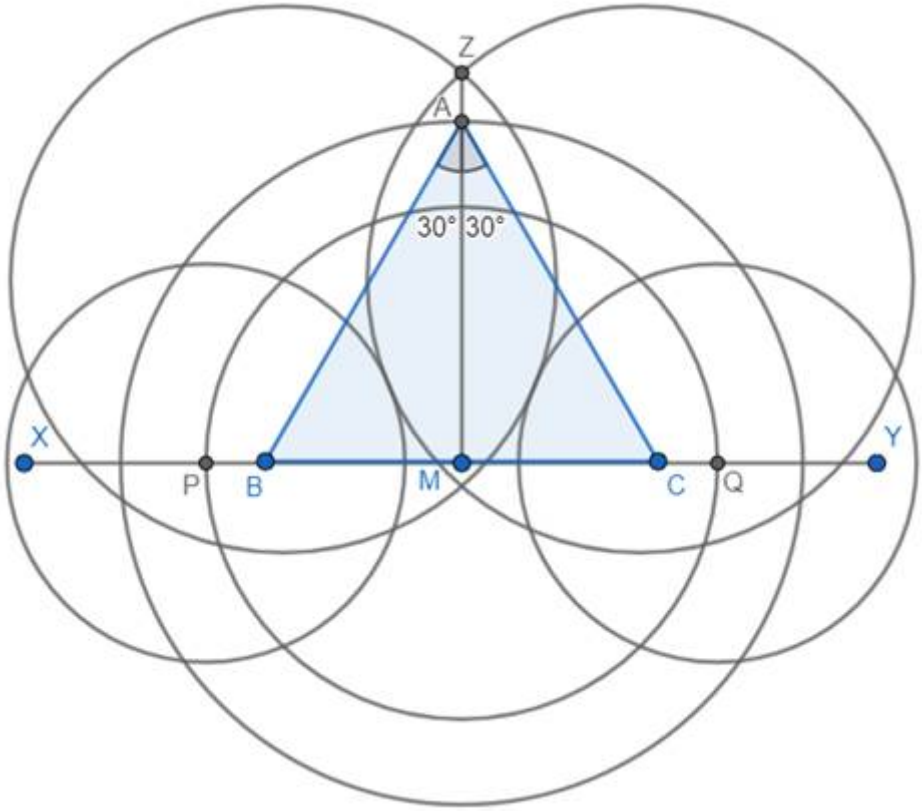
To draw perpendicular ZM: With M as centre, draw a circle/semicircle of radius say 4.5 cm cutting the line XY at P and Q on XY. Taking each P and Q as centres one by one, draw an arc or circle of radius 3.5 cm (say). These arcs or circle should intersect the circle of centre M. The points at which they intersect, draw two more arcs or circles of radius 4.8 cm. Let the point at which these arcs or circles intersect be Z. Join MZ.



3. With M as centre and radius 6 cm, draw an arc/circle/semicircle cutting MZ at A using a compass.

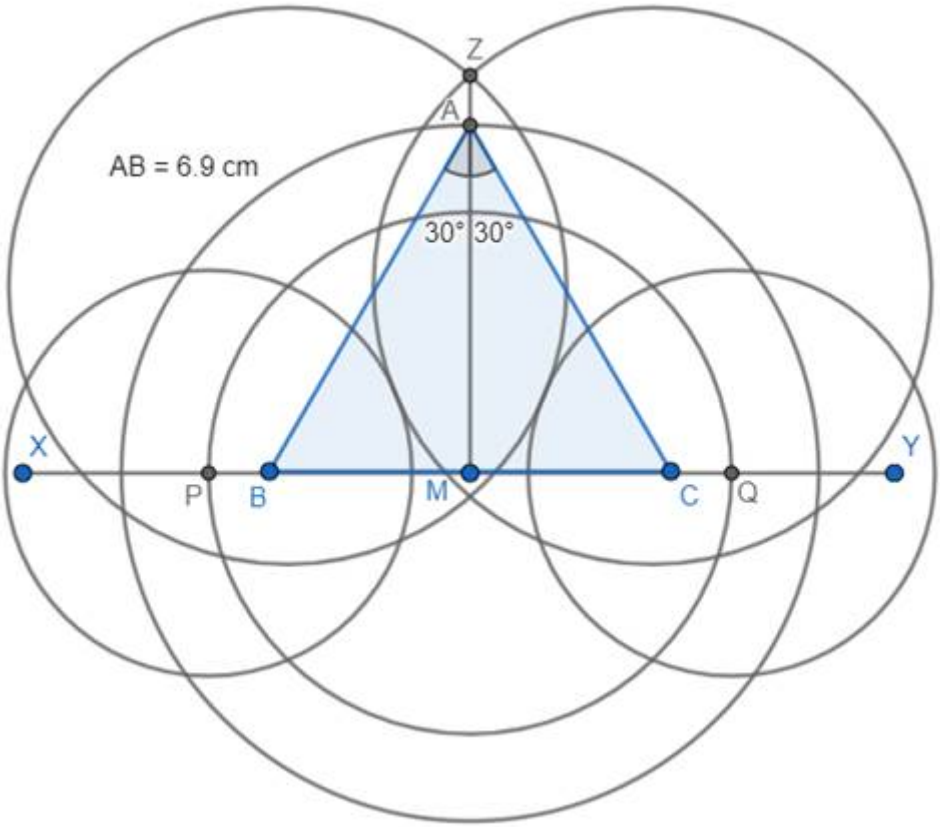


4. Construct ∠MAB = 30° and ∠MAC = 30°, with B and C on XY using a compass.



To measure the length of sides of the equilateral triangle, use a ruler and measure the length of one of the sides of the triangle so constructed.

Here, the length has come out to be 6.9 cm.



Thus, ABC is the required equilateral triangle and the length of its sides is 6.9 cm.

Exercise 12.10

1. Question

Construct a triangle PQR in which PQ = 5.5 cm, PR = 6.2 cm and length of the perpendicular from P on QR is 4 cm.

Answer

We have been given two sides of a triangle and its perpendicular height.

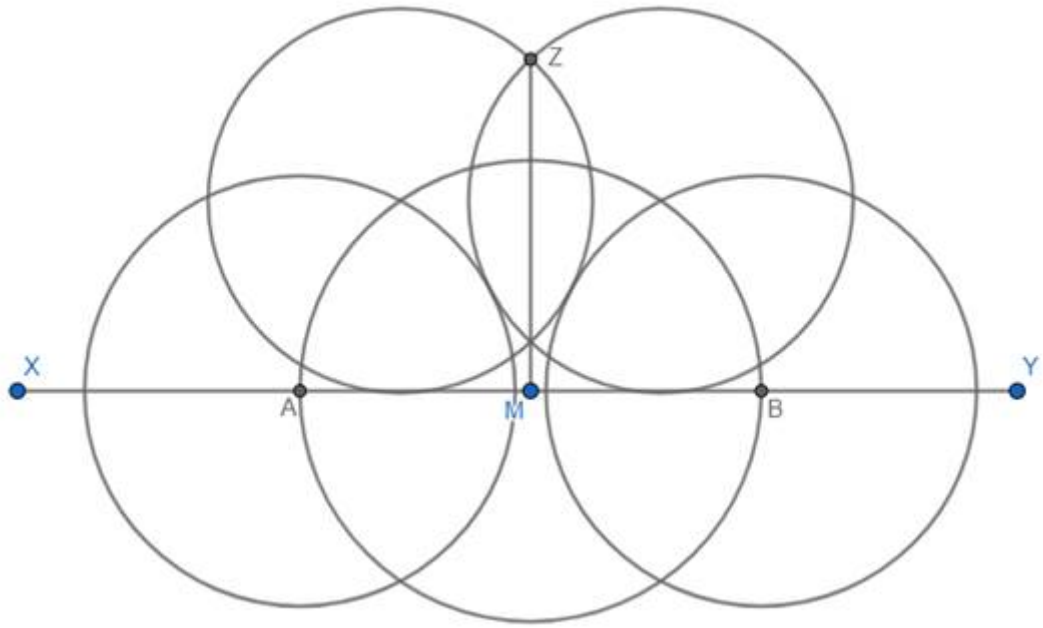
Steps of construction are:

1. Draw a line segment XY long enough using a ruler.

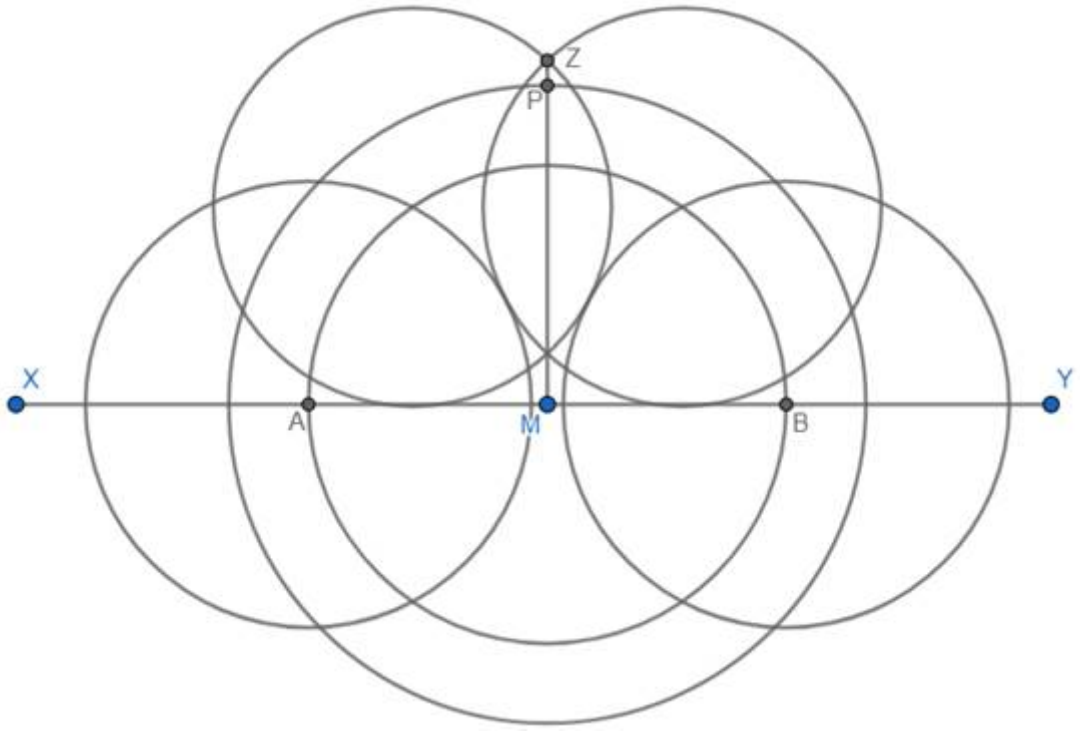
2. Take a point M on XY.

3. Draw ZM ⊥ XY, with ZM sufficiently large.

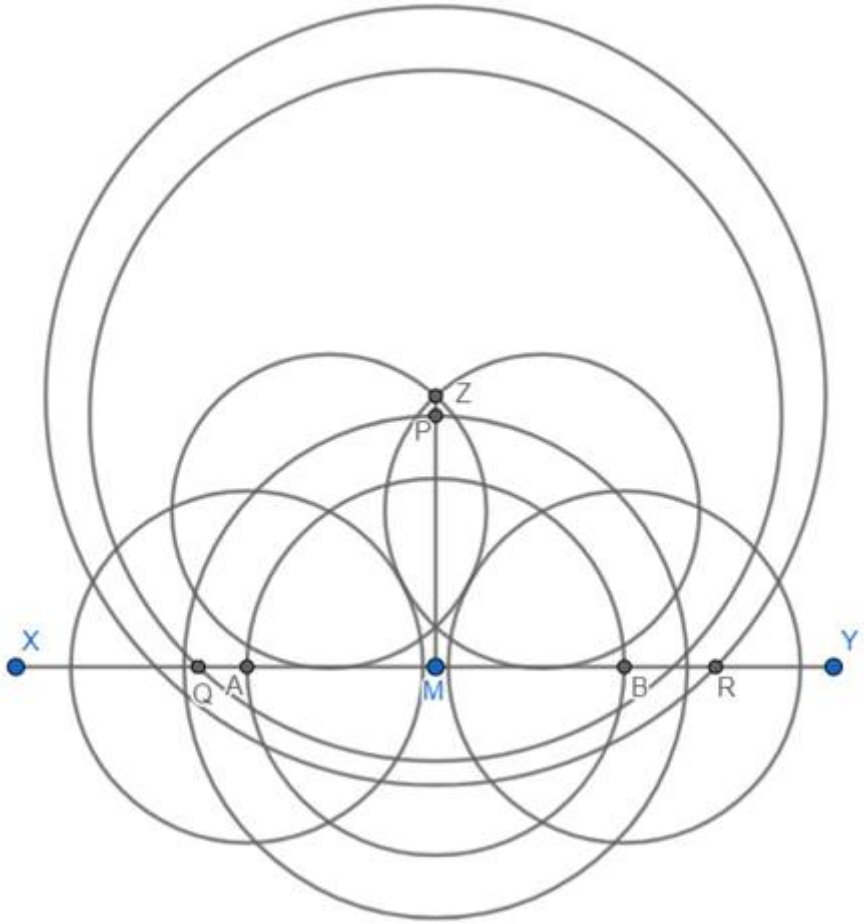
To draw perpendicular ZM: With M as centre, draw a circle/semicircle of radius say 3 cm cutting the line XY at A and B on XY. Taking each A and B as centre one by one, draw an arc or circle of radius 2.8 cm (say). These arcs or circle should intersect the circle of centre M. The points at which they intersect, draw two more arcs or circles of radius 2.5 cm. Let the point at which these arcs or circles intersect be Z. Join MZ.



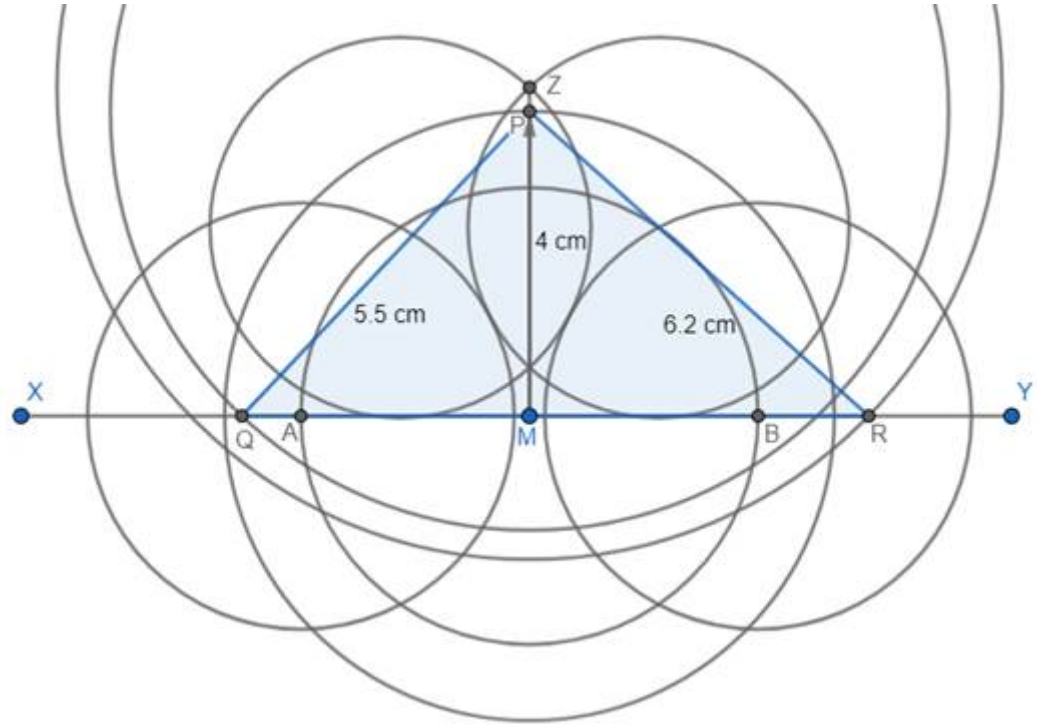
4. With M as centre and radius 4 cm, draw a circle or arc cutting the line segment ZM at P.



5. With P as centre and radii 5.5 cm and 6.2 cm, draw circles or arcs cutting XY at Q and R respectively.



6. Join PQ and PR.



Thus, PQR is the required triangle.

2. Question

Construct a triangle MNP in which MN = 4.5 cm, MP = 5.2 cm and length of perpendicular from M on NP is 3.8 cm.

Answer

We have been given two sides of a triangle and its perpendicular height.

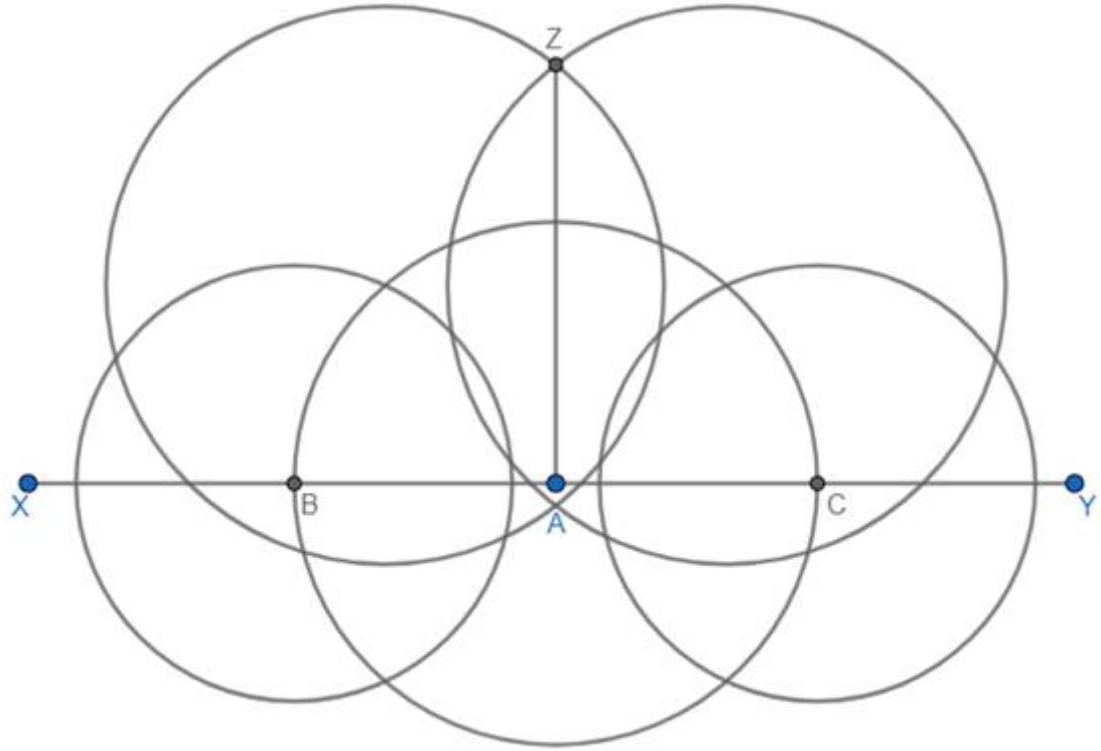
Steps of construction are:

1. Draw a line segment XY long enough using a ruler.

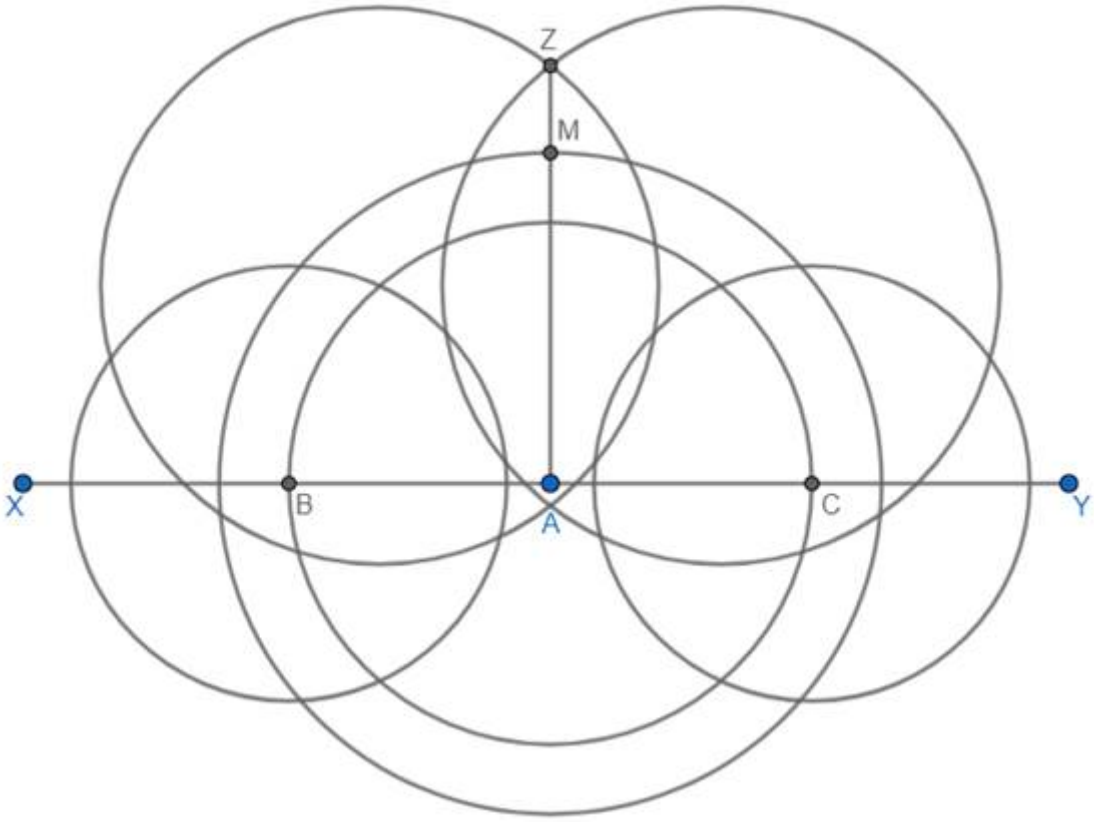
2. Take a point A on XY.

3. Draw ZA ⊥ XY, with ZA sufficiently large.

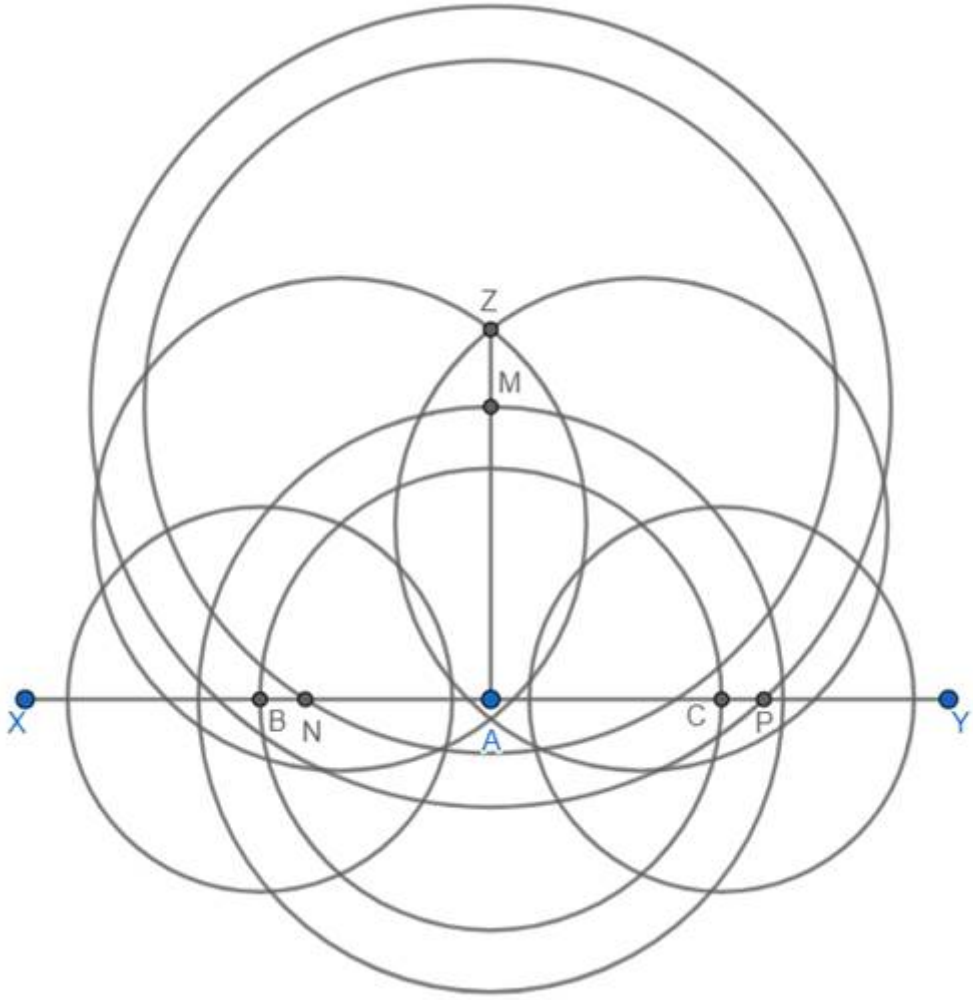
To draw perpendicular ZA: With A as centre, draw a circle/semicircle of radius say 3 cm cutting the line XY at B and C on XY. Taking B and C as centre, draw an arc or circle of radius 2.5 cm (say). These arcs or circle should intersect the circle of centre A. The points at which they intersect, draw two more arcs or circles of radius 3.2 cm. Let the point at which these arcs or circles intersect be Z. Join AZ.



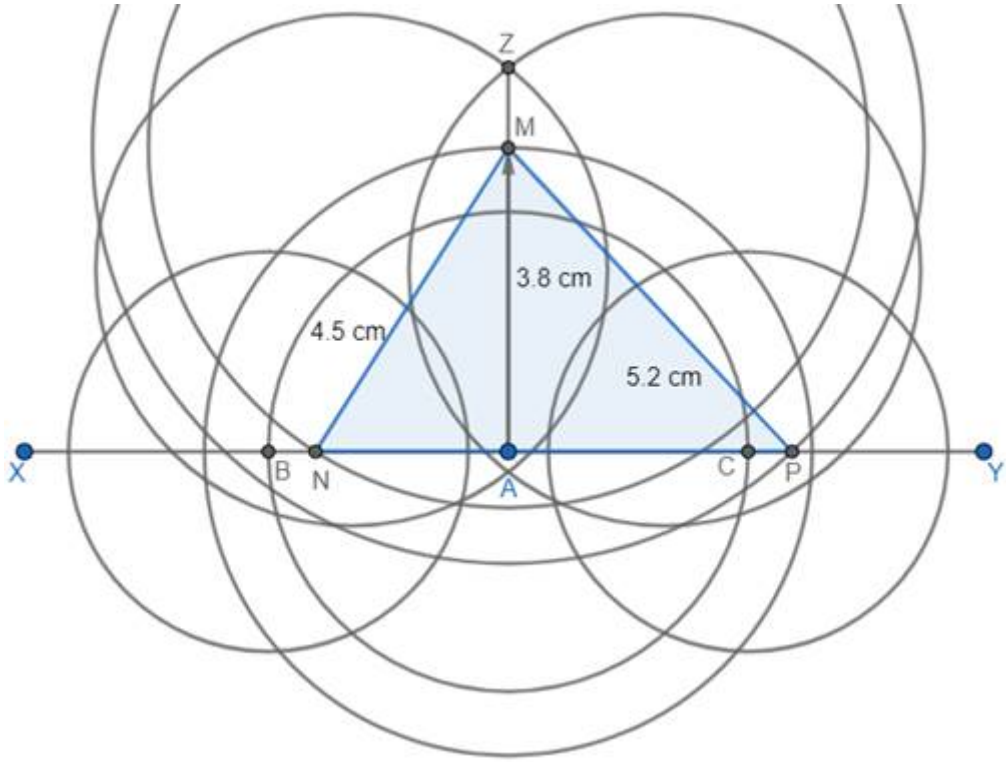
4. With A as centre and radius 3.8 cm, draw a circle or arc cutting the line segment ZA at M.



5. With M as centre and radii 4.5 cm and 5.2 cm, draw circles or arcs cutting XY at N and P respectively.



6. Join MN and MP.



Thus, MNP is the required triangle.

Exercise 12.11

1. Question

Construct a triangle ABC in which BC = 3.6 cm, AB + AC = 4.8cm and ∠B = 60°.

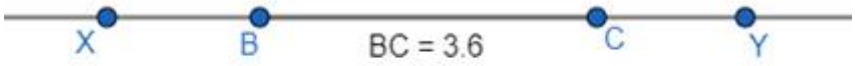
Answer

We have been given one of the side of triangle and the sum of the other two sides along with one of the angle of a triangle.

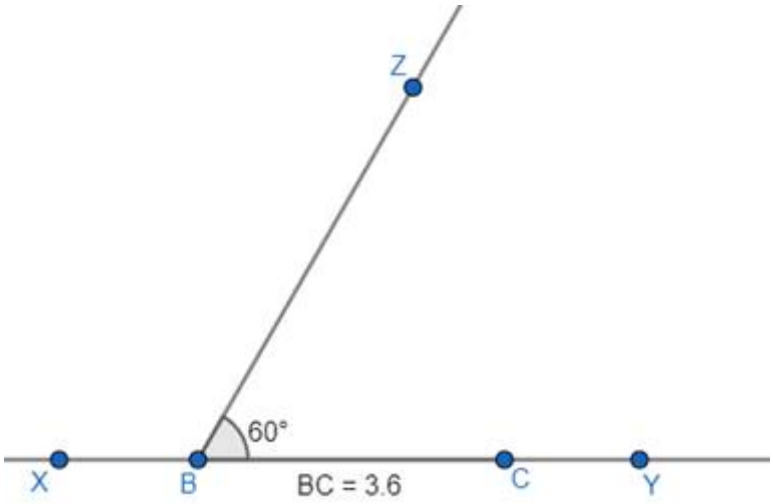
Steps of construction:

1. Draw a line segment XY large enough with the use of a ruler.

2. Locate points B and C on XY, such that BC = 3.6 cm, using a ruler.

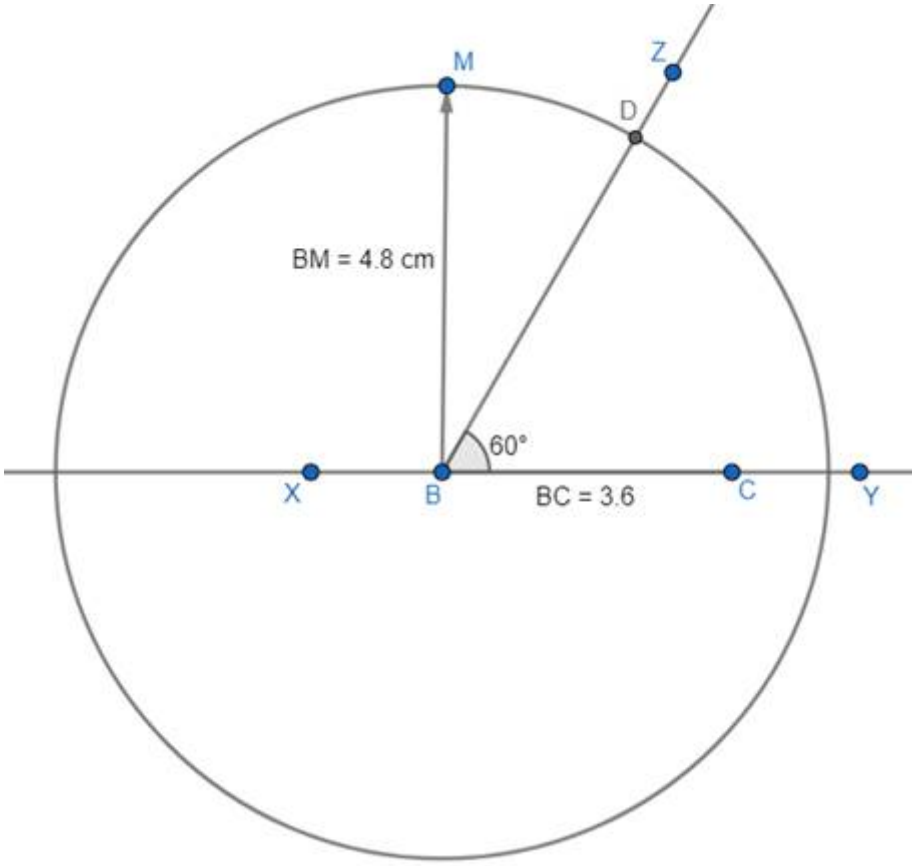


3. Draw a line segment BZ sufficiently large such that ∠CBZ = 60°; do this with the help of a protractor.

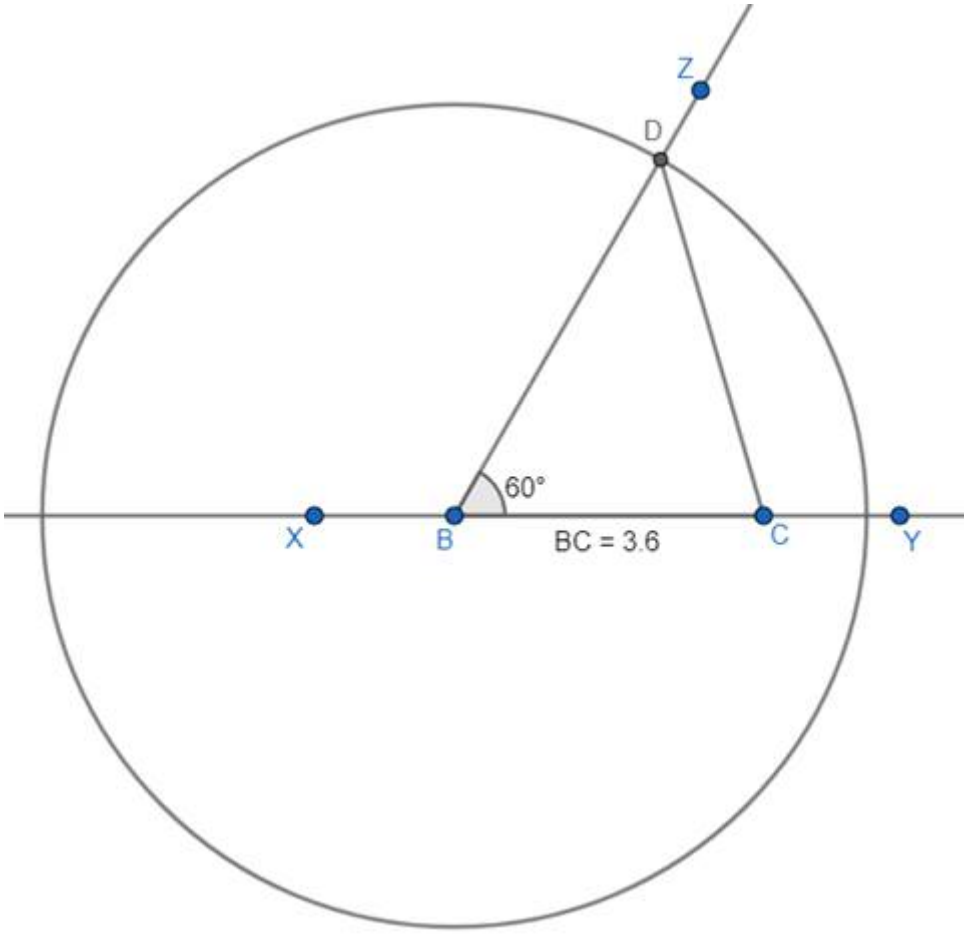


4. From the segment BZ, cut off the line segment BD such that BD = 4.8 cm (here, we have presumed AB + AC = BD), using a compass and a ruler.

With B as centre, set the compass at 4.8 cm length and draw a circle or semicircle or an arc, and name the point where it intersects at BZ as D.

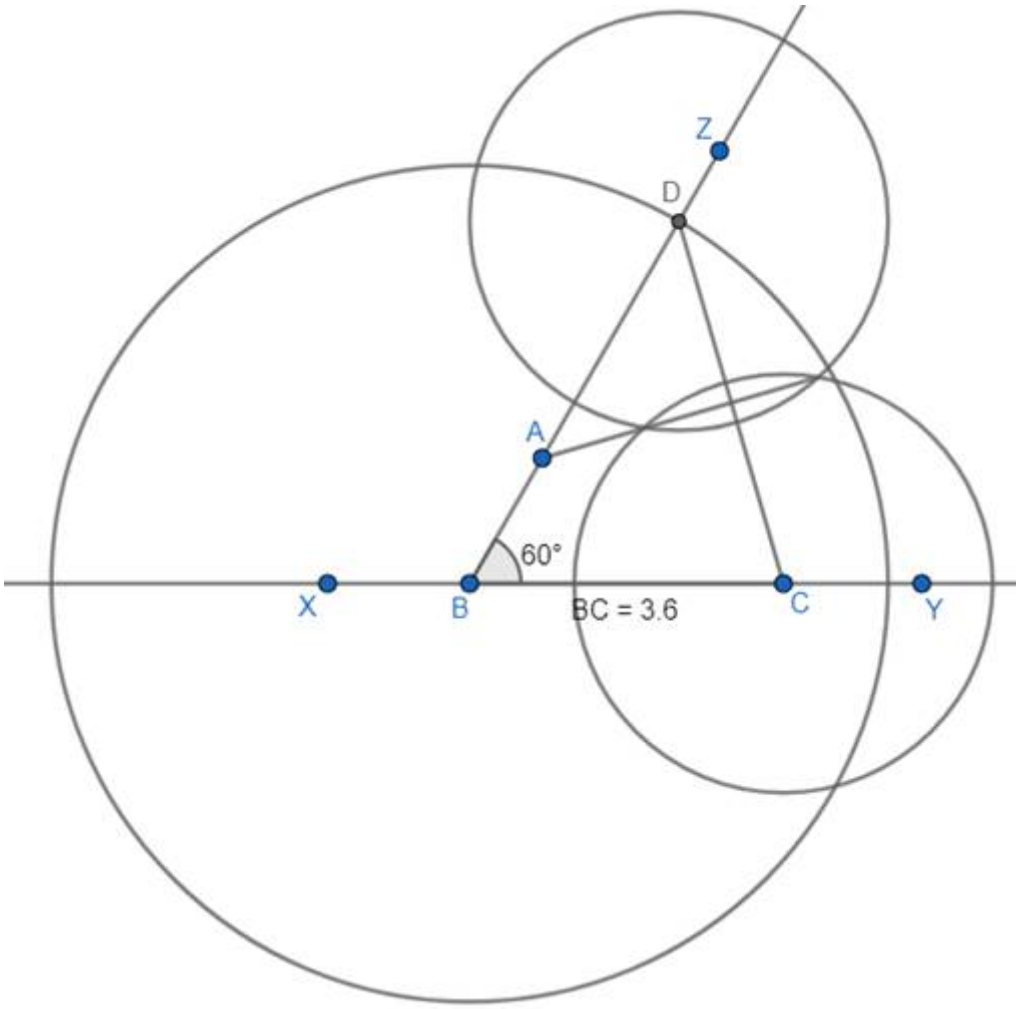


5. Join CD.

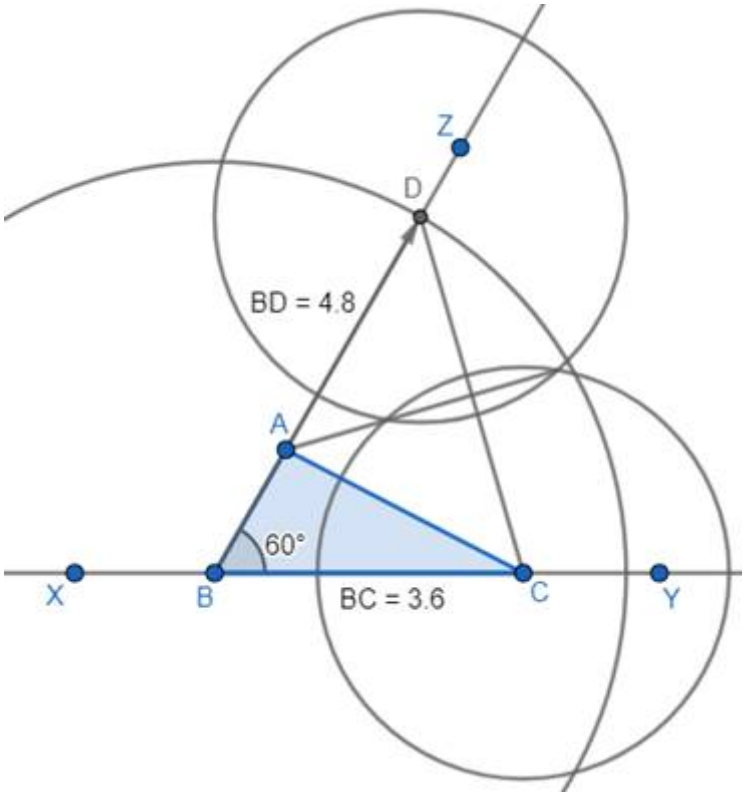


6. Draw perpendicular bisector of CD and let it meet BD at A.

For perpendicular bisector of CD, fix the compass at a length just more than the length of CD and draw circles or arcs on both sides of the line segment CD taking C and D as centres one by one.



7. Join AC.



Thus, ABC is the required triangle.

2. Question

Construct a triangle ABC in which AB + AC = 5.6 cm, BC = 4.5cm and ∠B = 45°.

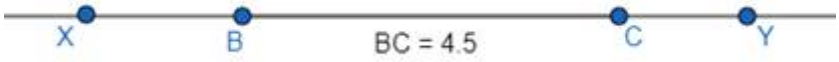
Answer

We have been given one of the side of triangle and the sum of the other two sides along with one of the angle of a triangle.

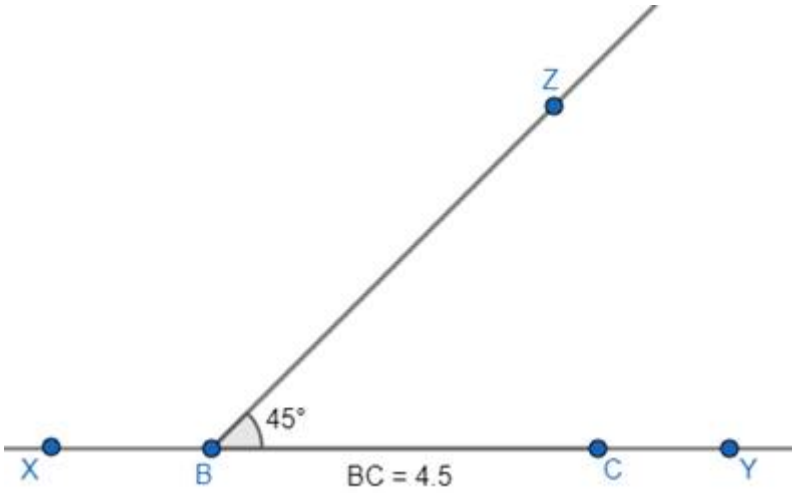
Steps of construction:

1. Draw a line segment XY large enough with the use of a ruler.

2. Locate points B and C on XY, such that BC = 4.5 cm.

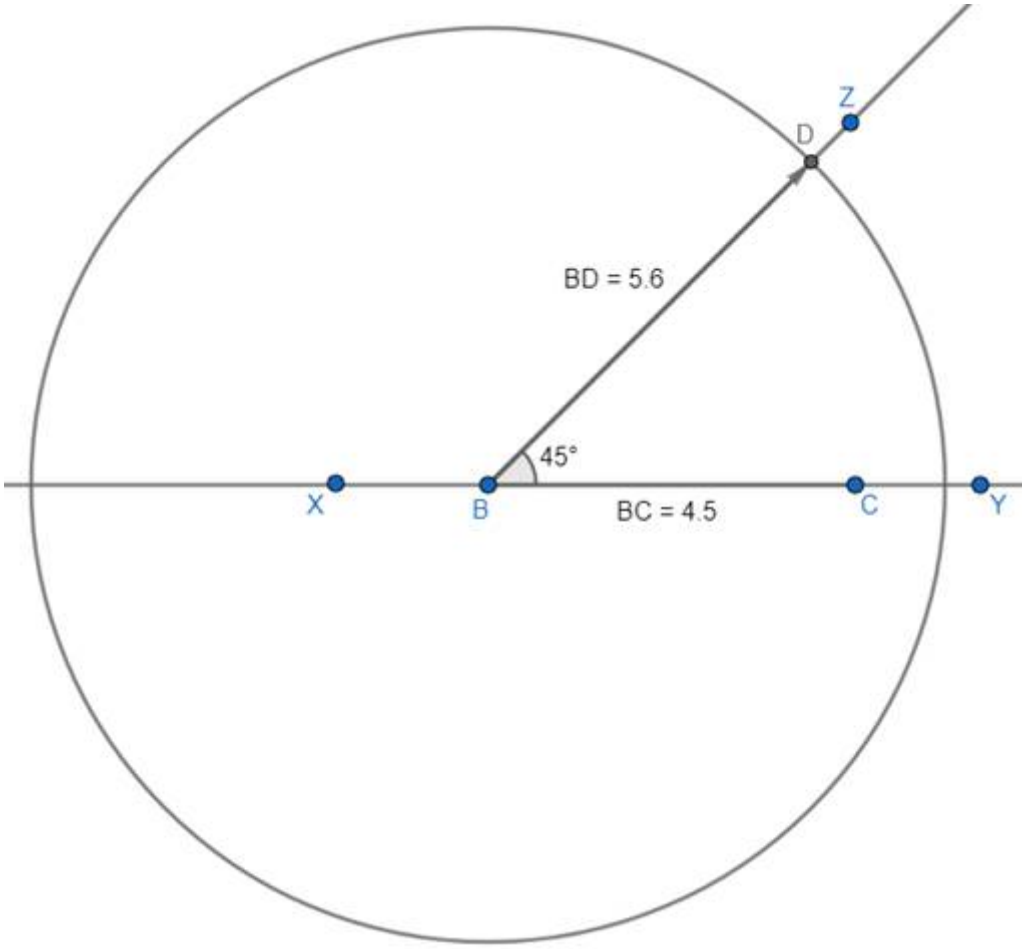


3. Draw a line segment BZ sufficiently large such that ∠CBZ = 45°; do this with the help of a protractor.

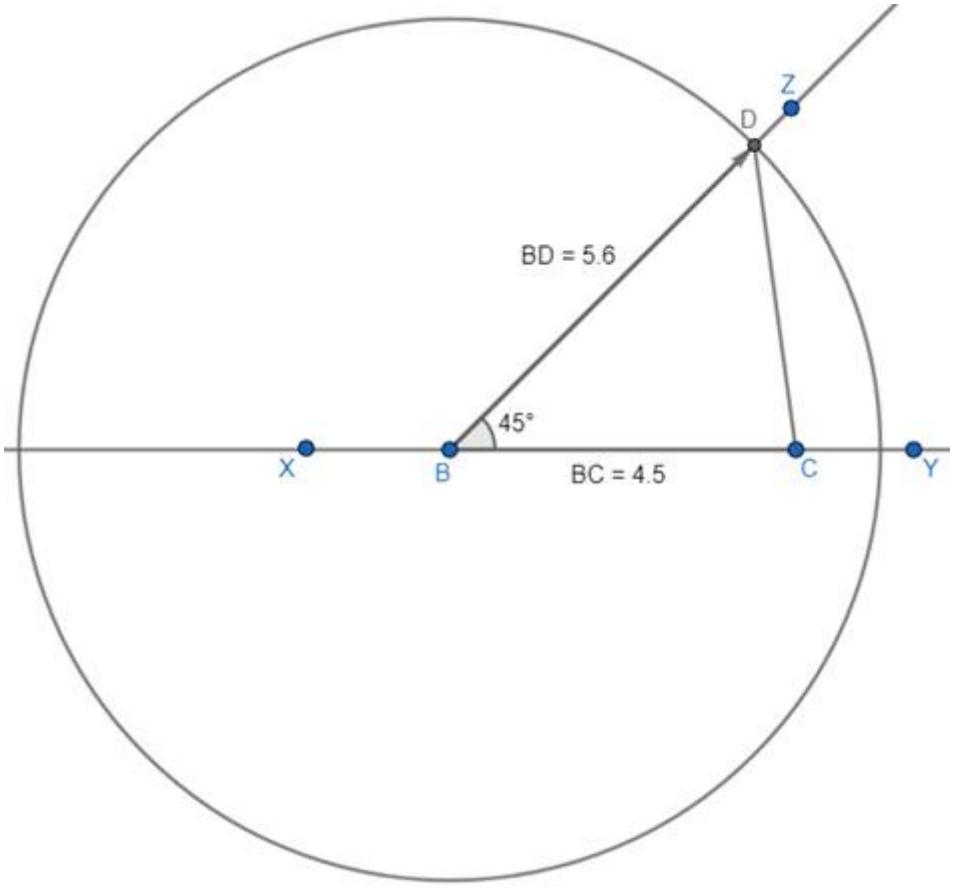


4. From the segment BZ, cut off the line segment BD such that BD = 5.6 cm (here, we have presumed AB + AC = BD), using a compass and a ruler.

With B as centre, set the compass at 5.6 cm length and draw a circle or semicircle or an arc, and name the point where it intersects at BZ as D.

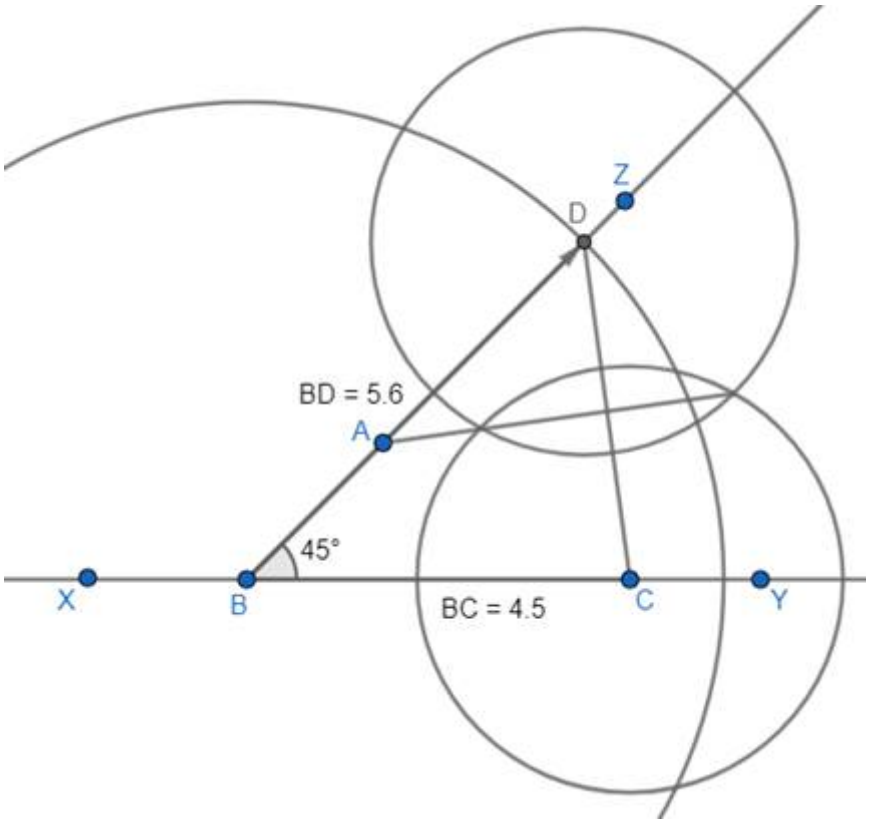


5. Join CD.

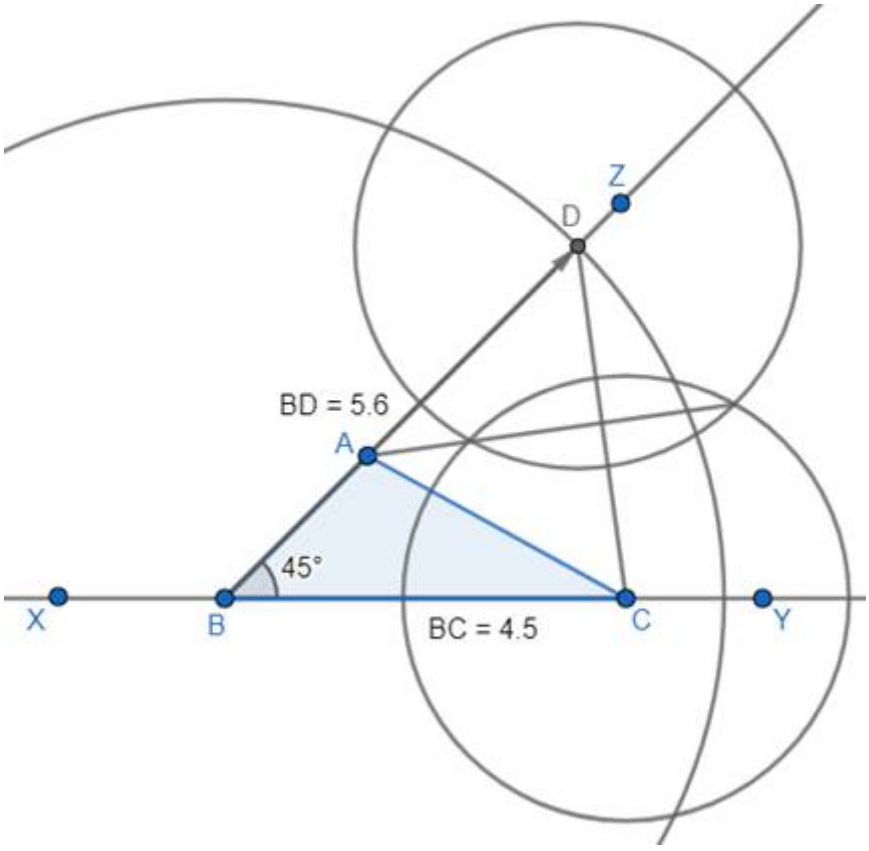


6. Draw perpendicular bisector of CD and let it meet BD at A. For perpendicular bisector of CD, fix the compass at a length just more than the

length of CD and draw circles or arcs on both sides of the line segment CD taking C and D as centres one by one.



7. Join AC.



Thus, ABC is the required triangle.

3. Question

Construct triangle PQR in which PQ + PR = 6.5 cm, QR = 5.4cm, ∠Q = 40°.

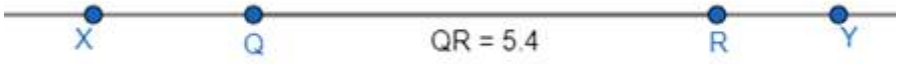
Answer

We have been given one of the side of triangle and the sum of the other two sides along with one of the angle of a triangle.

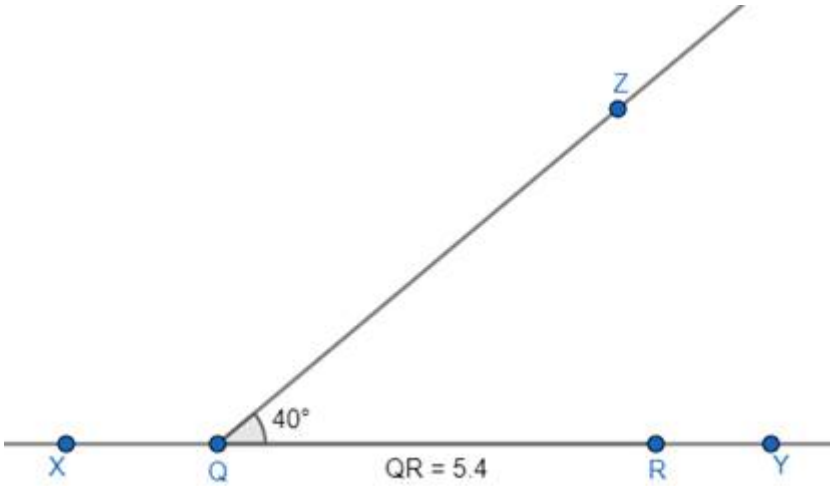
Steps of construction:

1. Draw a line segment XY large enough with the use of a ruler.

2. Locate points Q and R on XY, such that QR = 5.4 cm using a ruler.

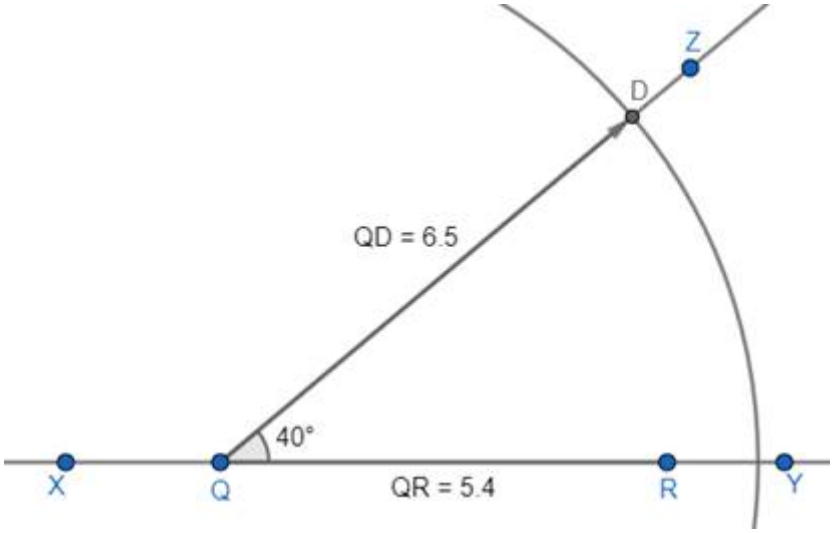


3. Draw a line segment QZ sufficiently large such that ∠RQZ = 40°; do this with the help of a protractor.

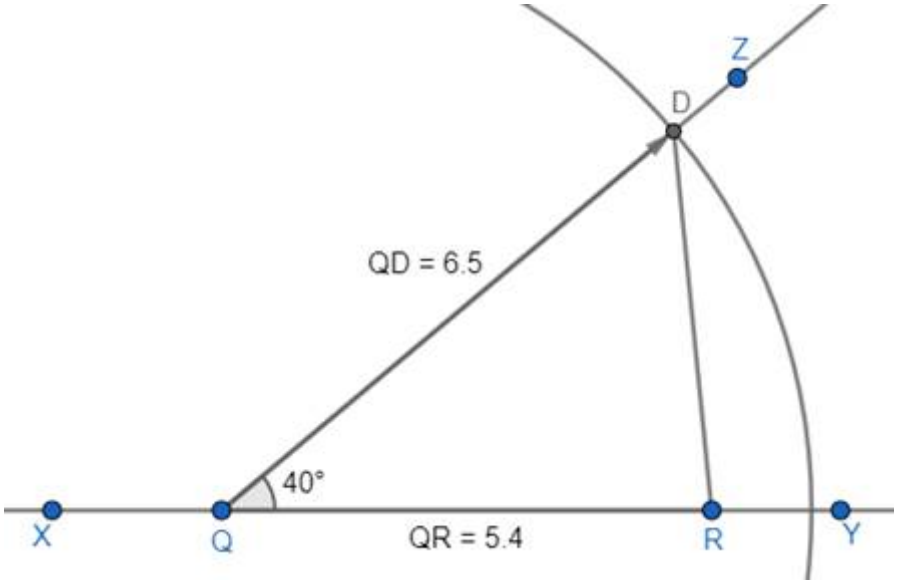


4. From the segment QZ, cut off the line segment QD such that QD = 6.5 cm (here, we have presumed PQ + PR = QD), using a compass and a ruler.

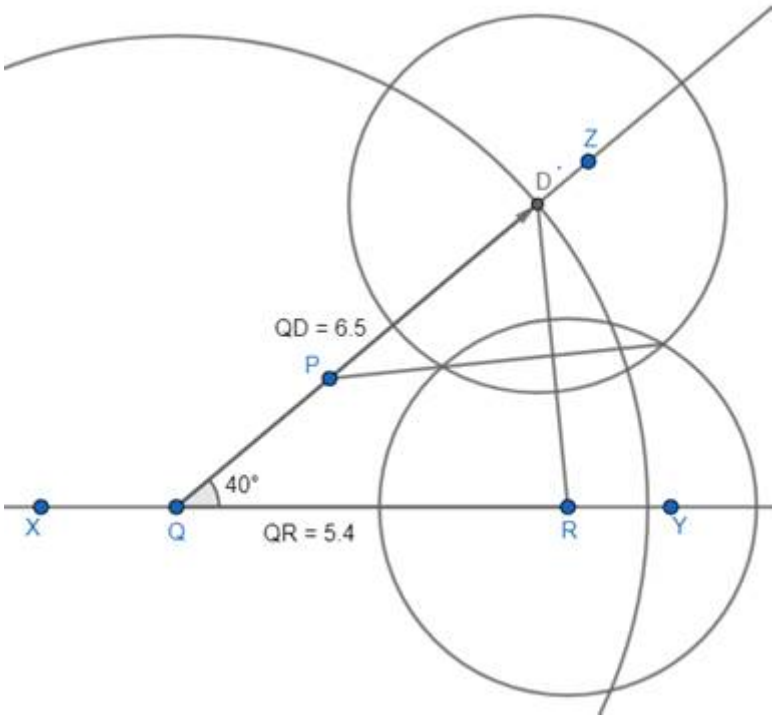
With Q as centre, set the compass at 6.5 cm length and draw a circle or semicircle or an arc, and name the point where it intersects at QZ as D.



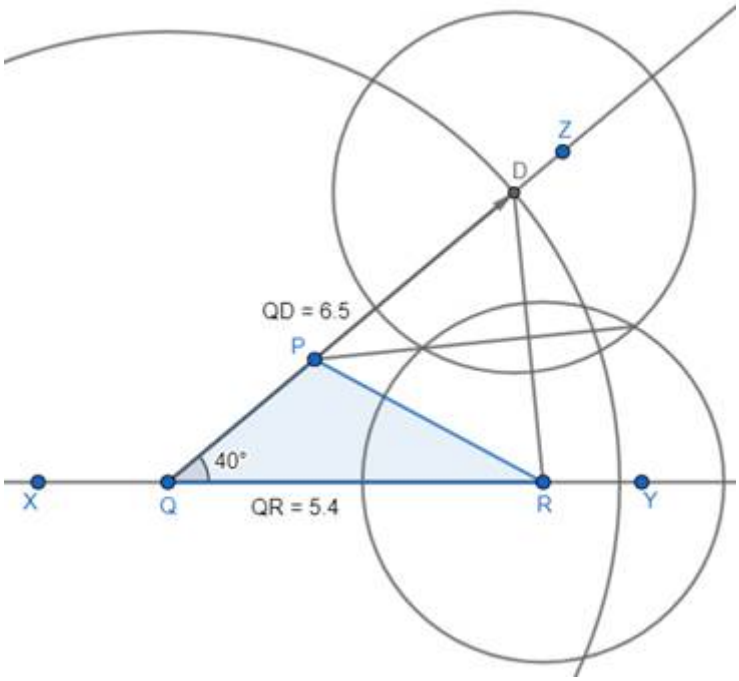
5. Join DR.



6. Draw perpendicular bisector of DR and let it meet QR at P. For perpendicular bisector of DR, fix the compass at a length just more than the length of DR and draw circles or arcs on both sides of the line segment DR taking D and R as centres one by one.



7. Join PR.



Thus, PQR is the required triangle.

Exercise 12.12

1. Question

Construct a triangle ABC in which BC = 3.4 cm AB – AC = 1.5 cm and ∠B = 45°.

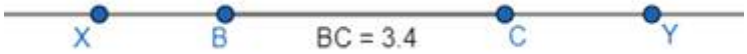
Answer

We have been given one of the side of triangle and the difference of the other two sides along with one of the angle of a triangle.

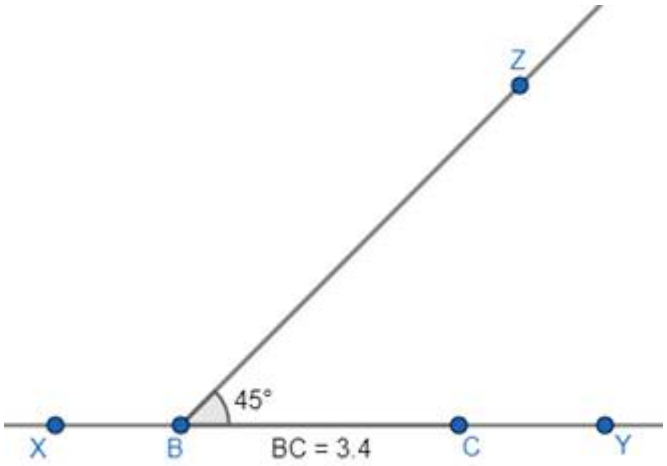
Steps of construction:

1. Draw a line segment XY large enough with the use of a ruler.

2. Locate points B and C on XY, such that BC = 3.4 cm.

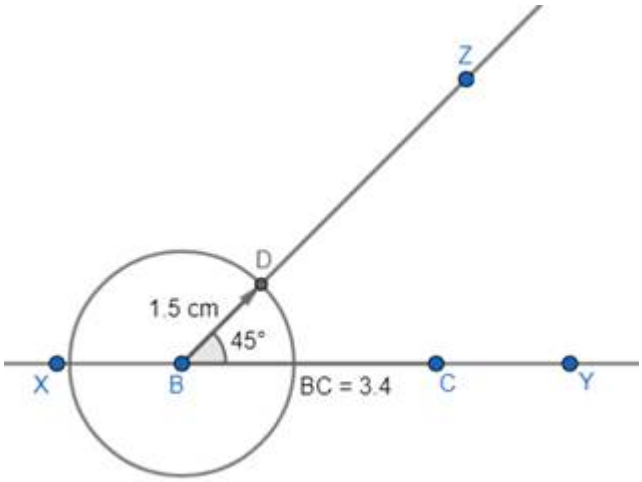


3. Draw a line segment BZ sufficiently large such that ∠CBZ = 45°; do this with the help of a protractor.

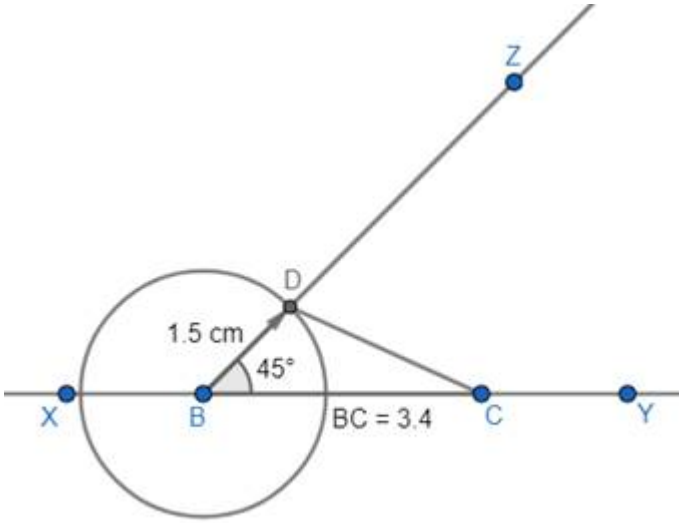


4. From the segment BZ, cut off the line segment BD such that BD = 1.5 cm (here, we have presumed AB – AC = BD), using a compass and a ruler.

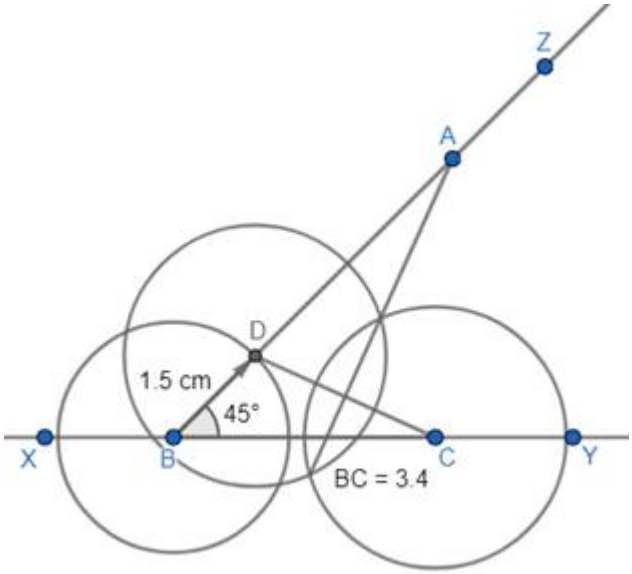
With B as centre, set the compass at 1.5 cm length and draw a circle or semicircle or an arc, and name the point where it intersects at BZ as D.



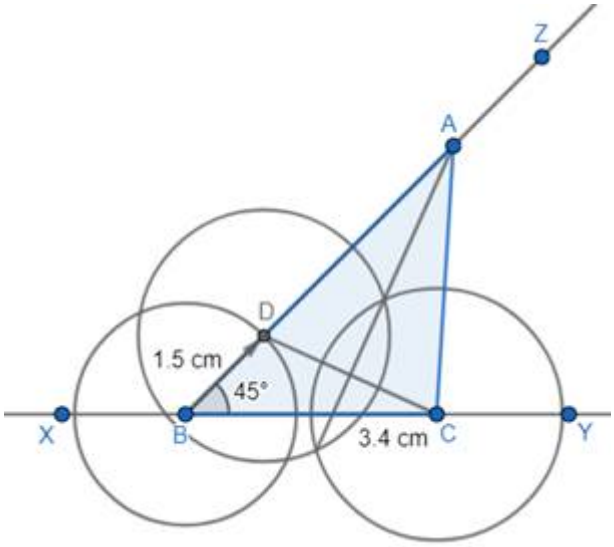
5. Join CD.



6. Draw perpendicular bisector of CD and let it meet BD at A. For perpendicular bisector of CD, fix the compass at a length just more than the length of CD and draw circles or arcs on both sides of the line segment CD taking C and D as centres one by one.



7. Join AC.



Thus, ABC is the required triangle.

2. Question

Construct a triangle ABC in which BC = 5 cm AB – AC = 2.8 cm and ∠B = 40°.

Answer

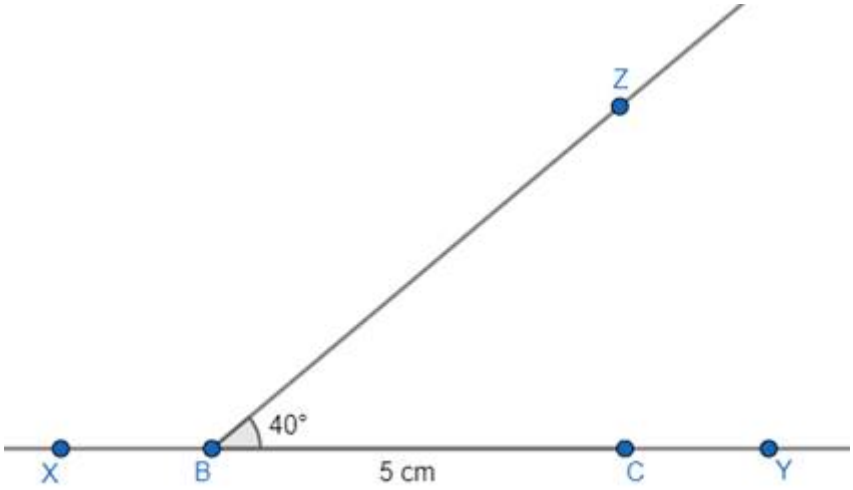
We have been given one of the side of triangle and the difference of the other two sides along with one of the angle of a triangle.

Steps of construction:

1. Draw a line segment XY large enough with the use of a ruler.

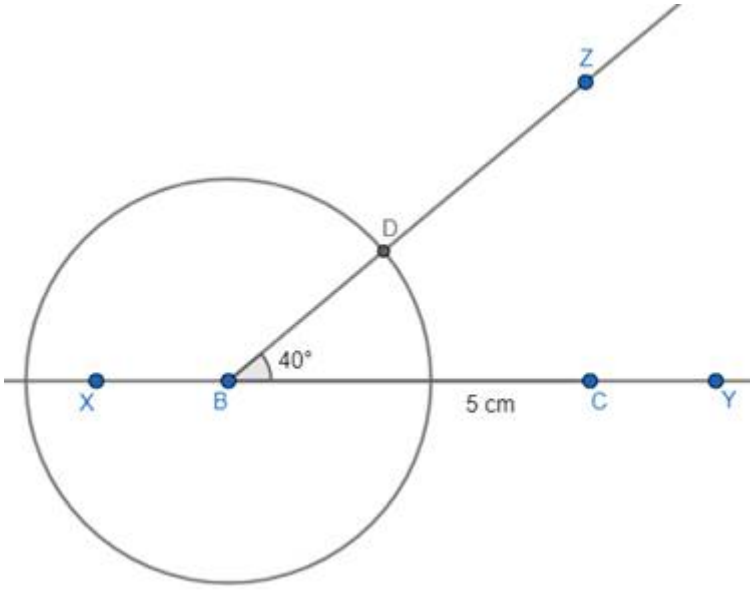
2. Locate points B and C on XY, such that BC = 5 cm.

3. Draw a line segment BZ sufficiently large such that ∠CBZ = 40°; do this with the help of a protractor.

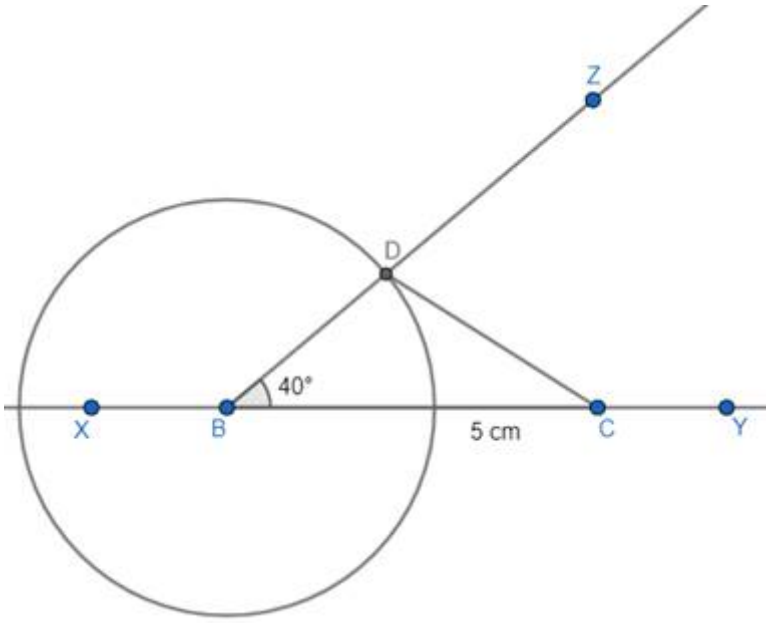


4. From the segment BZ, cut off the line segment BD such that BD = 2.8 cm (here, we have presumed AB – AC = BD), using a compass and a ruler.

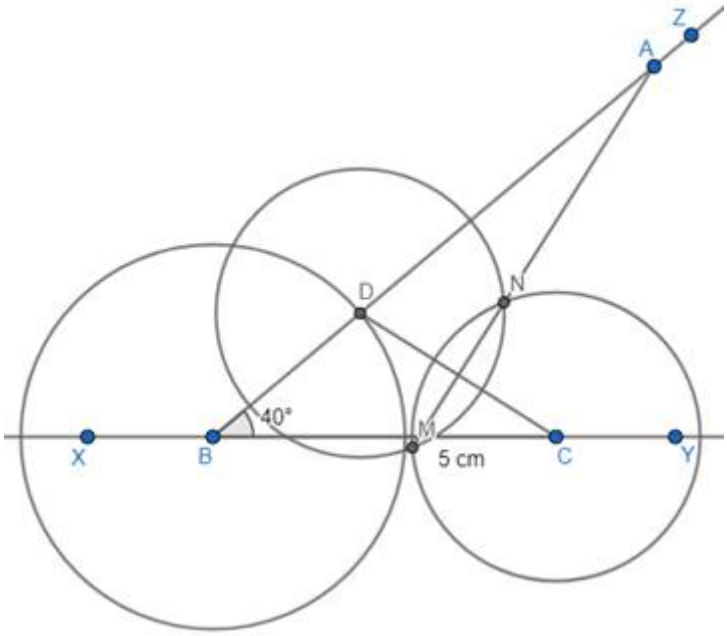
With B as centre, set the compass at 2.8 cm length and draw a circle or semicircle or an arc, and name the point where it intersects at BZ as D.



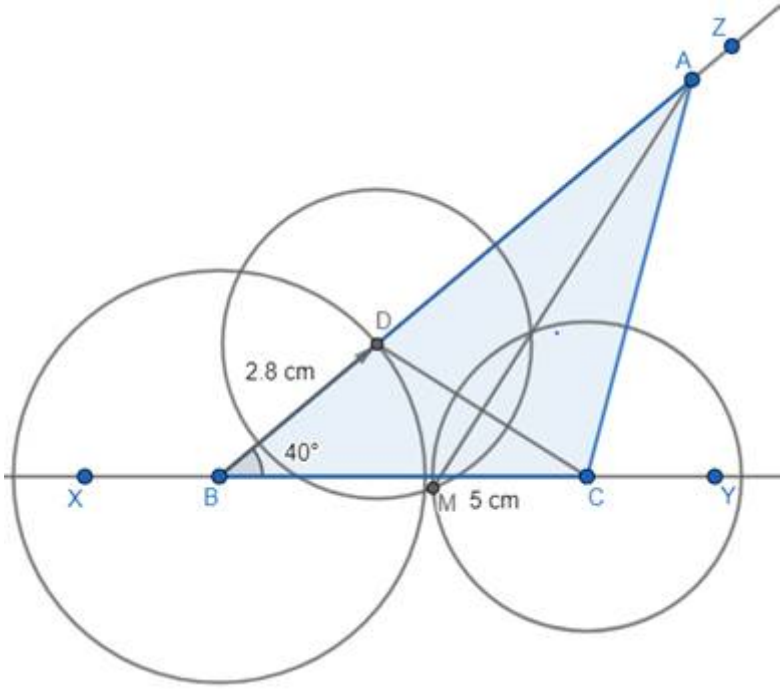
5. Join CD.



6. Draw perpendicular bisector of CD and let it meet BD at A. For perpendicular bisector of CD, fix the compass at a length just more than the length of CD and draw circles or arcs on both sides of the line segment CD taking C and D as centres one by one.



7. Join AC.



Thus, ABC is the required triangle.

3. Question

Construct a triangle ABC in which BC = 6 cm, AB – AC = 3.1 cm and ∠B = 30°.

Answer

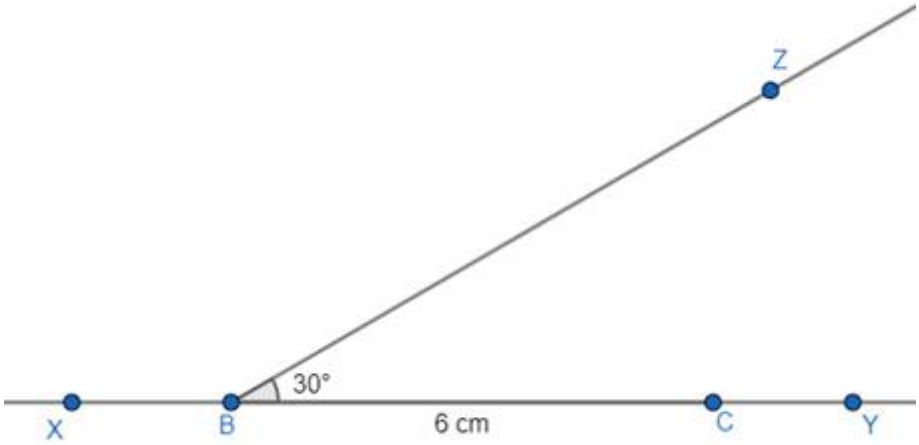
We have been given one of the side of triangle and the difference of the other two sides along with one of the angle of a triangle.

Steps of construction:

1. Draw a line segment XY large enough with the use of a ruler.

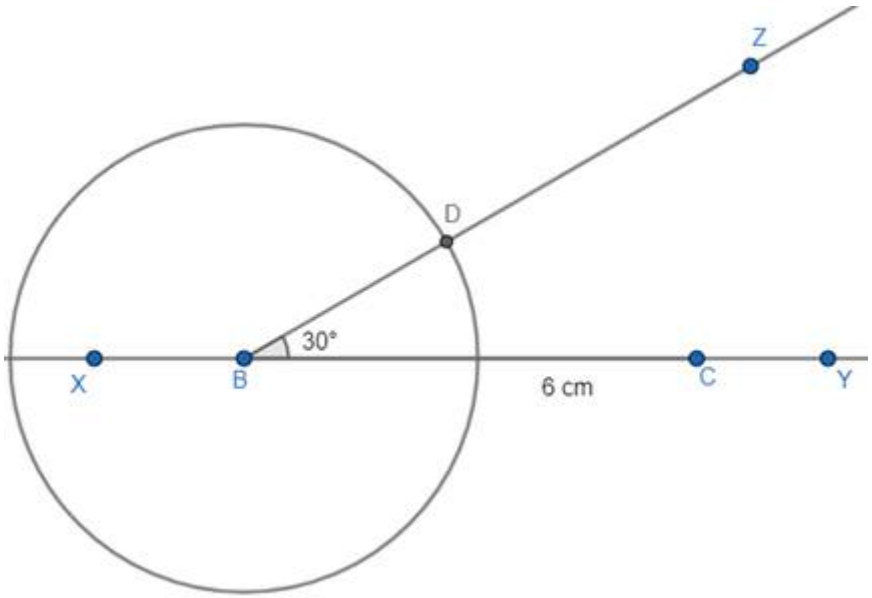
2. Locate points B and C on XY, such that BC = 6 cm.

3. Draw a line segment BZ sufficiently large such that ∠CBZ = 30°; do this with the help of a protractor.

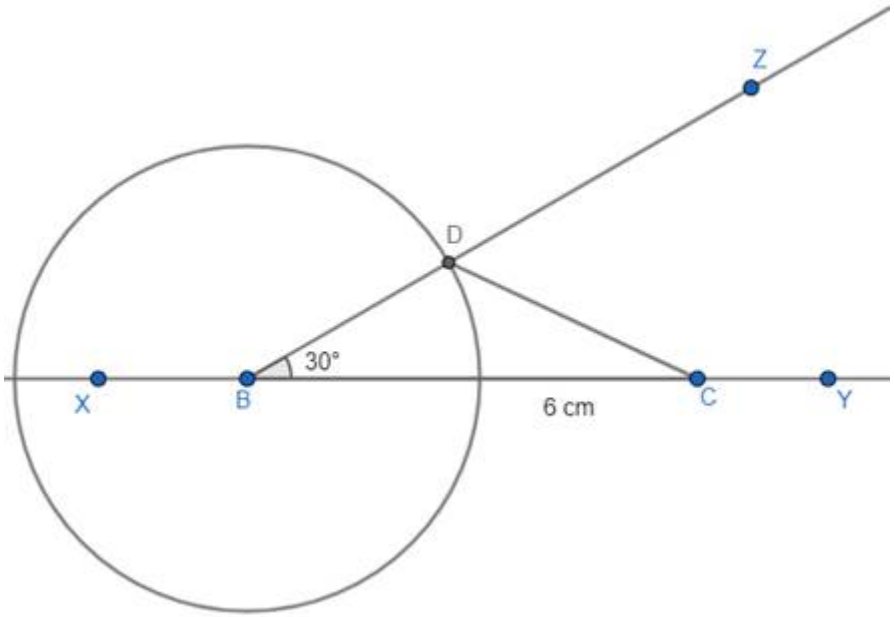


4. From the segment BZ, cut off the line segment BD such that BD = 3.1 cm (here, we have presumed AB – AC = BD), using a compass and a ruler.

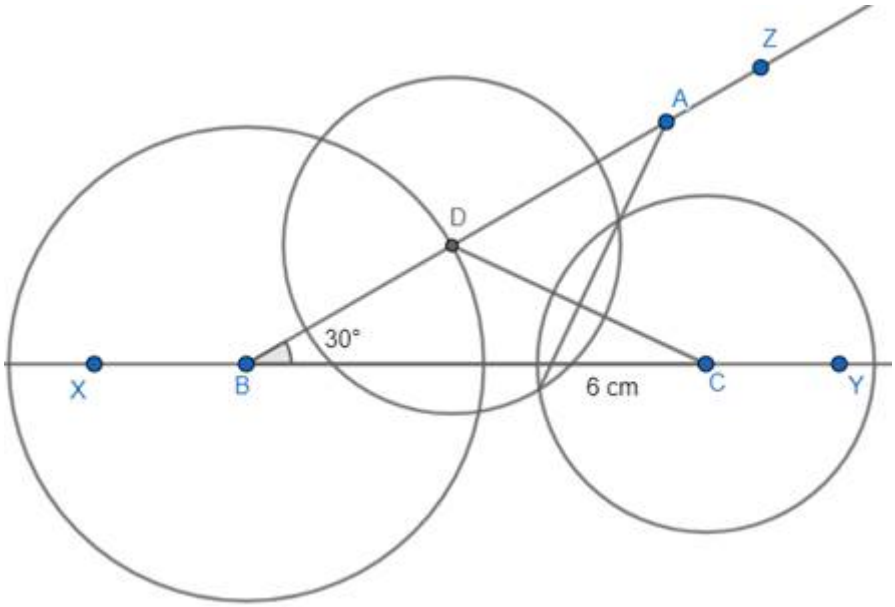
With B as centre, set the compass at 3.1 cm length and draw a circle or semicircle or an arc, and name the point where it intersects at BZ as D.



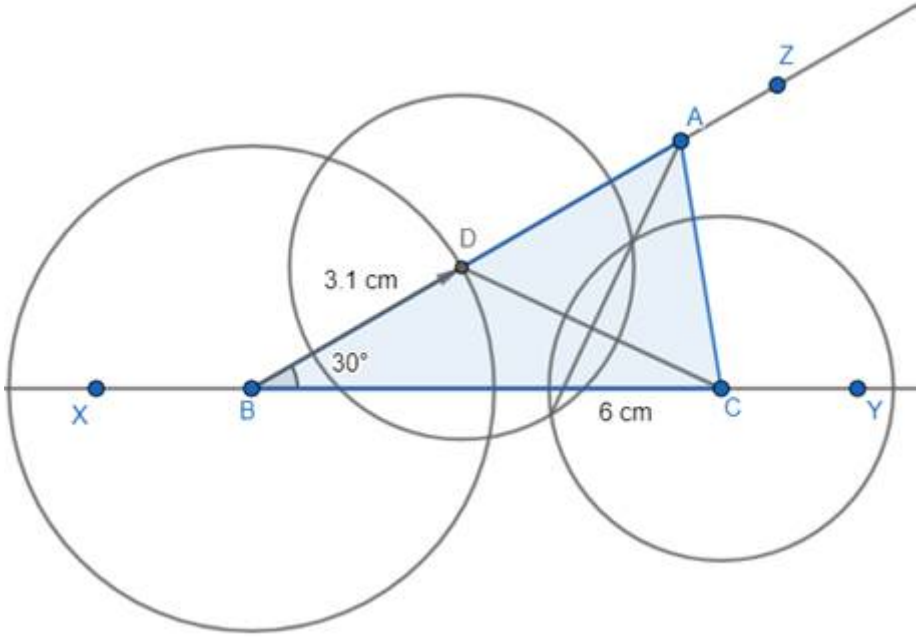
5. Join CD.



6. Draw perpendicular bisector of CD and let it meet BD at A. For perpendicular bisector of CD, fix the compass at a length just more than the length of CD and draw circles or arcs on both sides of the line segment CD taking C and D as centres one by one.



7. Join AC.



Thus, ABC is the required triangle.

Additional Problems 12

1. Question

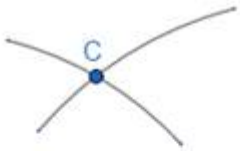
Construct a triangle ABC in which AB = 5 cm, BC = 4.7 cm and AC = 4.3 cm.

Answer

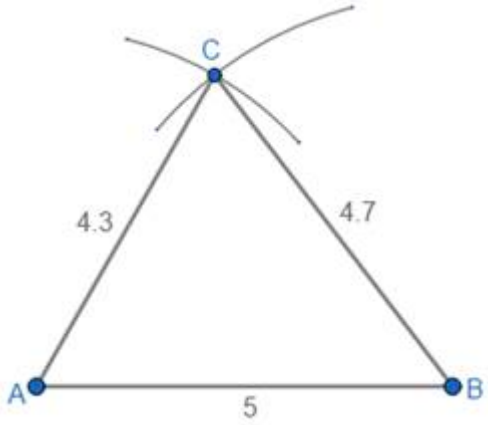
Step1: construct a segment AB of 5 cm

Step2: take distance 4.7 cm in compass and keep the needle of compass on point B and mark an arc above segment AB

Step3: now take distance 4.3 cm in compass keep the needle of compass on point A and mark an arc intersecting the previous one. Mark the intersection point as C



Step4: join AC and BC and ΔABC is ready



2. Question

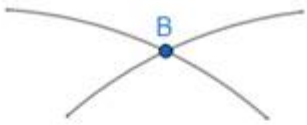
Construct a triangle ABC in which AB = 5 cm, BC = 5 cm and AC = 4.3 cm.

Answer

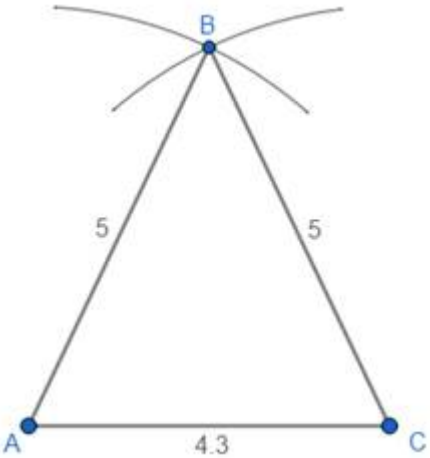
Step1: construct segment AC of 4.3 cm

Step2: take 5 cm in compass and keep the needle of the compass on point A and draw an arc above AC

Step3: keeping the distance in the compass same 5 cm keep the needle of the compass on point C and draw an arc intersecting the previous arc. Mark the intersection point as point B



Step4: join points AB and BC and ΔABC is ready



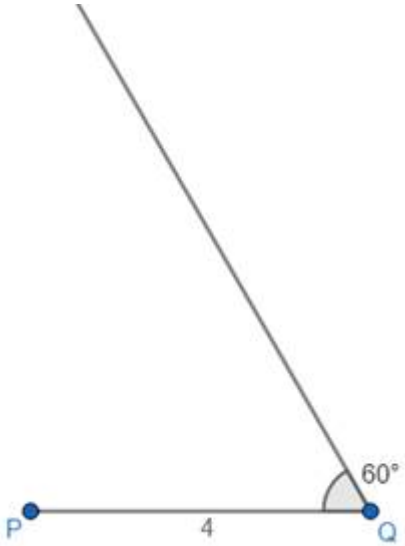
3. Question

Construct a triangle PQR in which PQ = 4 cm, QR = 4.5 cm and ∠Q = 60°.

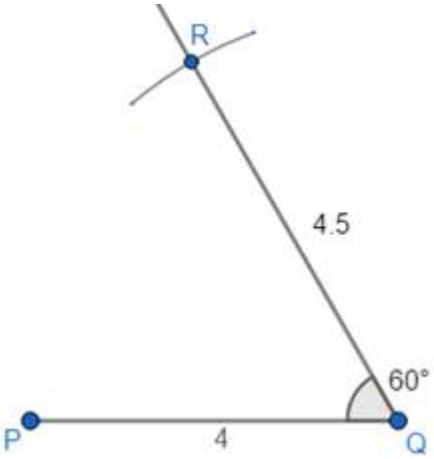
Answer

Step1: construct segment PQ of 4 cm

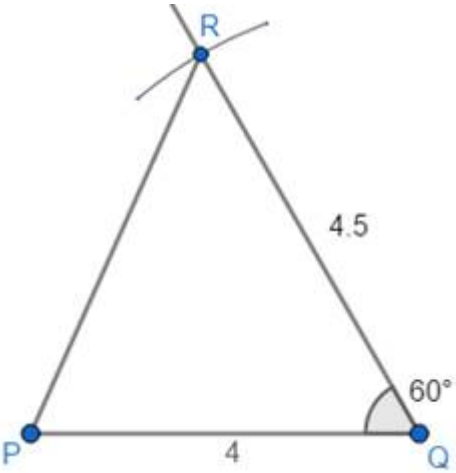
Step2: construct a line at 60° from point Q using a protractor



Step3: take distance 4.5 cm in compass and keep the needle of the compass on point Q and mark an arc intersecting the line drawn in Step2. Mark the intersection point as R



Step4: join PR and ΔPQR is ready



4. Question

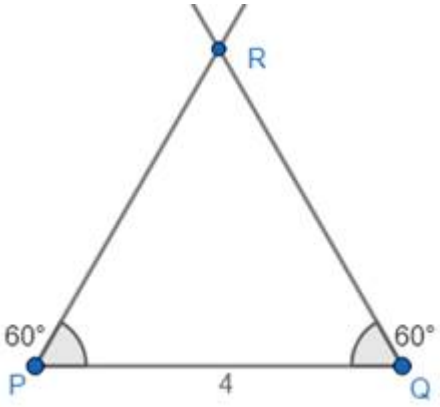
Construct a triangle PQR in which PQ = 4 cm, ∠P = 60° and ∠Q = 60°

Answer

Step1: Construct a segment PQ of 4 cm

Step2: draw line at 60° from point P using a protractor

Step3: similarly draw line at 60° from point Q and mark the intersection point with the previous line as R and ΔPQR is ready

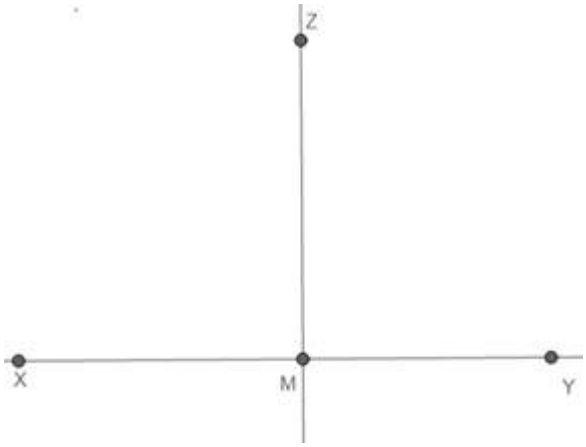


5. Question

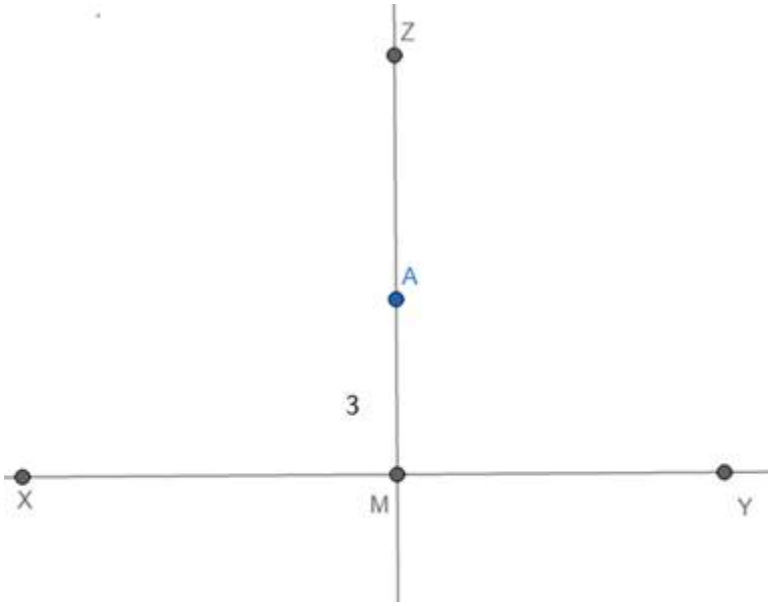
Construct a triangle ABC in which AB = 3.5 cm, AC = 4 cm and length of the perpendicular from A to BC is 3 cm.

Answer

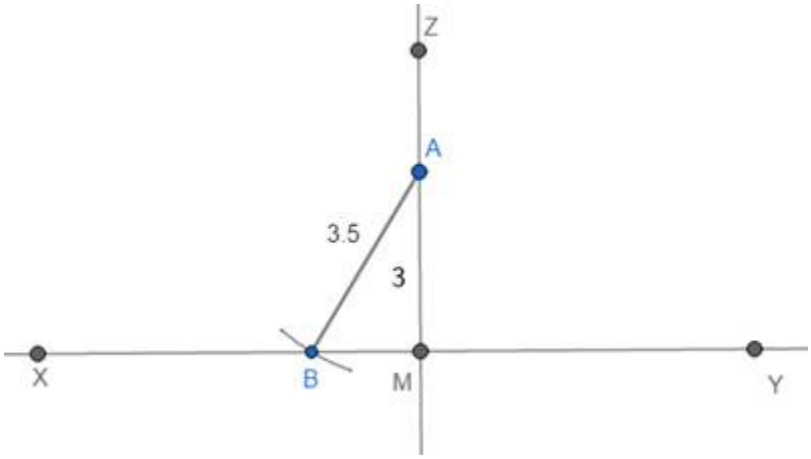
Step1: Construct a line XY and take a point M on it and draw a ray MZ perpendicular to XY as shown



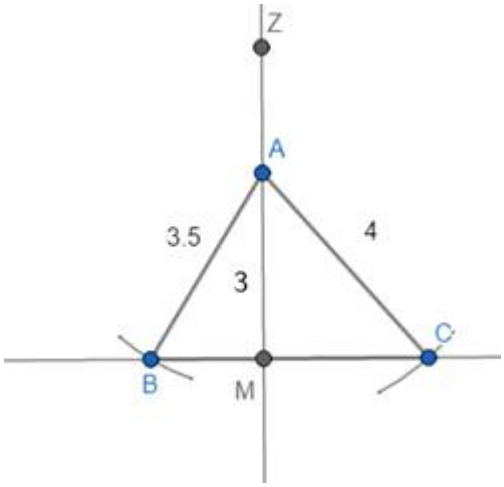
Step2: as the altitude is 3 cm mark point A above XY on MZ at 3 cm from point M using a scale or a compass



Step3: take distance of 3.5 cm in compass keep the needle of the compass on point A and mark an arc intersecting XY at B. join AB



Step4: take distance 4 cm in compass keep the needle of the compass on point A and mark an arc intersecting XY at C. join AC and ΔABC is ready



6. Question

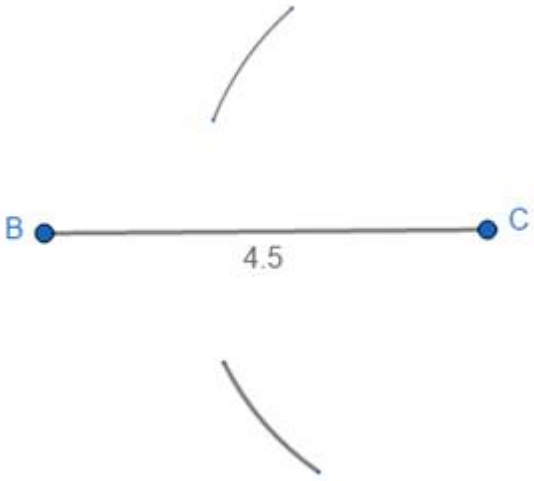
Construct an isosceles triangle ABC in which base BC = 4.5 cm and altitude from A on BC is 3.8 cm.

Answer

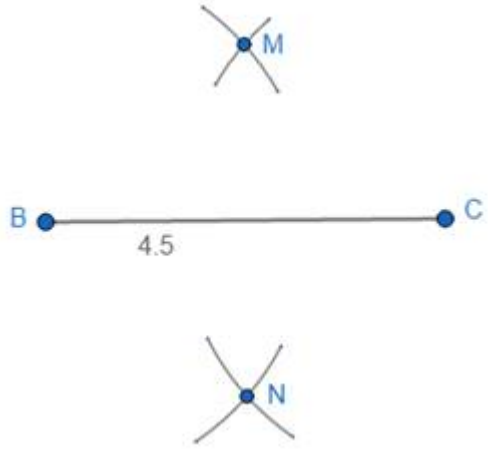
Step1: construct a segment BC with the length of 4.5 cm

Now we have to draw perpendicular bisector to BC because in an isosceles triangle the altitude from vertex point i.e. A is also the perpendicular bisector

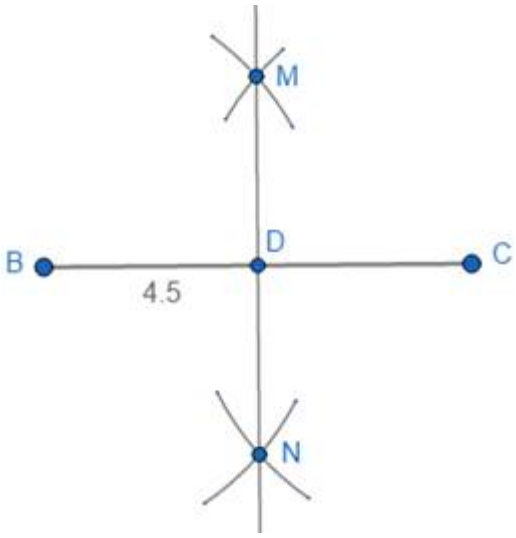
Step2: take distance in compass greater than half of BC. Keep the needle of the compass on point C and draw arcs above and below BC



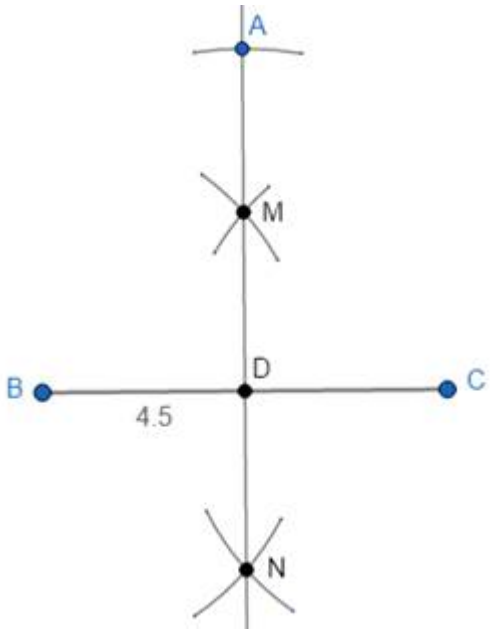
Step3: keeping the distance in the compass same as in the above step keep the needle of compass on point B and draw arcs intersecting the previous arcs above and below BC. Mark the intersection points of arcs as M and N



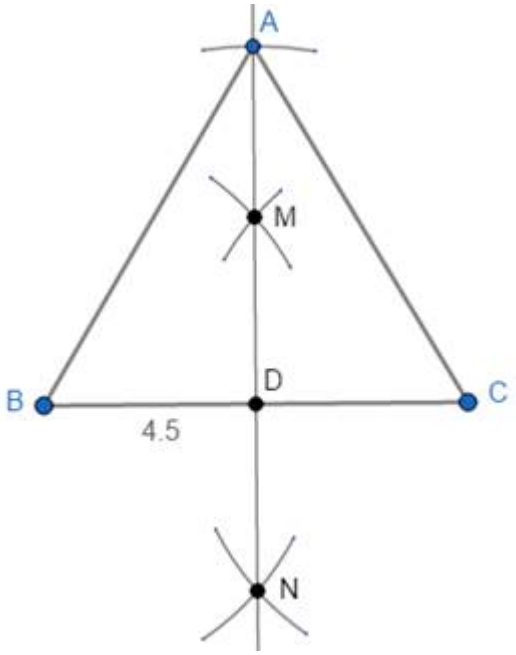
Step4: draw a line passing through points M and N and mark the intersection point with BC as point D



Step5: take distance 3.8 cm in compass keep the needle of compass on point D and mark an arc intersecting the line MN above BC. Mark this intersection point as A



Step6: draw segment AB and AC and required ΔABC is ready



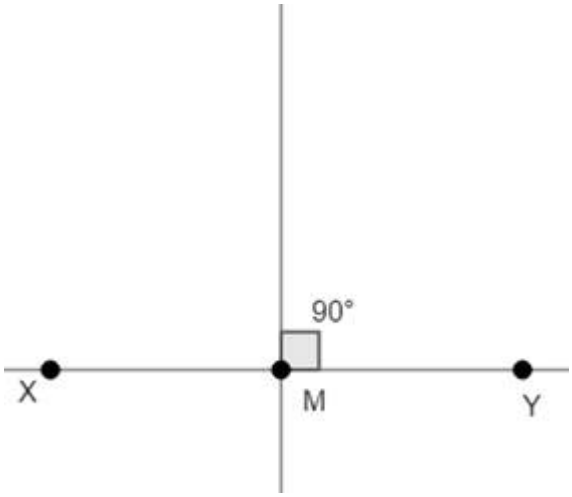
7. Question

Construct an isosceles triangle whose altitude is 5 cm and whose vertex angle is 70 °.

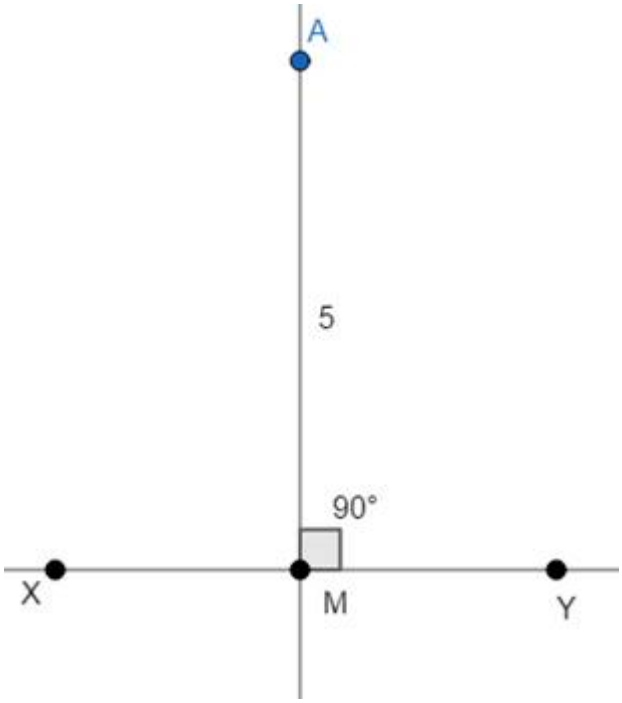
Answer

In an isosceles triangle, the altitude dropped from the vertex is also its angle bisector using this property we are going to construct the triangle

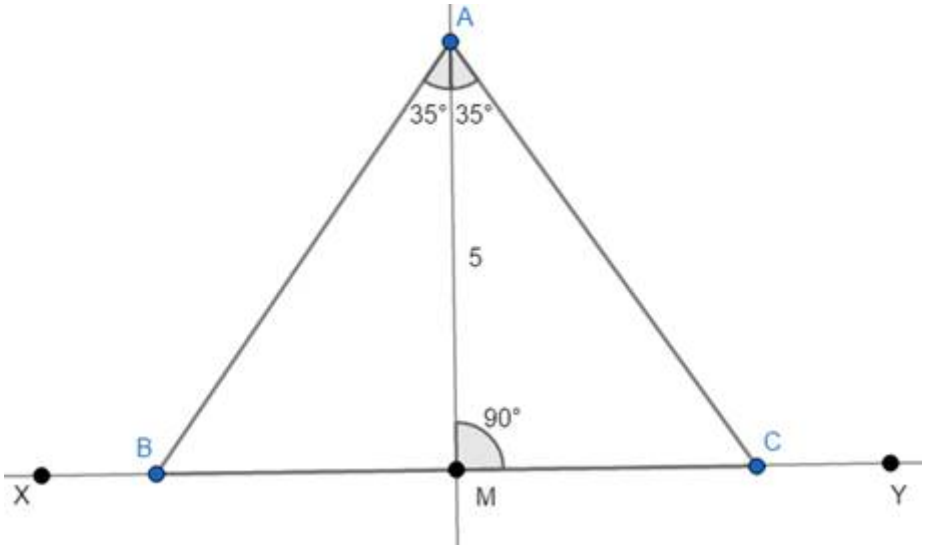
Step1: construct a line segment XY and consider a point M on it and using protractor draw a line perpendicular to XY passing through M



Step2: as the altitude is 5 cm mark point A above M at 5 cm



Step3: now using protractor draw lines at angles at 35° to the left of A and 35° to the right of A and mark the intersection points with line XY as B and C respectively thus required ΔABC is ready



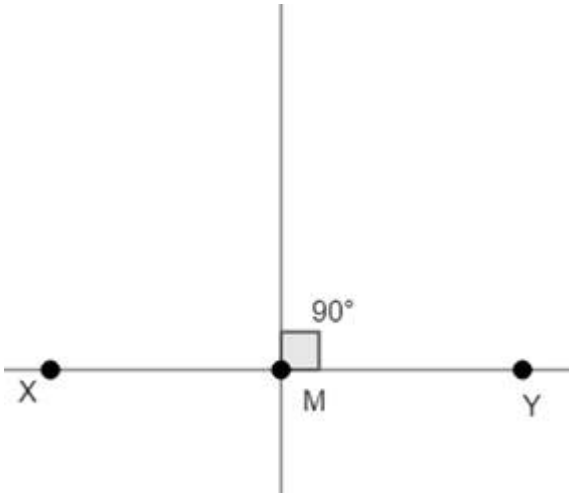
8. Question

Construct an isosceles triangle whose altitude is 5 cm and whose vertex angle is 80°.

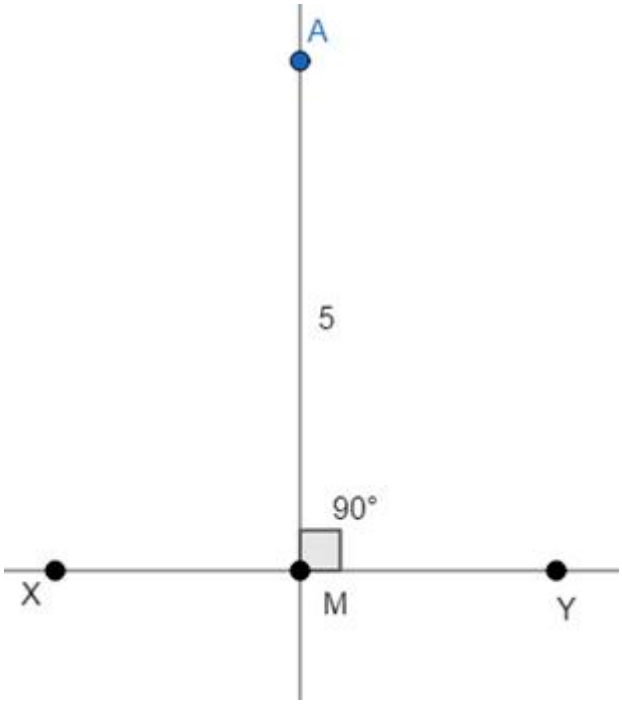
Answer

In an isosceles triangle, the altitude dropped from the vertex is also its angle bisector using this property we are going to construct the triangle

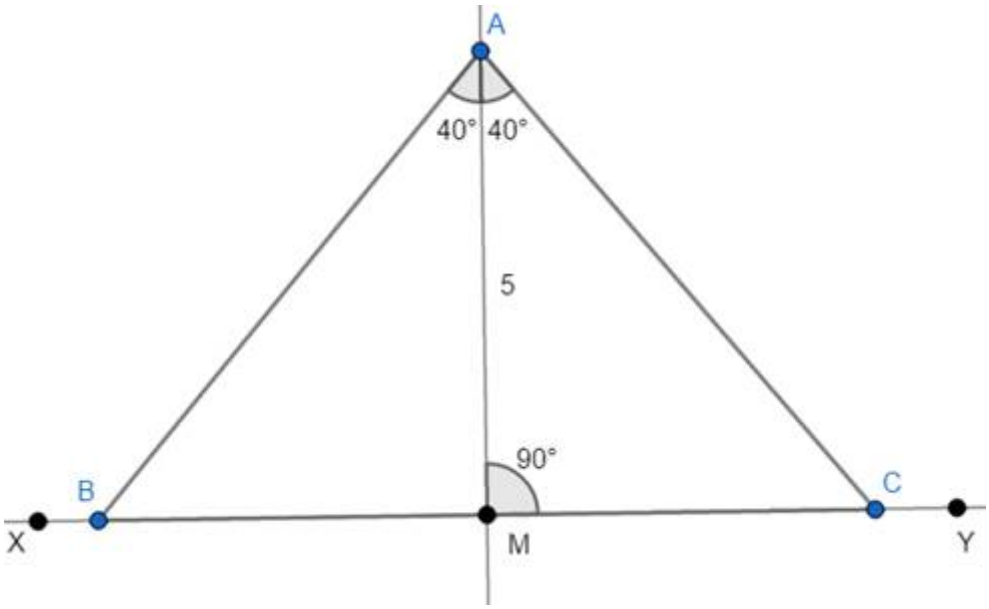
Step1: construct a line segment XY and consider a point M on it and using protractor draw a line perpendicular to XY passing through M



Step2: as the altitude is 5 cm mark point A above M at 5 cm



Step3: now using protractor draw lines at angles at 40° to the left of A and 40° to the right of A and mark the intersection points with line XY as B and C respectively thus required ΔABC is ready



9. Question

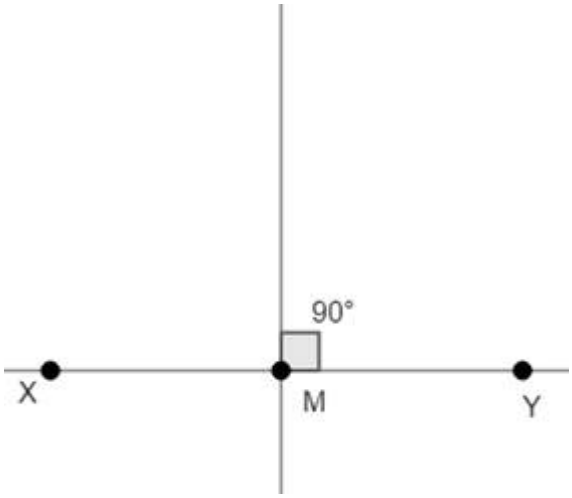
Construct an equilateral triangle of height 3.5 cm.

Answer

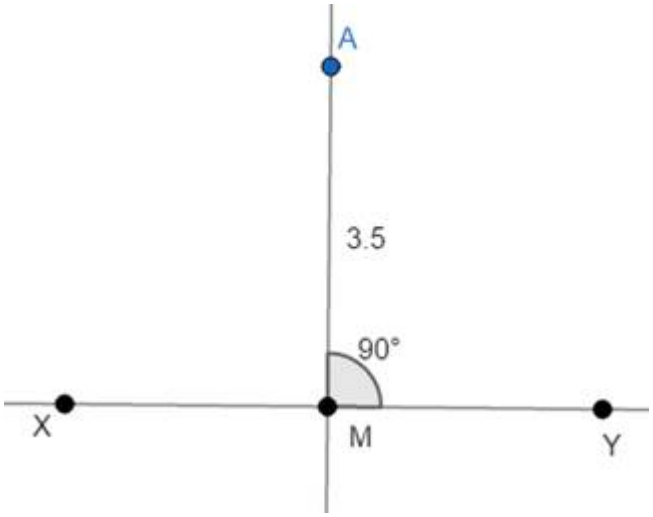
An equilateral triangle has all its angles 60° and all sides are equal

In an equilateral triangle, the altitude dropped from a vertex on its opposite side is also its angle bisector and each angle is 60° using this property we are going to construct the triangle

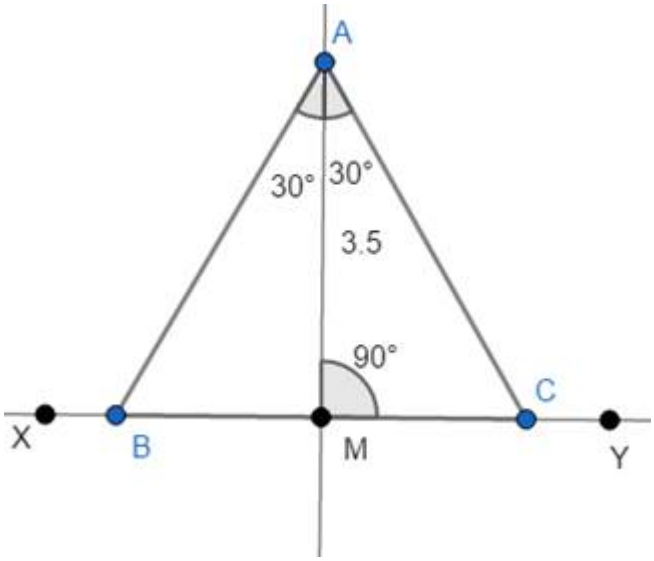
Step1: construct a line segment XY and consider a point M on it and using protractor draw a line perpendicular to XY passing through M



Step2: as the altitude is 3.5 cm mark point A above M at 3.5 cm



Step3: now using protractor draw lines at angles at 30° to the left of A and 30° to the right of A and mark the intersection points with line XY as B and C respectively thus required ΔABC is ready



10. Question

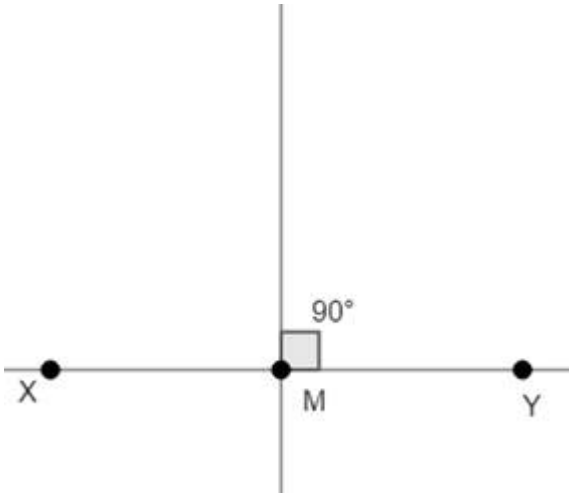
Construct an equilateral triangle of height 4.3 cm.

Answer

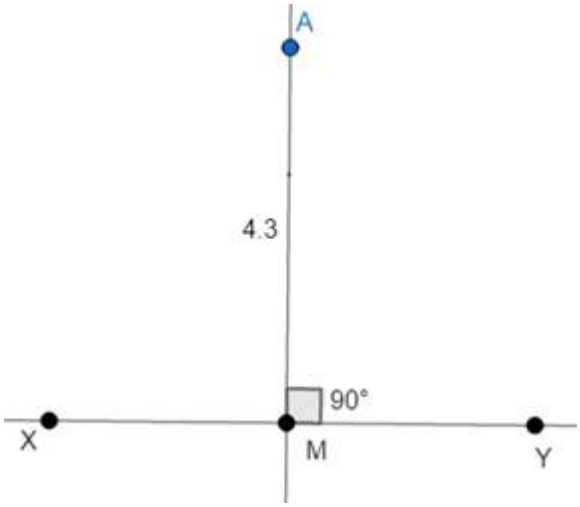
An equilateral triangle has all its angles 60° and all sides are equal

In an equilateral triangle, the altitude dropped from a vertex on its opposite side is also its angle bisector and each angle is 60° using this property we are going to construct the triangle

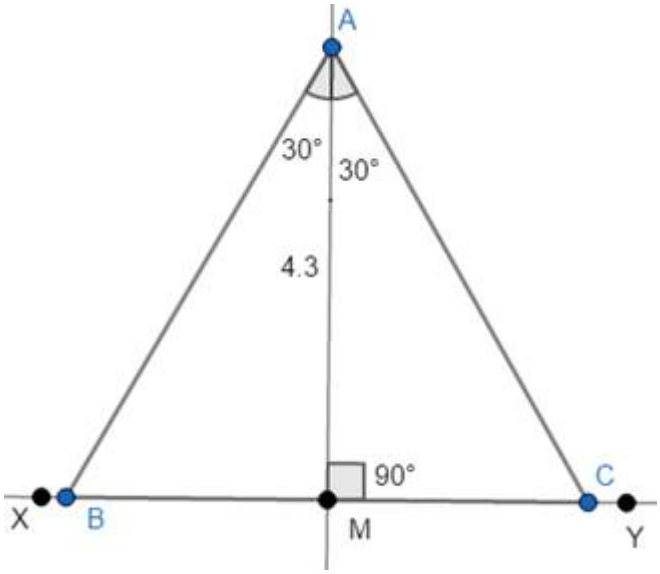
Step1: construct a line segment XY and consider a point M on it and using protractor draw a line perpendicular to XY passing through M



Step2: as the altitude is 4.3 cm mark point A above M at 4.3 cm



Step3: now using protractor draw lines at angles at 30° to the left of A and 30° to the right of A and mark the intersection points with line XY as B and C respectively thus required ΔABC is ready



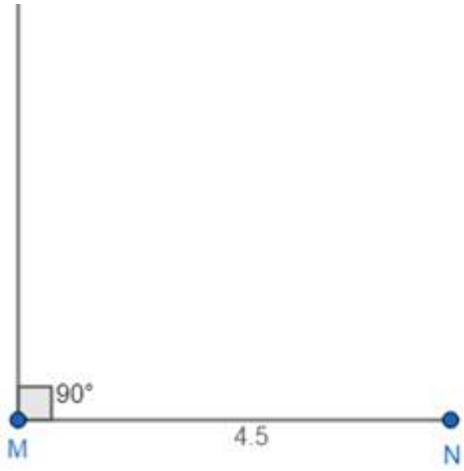
11. Question

Construct right angle triangle LMN in which ∠M = 90° , MN = 4.5 cm and LN = 5.6 cm.

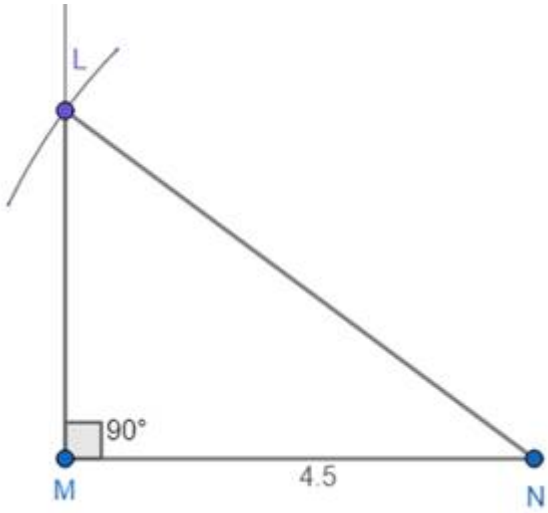
Answer

Step1: construct segment MN of 4.5 cm

Step2: using protractor draw a line at 90° from point M to segment MN



Step3: as LN is 5.6 cm take distance 5.6 cm in compass and keep the needle of the compass on point N and draw an arc cutting the line drawn in step2 mark the intersection point as L and ΔLMN is ready



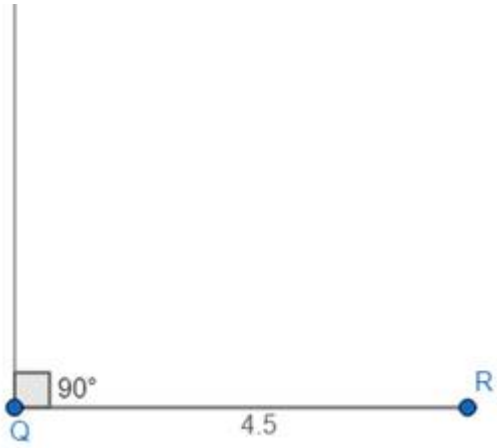
12. Question

Construct right angle triangle PQR in which ∠Q = 90◦ , QR = 4.5 cm and ∠R =50◦ .

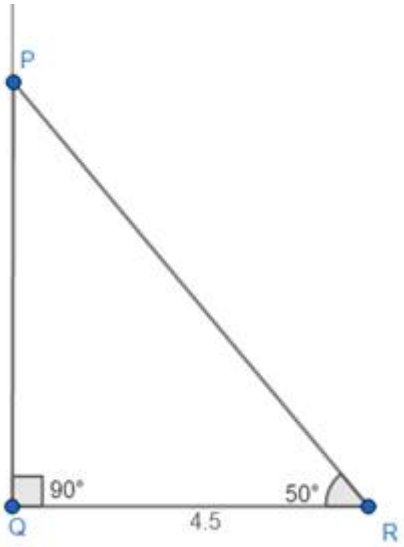
Answer

Step1: construct segment QR of 4.5 cm

Step2: using protractor draw a line at 90° from point Q to segment QR



Step3: using protractor draw a line at 50° from point R which intersects the line drawn in step2 mark this intersection point as P and ΔPQR is ready



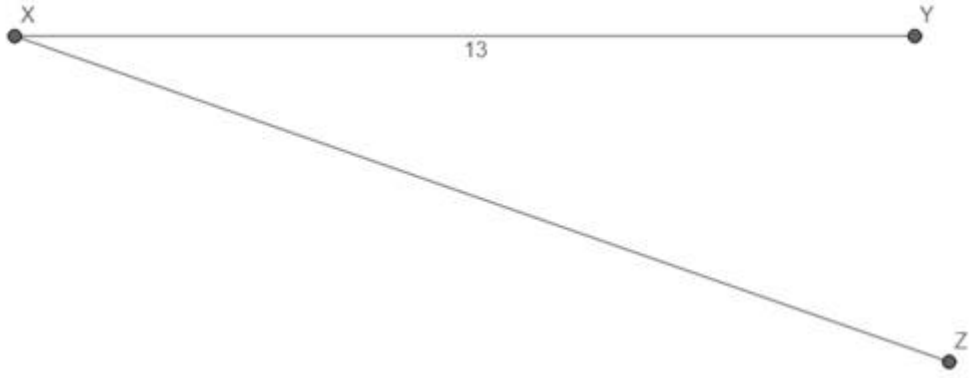
13. Question

Construct a triangle PQR, whose perimeter is 13 cm and whose sides are in the ratio 2:3:4.

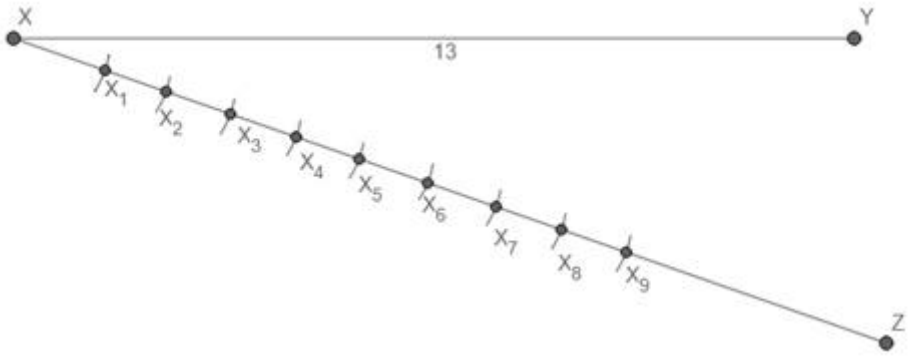
Answer

Step1: draw a line segment XY of the length of the perimeter of the triangle so here XY = 13 cm

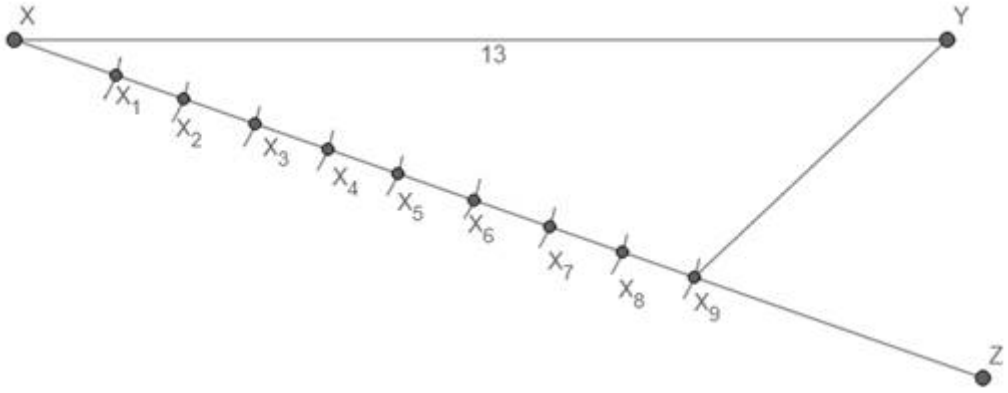
Step2: Now from point X construct a line XZ of any length at any acute angle below XY



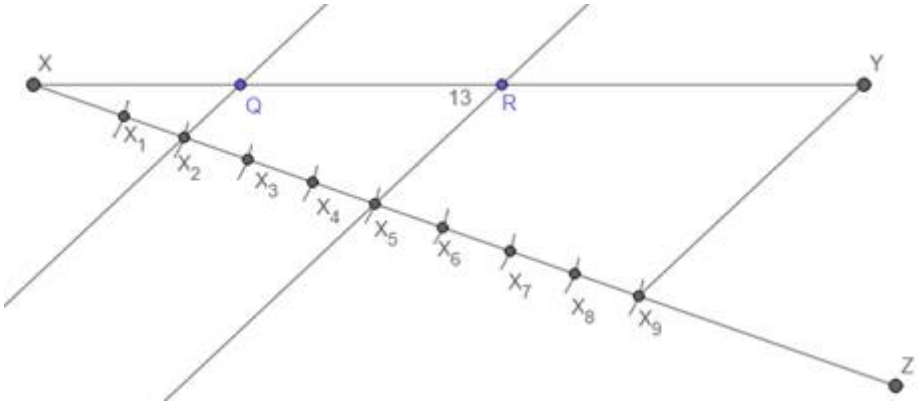
Step3: take any distance in compass and keeping the needle of the compass on point X cut an arc on line XZ and name that point X_1. Keeping the distance in compass same keep the needle of the compass on point X_1 and cut an arc on line XZ and mark that point as X_2. By doing this we are diving the line XZ in equal parts. Divide line into 2+3+4 = 9 parts i.e. by repeating this process mark points to X_9



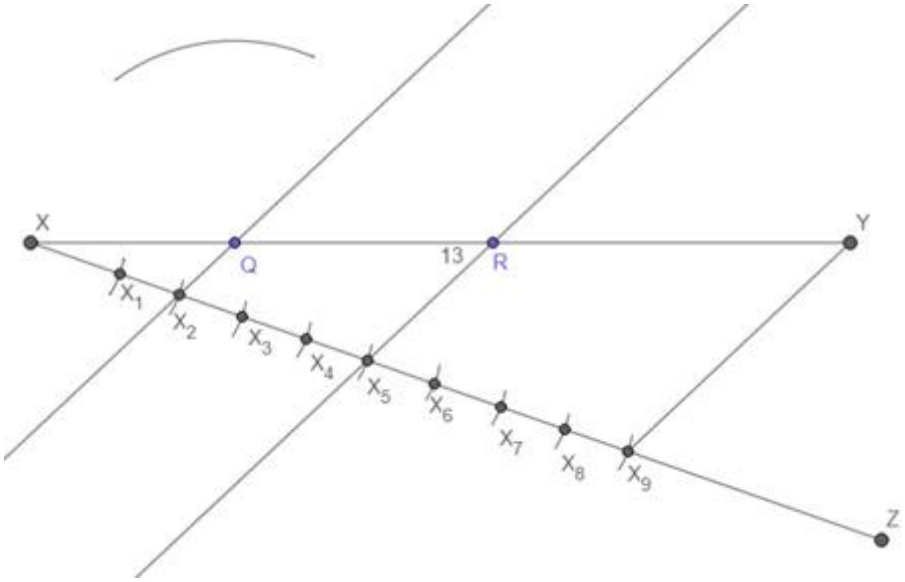
Step4: join points X_9 and Y



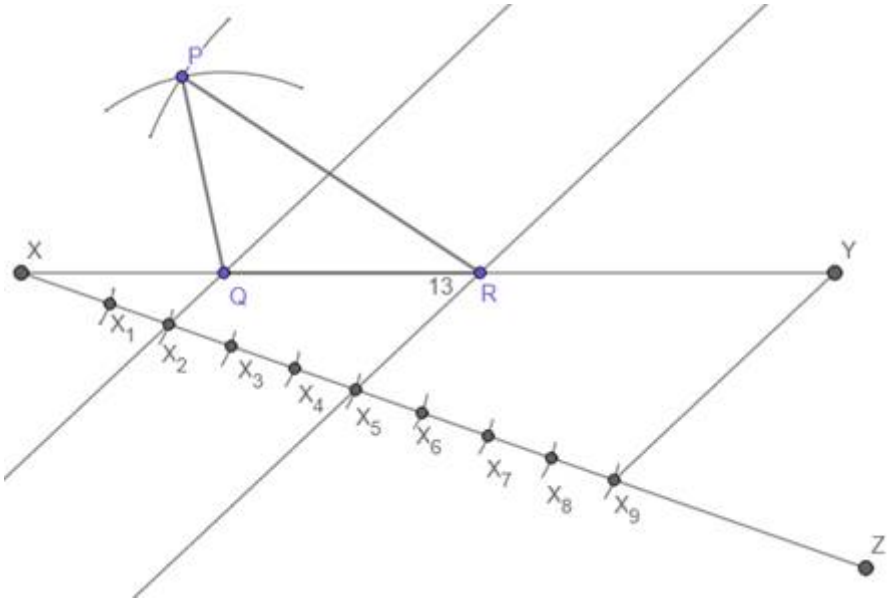
Step5: as the ratio is 2:3:4 consider 2 parts i.e. point X_2 then 3 parts i.e. point X_5 and then 4 parts i.e. point X_9 construct lines from point X_2 and X_5 parallel to line YX_9 intersecting line XY at points Q and R respectively



Step6: take distance XQ in compass keep the needle of compass on point Q and mark an arc above XY



Step7: take distance RY in compass keep the needle at point R and draw an arc intersecting the arc drawn in step6 mark the intersection point as point P. draw segments PQ and PR and required ΔPQR is ready



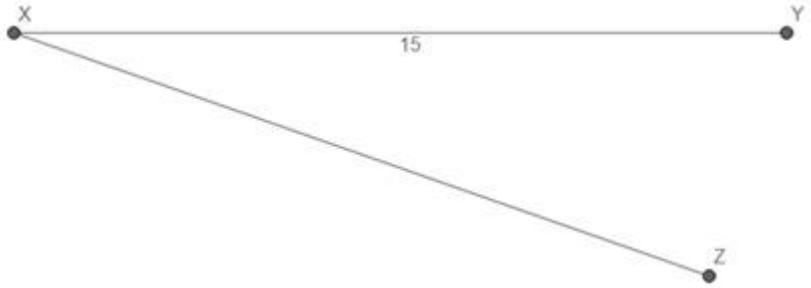
14. Question

Construct a triangle PQR, whose perimeter is15 cm and whose sides are in the ratio 3:4:6.

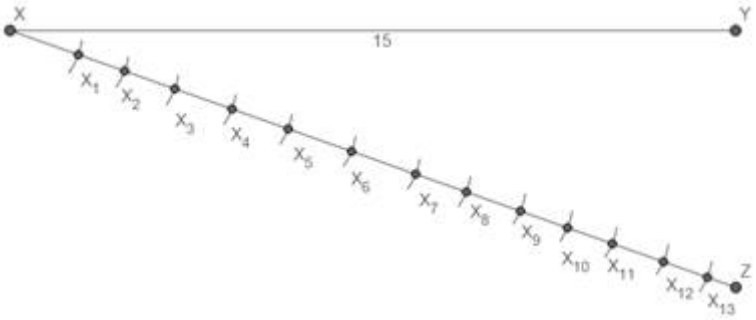
Answer

Step1: draw a line segment XY of the length of the perimeter of the triangle so here XY = 15 cm

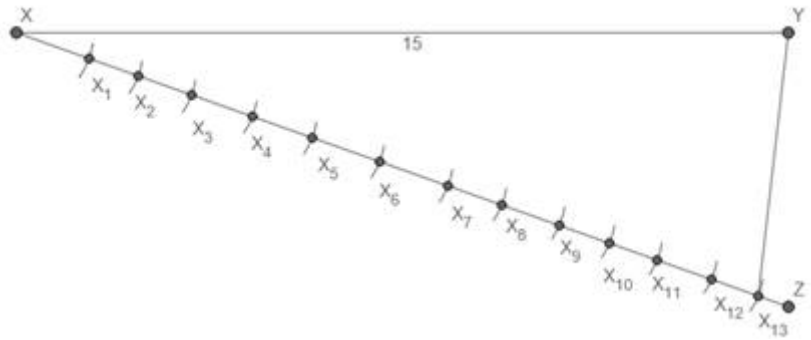
Step2: Now from point X construct a line XZ of any length at any acute angle below XY



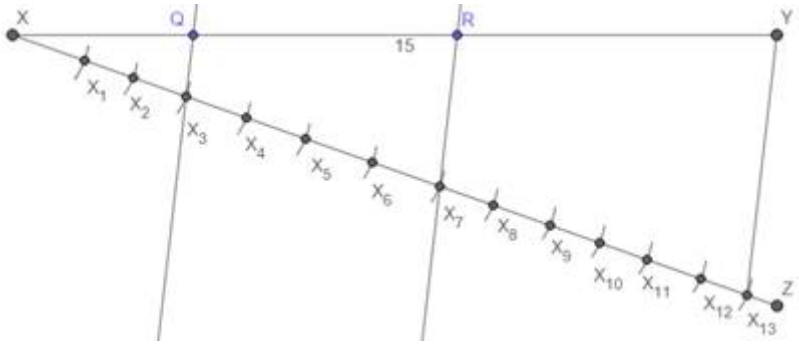
Step3: take any distance in compass and keeping the needle of the compass on point X cut an arc on line XZ and name that point X_1. Keeping the distance in compass same keep the needle of the compass on point X_1 and cut an arc on line XZ and mark that point as X_2. By doing this we are diving the line XZ in equal parts. Divide line into 3+4+6 = 13 parts i.e. by repeating this process mark points to X_{13}



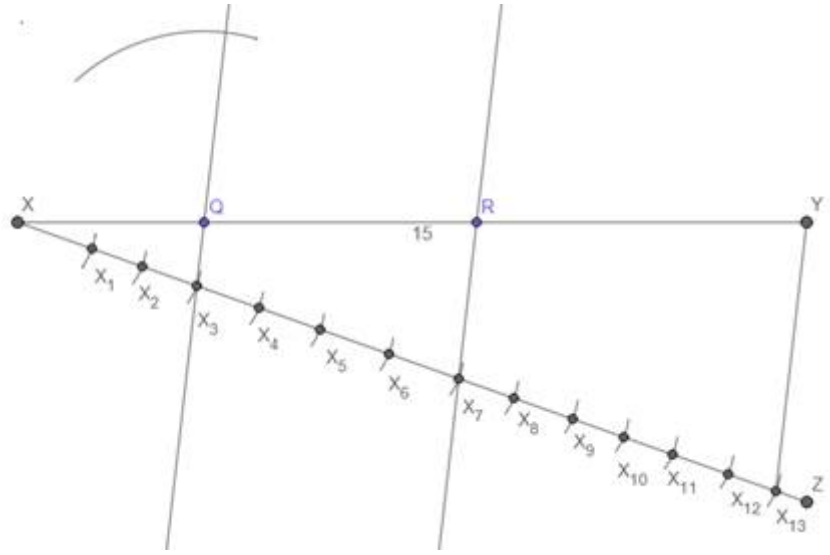
Step4: join points X_{13} and Y



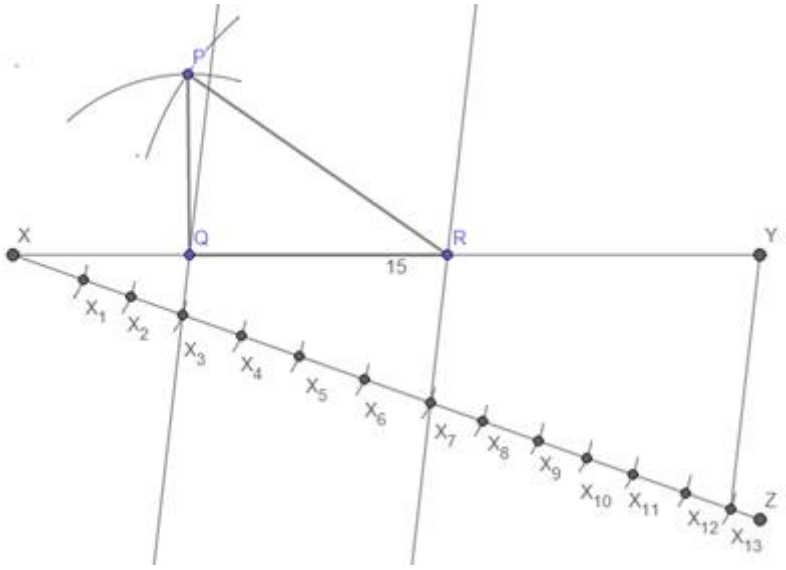
Step5: as the ratio is 3:4:6 consider 3 parts i.e. point X_3 then 4 parts i.e. point X_7 and then 6 parts i.e. point X_{13} construct lines from point X_3 and X_7 parallel to line YX_{13} intersecting line XY at points Q and R respectively



Step6: take distance XQ in compass keep the needle of compass on point Q and mark an arc above XY



Step7: take distance RY in compass keep the needle at point R and draw an arc intersecting the arc drawn in step6 mark the intersection point as point P. draw segments PQ and PR and required ΔPQR is ready



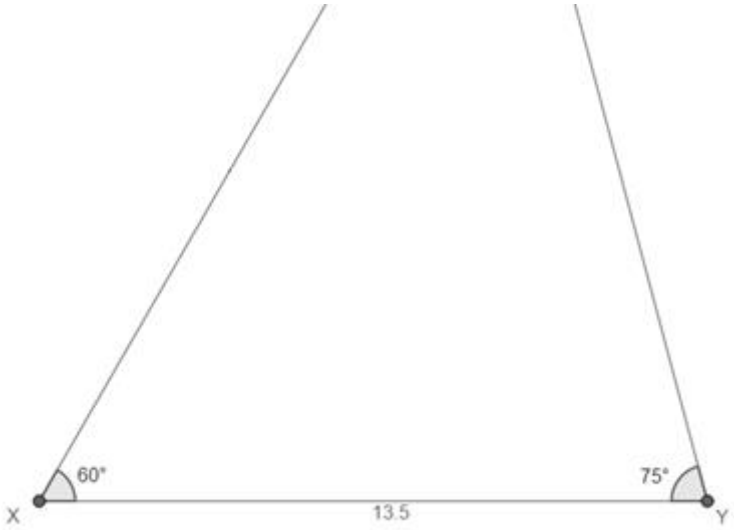
15. Question

Construct a triangle ABC, whose perimeter is 13.5 cm and whose base angles are 60° and 75 °.

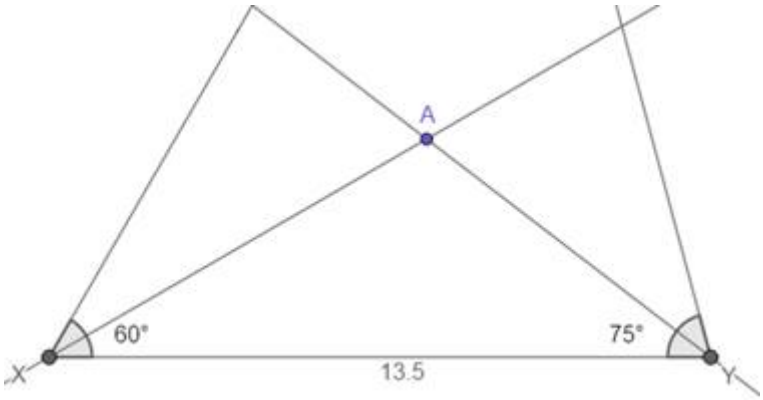
Answer

Step1: construct a segment XY of length perimeter which is 13.5 cm

Step2: draw ray XP at angle 60° from point X and a ray XQ at 75° from point Y

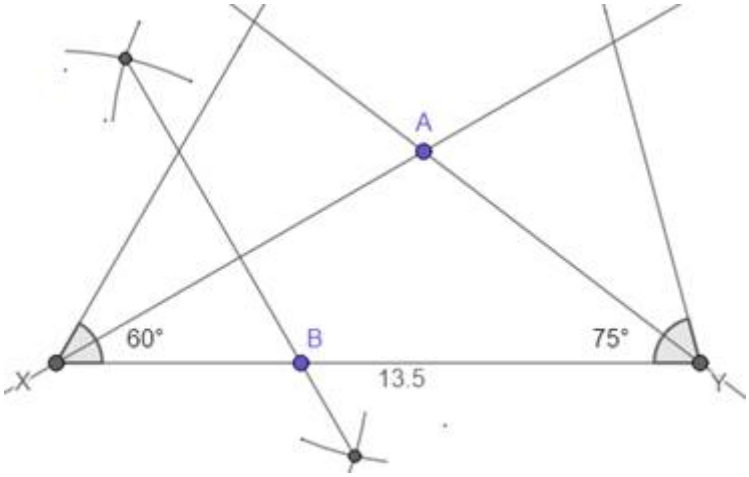


Step3: draw angle bisectors using protractor of ∠X and ∠Y and mark their intersection point as A

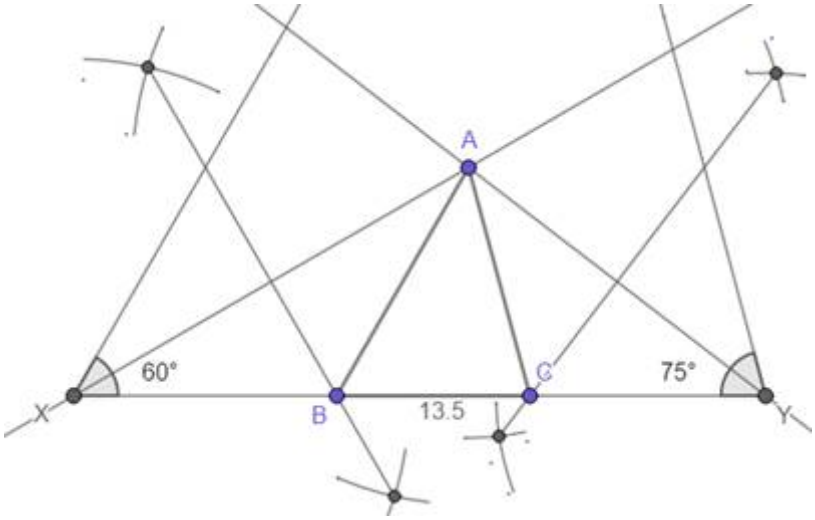


Now we have to draw perpendicular bisector of line AX and AY

Step4: take any distance approximately by observation in compass greater than half of XA. Keep the needle of the compass on point A and mark arcs above and below XA and keeping the same distance in compass keep the needle on point X and cut the arcs as shown and join both the intersected arcs. Thus we have drawn the perpendicular bisector of AX. Mark the intersection point of the perpendicular bisector of AX and XY as point B



Step5: similarly draw perpendicular bisector of segment AY and mark the intersection point with XY as C join AB and AC and required ΔABC is ready



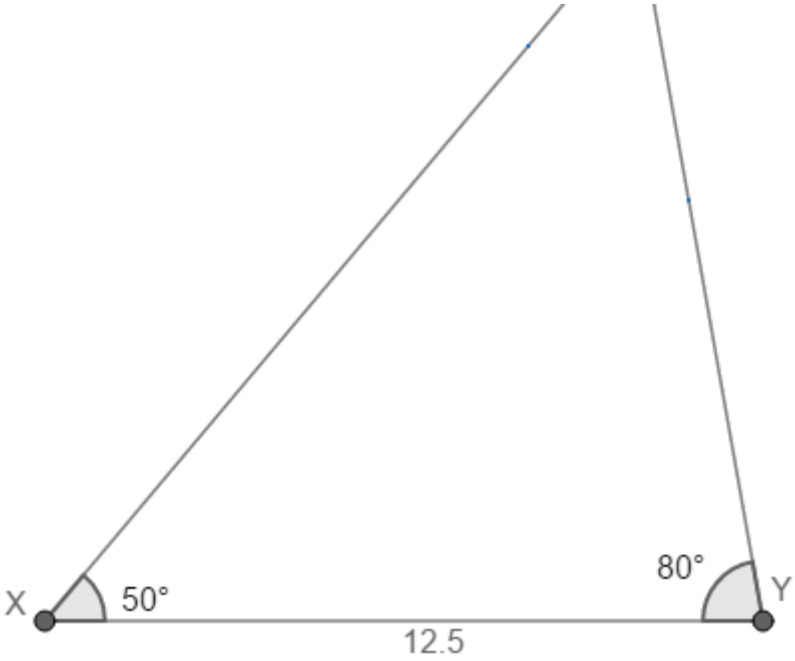
16. Question

Construct a triangle ABC, whose perimeter is 12.5 cm and whose base angles are 50° and 80°.

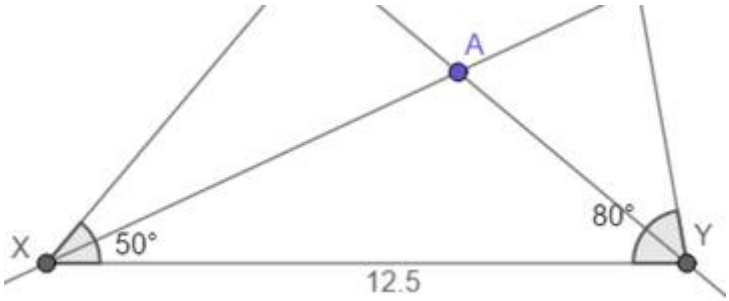
Answer

Step1: construct a segment XY of length perimeter which is 12.5 cm

Step2: draw ray at an angle of 50° from point X and a ray at 80° from point Y

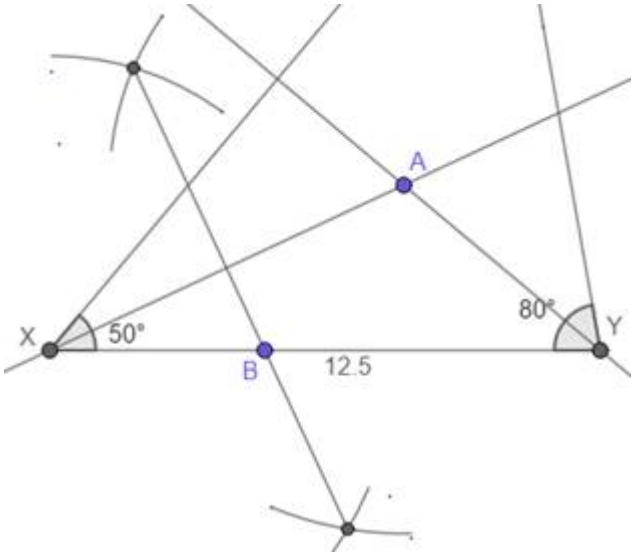


Step3: draw angle bisectors using protractor of ∠X and ∠Y and mark their intersection point as A

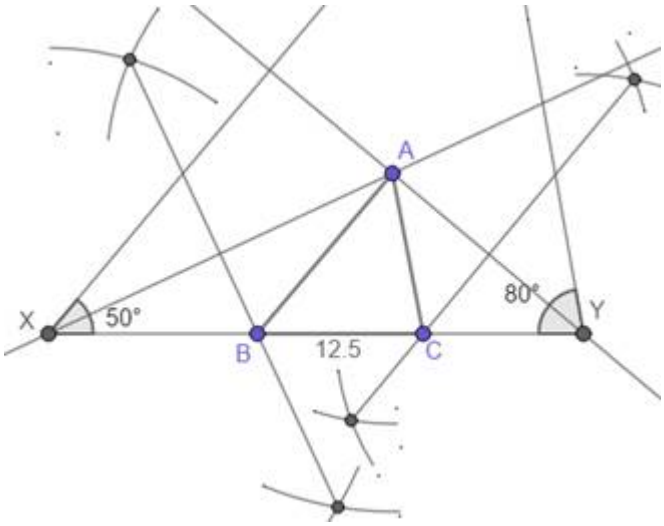


Now we have to draw perpendicular bisector of line AX and AY

Step4: take any distance approximately by observation in compass greater than half of XA. Keep the needle of the compass on point A and mark arcs above and below XA and keeping the same distance in compass keep the needle on point X and cut the arcs as shown and join both the intersected arcs. Thus we have drawn the perpendicular bisector of AX. Mark the intersection point of the perpendicular bisector of AX and XY as point B



Step5: similarly draw perpendicular bisector of segment AY and mark the intersection point with XY as C join AB and AC and required ΔABC is ready

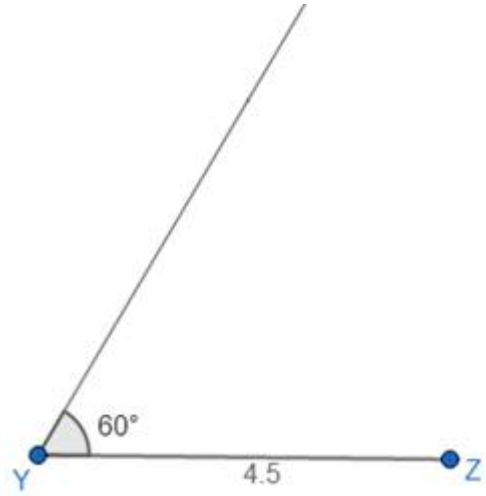


17. Question

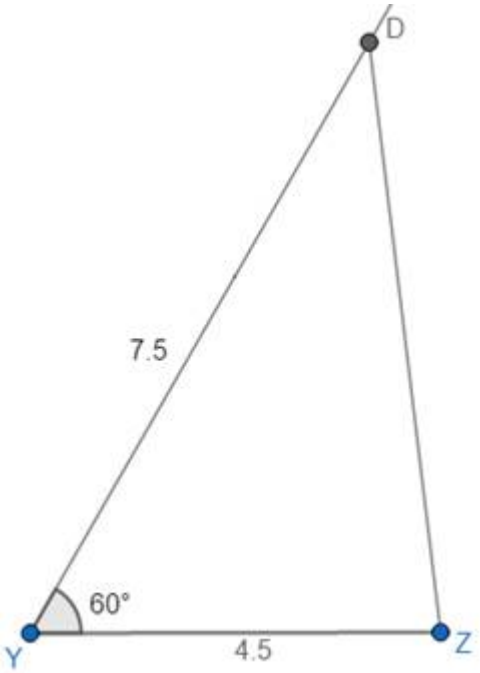
Construct a triangle XYZ in which YZ = 4.5 cm, ∠Y = 60° and the sum of other two sides is 7.5 cm.

Answer

Step1: construct segment YZ which is 4.5 cm and draw a ray at 60° from point Y

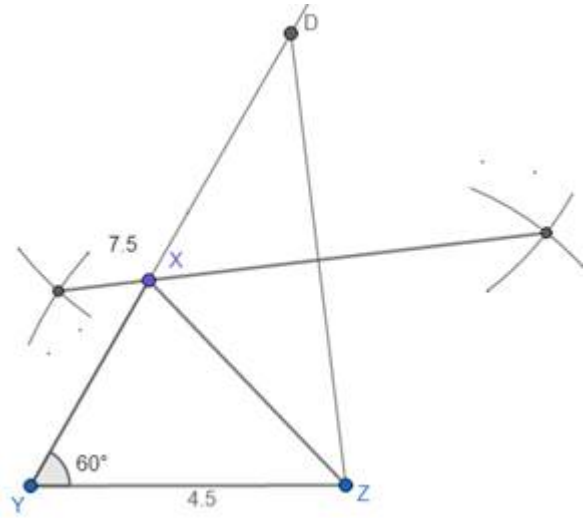


Step2: using a scale or compass mark a point D on the ray at 7.5 cm from Y and join ZD



Now we have to construct the perpendicular bisector of ZD

Step3: take any distance approximately by observation in compass greater than half of ZD. Keep the needle of the compass on point D and mark arcs left and right of ZD and keeping the same distance in compass keep the needle on point Z and cut the arcs as shown and join both the intersected arcs. Thus we have drawn the perpendicular bisector of ZD. Mark the intersection point of the perpendicular bisector of ZD and YD as point X join XZ and ΔXYZ is ready



18. Question

Construct a triangle ABC whose perimeter is 9 cm and the angles are in the ratio 3:4:5.

Answer

Let the angles be 3x, 4x and 5x so that they are in the ratio 3:4:5 now sum of all angles of a triangle is 180°

⇒ 3x + 4x + 5x = 180°

$\Rightarrow 12x = 180°$

$$\Rightarrow x = \frac{180}{12} = \frac{60}{4}$$

$\Rightarrow x = 15$

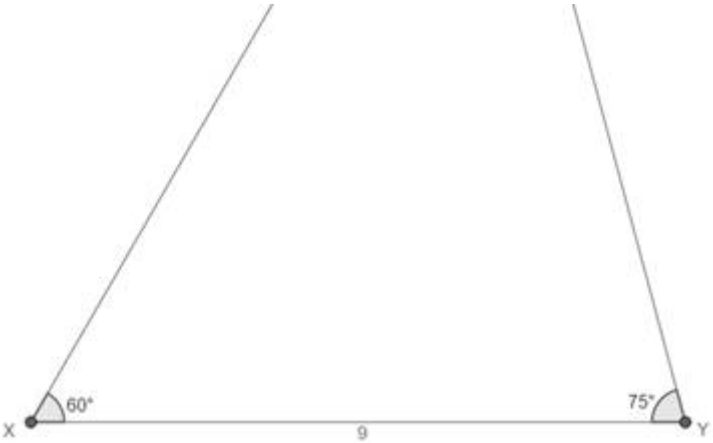
Thus, angles are $3 \times 15 = 45°$ and $4 \times 15 = 60°$ and $5 \times 15 = 75°$

Consider 60° and 75° as base angles here

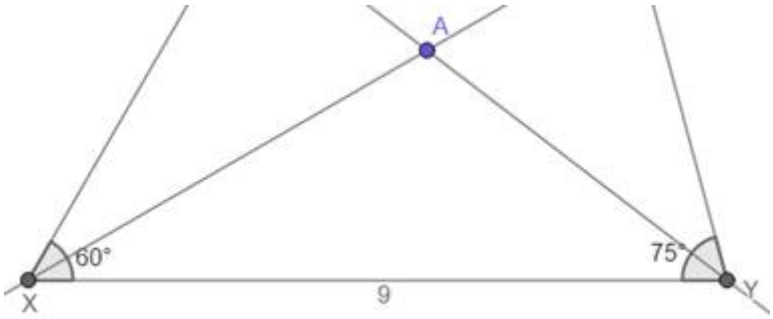
We can use the same method to construct the triangle that we use when perimeter and the base angles are given

Step1: construct a segment XY of length perimeter which is 9 cm

Step2: draw ray at an angle of 60° from point X and a ray at 75° from point Y

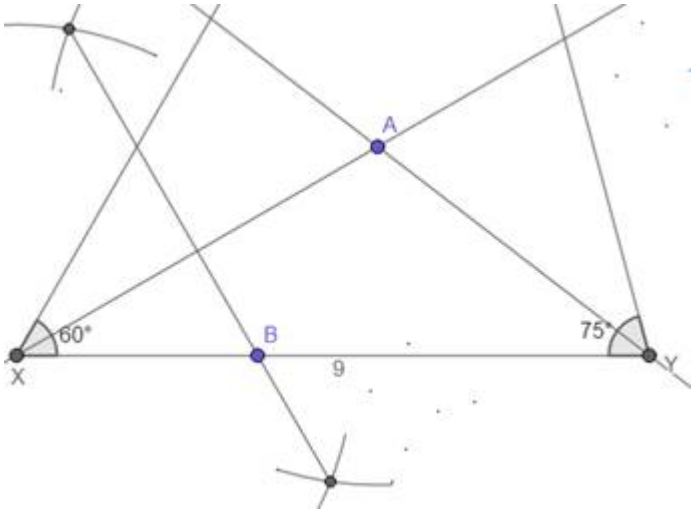


Step3: draw angle bisectors using protractor of ∠X and ∠Y and mark their intersection point as A

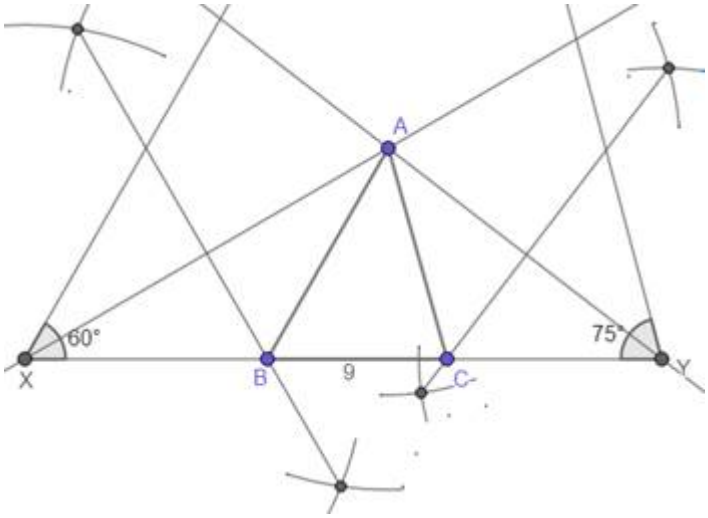


Now we have to draw perpendicular bisector of line AX and AY

Step4: take any distance approximately by observation in compass greater than half of XA. Keep the needle of the compass on point A and mark arcs above and below XA and keeping the same distance in compass keep the needle on point X and cut the arcs as shown and join both the intersected arcs. Thus we have drawn the perpendicular bisector of AX. Mark the intersection point of the perpendicular bisector of AX and XY as point B



Step5: similarly draw perpendicular bisector of segment AY and mark the intersection point with XY as C join AB and AC and required ΔABC is ready



19. Question

Construct a triangle ABC whose perimeter is 12 cm and the angles are in the ratio 2:3:5.

Answer

Let the angles be 2x, 3x and 5x so that they are in the ratio 2:3:5 now sum of all angles of a triangle is 180°

⇒ 2x + 3x + 5x = 180°

⇒ 10x = 180°

$$\Rightarrow x = \frac{180}{10}$$

⇒ x = 18

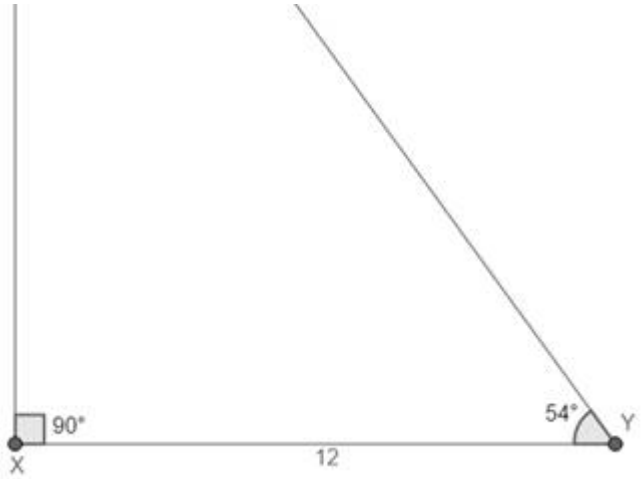
Thus, angles are 2 × 18 = 36° and 3 × 18 = 54° and 5 × 18 = 90°

Consider 90° and 54° as base angles here

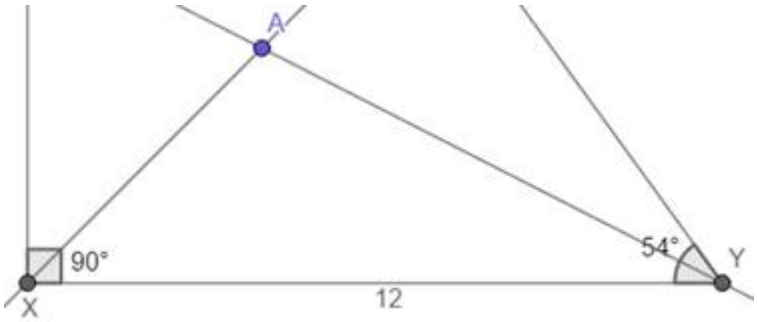
We can use the same method to construct the triangle that we use when perimeter and the base angles are given

Step1: construct a segment XY of length perimeter which is 12 cm

Step2: draw ray at angle 90° from point X and a ray at 54° from point Y

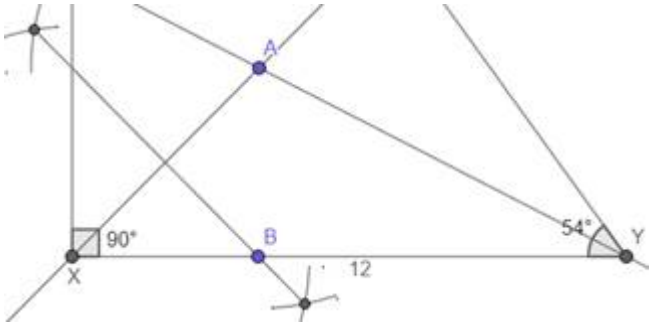


Step3: draw angle bisectors using protractor of ∠X and ∠Y and mark their intersection point as A

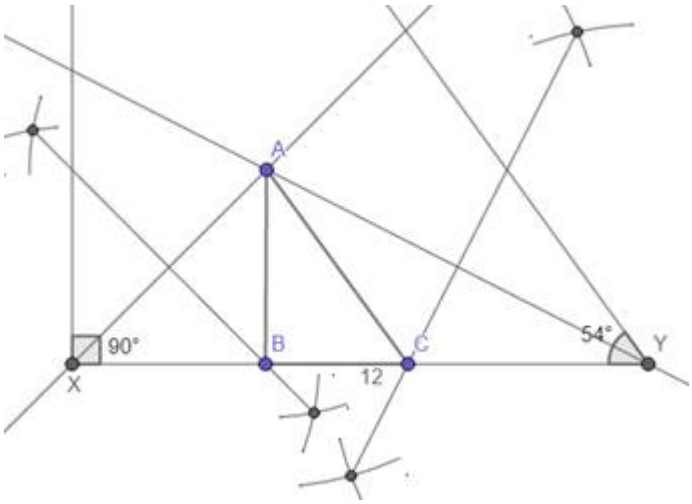


Now we have to draw perpendicular bisector of line AX and AY

Step4: take any distance approximately by observation in compass greater than half of XA. Keep the needle of the compass on point A and mark arcs above and below XA and keeping the same distance in compass keep the needle on point X and cut the arcs as shown and join both the intersected arcs. Thus we have drawn the perpendicular bisector of AX. Mark the intersection point of the perpendicular bisector of AX and XY as point B



Step5: similarly draw perpendicular bisector of segment AY and mark the intersection point with XY as C join AB and AC and required ΔABC is ready

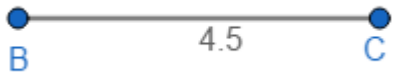


20. Question

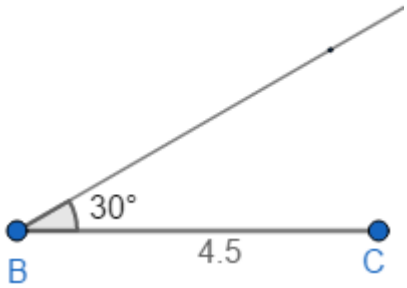
Construct a triangle ABC in which BC = 4.5 cm, ∠B = 35° and the difference between the other two sides is 2.8 cm.

Answer

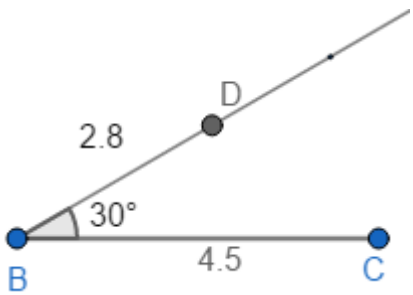
Step1: draw segment BC of length 4.5 cm which is base



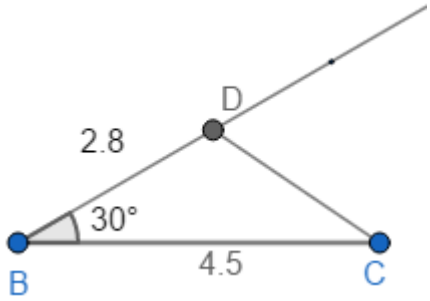
Step2: draw a ray at 30° from point B



Step3: using a compass or scale mark a point on the ray constructed in step2 at a distance of 2.8 cm(difference is given) from point B. mark that point as D i.e. BD = 2.8 cm

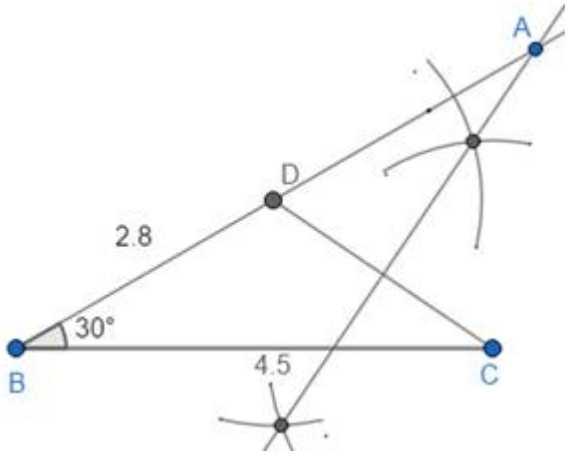


Step4: join points C and D to make segment CD



now we have to draw perpendicular bisector of CD

Step5: take any distance approximately by observation in compass greater than half of CD. Keep the needle of the compass on point C and mark arcs above and below CD and keeping the same distance in compass keep the needle on point D and cut the arcs as shown and join both the intersected arcs. Thus we have drawn the perpendicular bisector of the CD. Mark the intersection point of the perpendicular bisector of CD and ray drawn in step2 as point A



Step6: join AC and ΔABC is ready