IX
Mathematics
Chapter 11: Geometric Constructions

Chapter Notes

Top Concepts

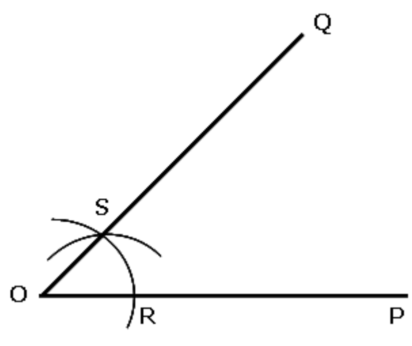
1. To construct an angle equal to a given angle.

Given : Any ∠POQ and a point A.

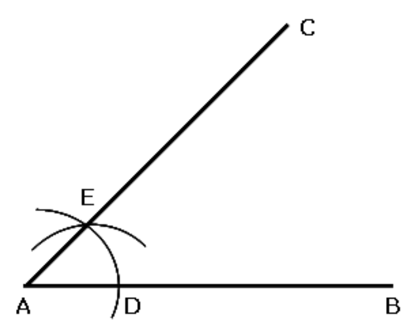
Required : To construct an angle at A equal to ∠POQ.

Steps of Construction:

1. With O as centre and any (suitable) radius, draw an arc to meet OP at R and OQ at S.
2. Through A draw a line AB.
3. Taking A as centre and same radius (as in step 1), draw an arc to meet AB at D.
4. Measure the segment RS with compasses.
5. With d as centre and radius equal to RS, draw an arc to meet the previous arc at E.
6. Join AE and produce it to C, then ∠BAC is the required angle equal to ∠POQ



(i)



(ii)

2. To bisect a given angle.

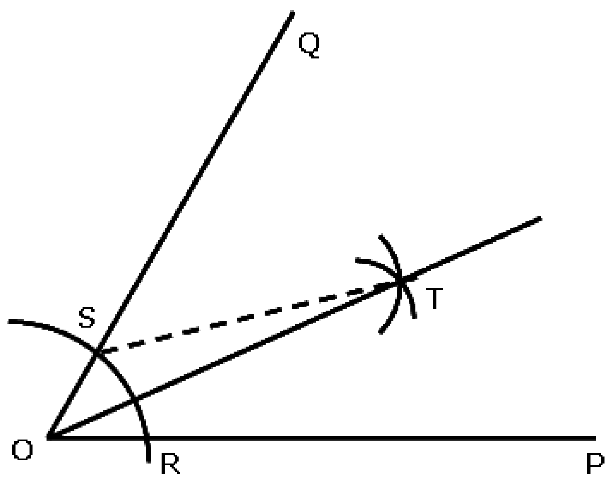
Given : Any ∠POQ

Required : To bisect ∠POQ.

Steps of Construction:

1. With O as centre and any (suitable) radius, draw an arc to meet OP at R and OQ at S.

2. With R as centre and any suitable radius (not necessarily) equal to radius of step 1 (but > $\frac{1}{2}$ RS), draw an arc. Also, with S as centre and same radius draw another arc to meet the previous arc at T.
3. Join OT and produce it, then OT is the required bisector of ∠POQ.

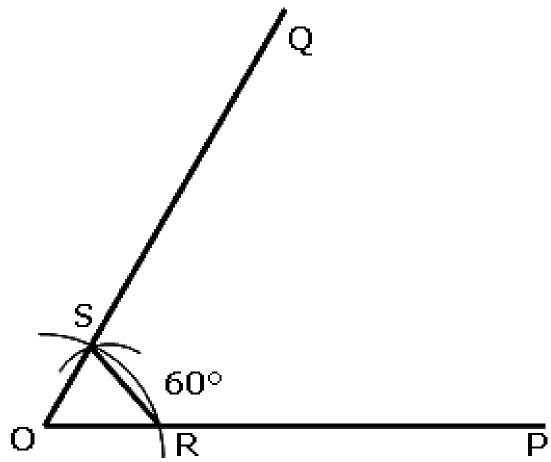


3. To construct angles of 60°, 30°, 120°, 90°, 45°

(i) To construct an angle of 60°

Steps of Construction:

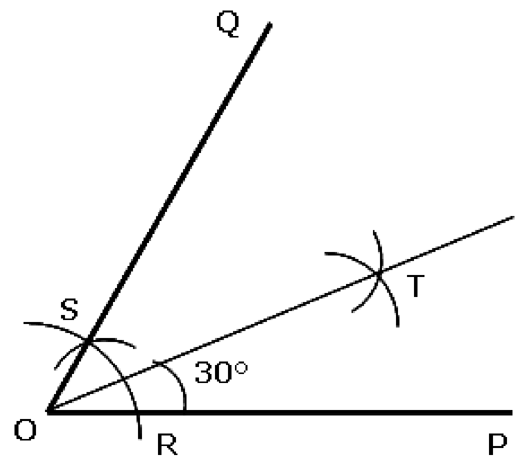
1. Draw any line OP.
2. With O as centre and any suitable radius, draw an arc to meet OP at R.
3. With R as centre and same radius (as in step 2), draw an arc to meet the previous arc at S.
4. Join OS and produce it to Q, then ∠POQ = 60°.



(ii) To construct an angle of 30°

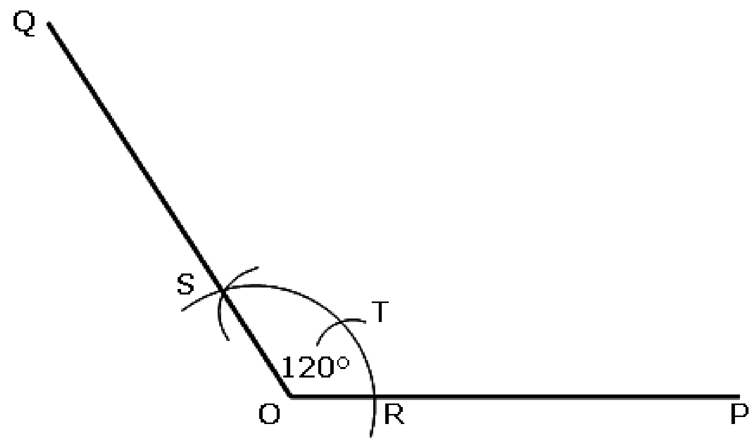
Steps of Construction

1. Construct ∠POQ = 60° (as above).
2. Bisect ∠POQ (as in construction 2). Let OT be the bisector of ∠POQ, then ∠POT = 30°



(iii) To construct an angle of 120°

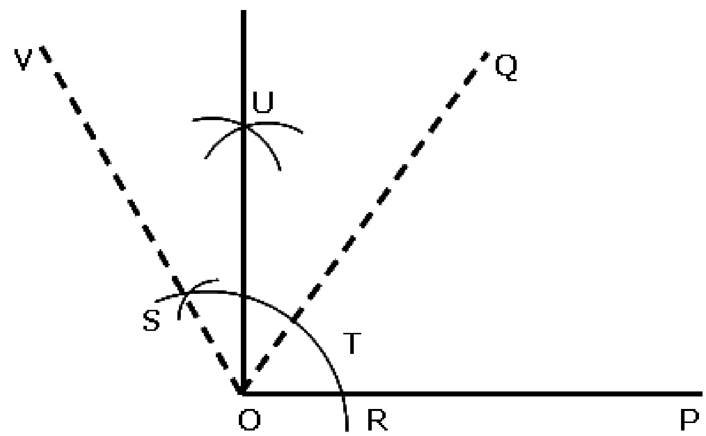
1. Draw any line OP.
2. With O as centre and any suitable radius, draw an arc to meet OP at R.
3. With R as centre and same radius (as in step 2), draw an arc to meet the previous arc at T. With T as centre and same radius, draw another arc to cut the first arc at S.
4. Join OS and produce it to Q, then ∠POQ = 120°.



(iv) To construct an angle of 90°

Steps of Construction

1. Construct ∠POQ = 60°
   (as in construction 3(i)).
2. Construct ∠POV = 120° (as above).
3. Bisect ∠QOV (as in construction 2). Let OU be the bisector of ∠QOV, then ∠POU = 90°.

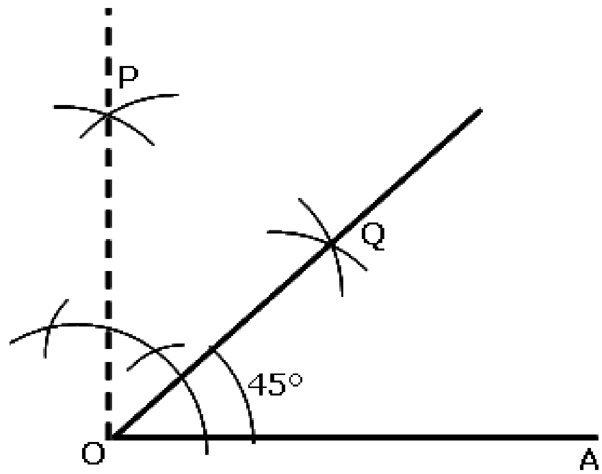


(v) To construct an angle of 45°

Steps of Construction

1. Construct ∠AOP = 90° (as above).
2. Bisect AOP (as in construction 2).

Let OQ be the bisector of ∠AOP, then ∠AOQ = 45°



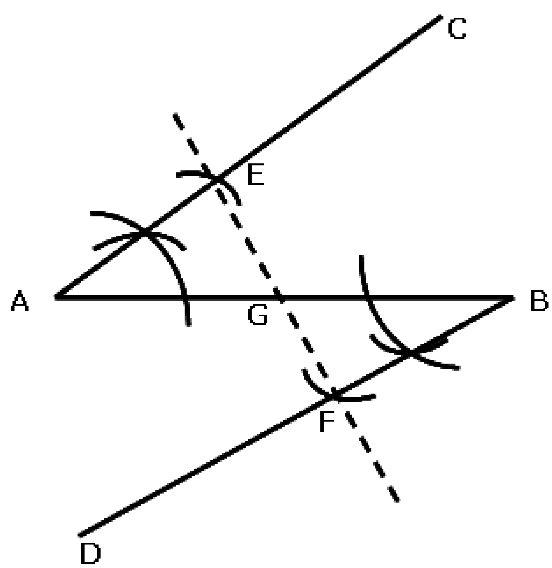
4. To bisect a given line segment.

Given : Any line segment AB.

Required : To bisect line segment AB.

Steps of Construction:

1. At A, construct any suitable angle BAC.
2. At B, construct ∠ABD = ∠BAC on the other side of the line AB.
3. With A as centre and any suitable radius, draw an arc to meet AC at E.
4. From BD, cut off BF = AE.
5. Join EF to meet AB at G, then EG is a bisector of the line segment AB and G is mid – point of AB.



(ii) To divided a given line segment in a number of equal part.

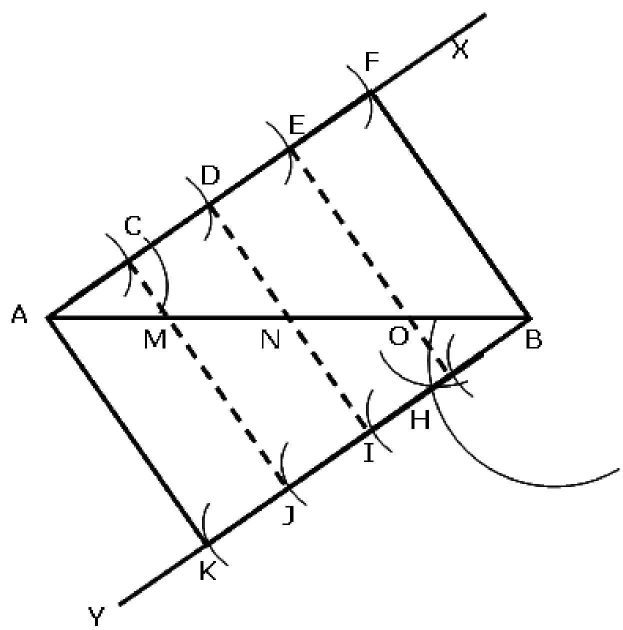
5. Divided a line segment AB of length 8 cm into 4 equal part.

Given : A line segment AB of length 8 cm.

Required : To divide line segment 8 cm into 4 equal parts.

Steps of Construction:

1. Draw lien segment AB = 8 cm.
2. At A, construct any suitable angle BAX.
3. At B, construct ∠ABY = ∠BAX on the other side of the line AB.
4. From AX, cut off 4 equal distances at the points C, D, E and F such that AC = CD = DE = EF.
5. With the same radius, cut off 4 equal distances along BY at the points H, I, J and K such that BH = HI = IJ = JK.
6. Join AK, CJ, DI, EH and FB. Let CJ, DI and EH meet the line segment AB at the points M, N and O respectively. Then, M, N and O are the points of division of AB such that AM = MN = NO = OB.



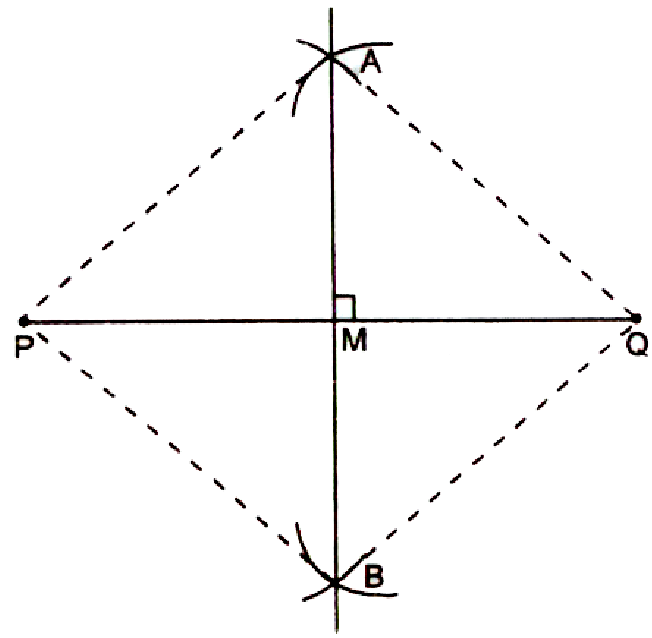
6. To draw a perpendicular bisector of a line segment.

Given : Any line segment PQ.

Required : To draw a perpendicular bisector of lien segment PQ.

Steps of Construction:

1. With P as centre and any line suitable radius draw arcs, one on each side of PQ.
2. With Q as centre and same radius (as in step 1), draw two more arcs, one on each side of PQ cutting the previous arcs at A and B.
3. Join AB to meet PQ at M, then AB bisects PQ at M, and is perpendicular to PQ, Thus, AB is the required perpendicular bisector of PQ.



7. To construct an equilateral triangle when one of its side is given.

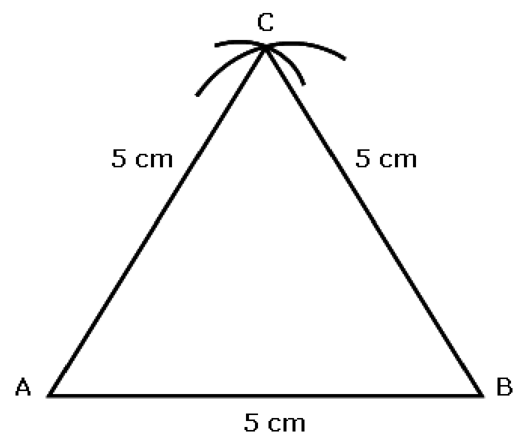
E.g.: Construct and equilateral triangle whose each side is 5 cm.

Given : Each side of an equilateral triangle is 5 cm.

Required : To construct the equilateral triangle.

Steps of Construction:

1. Draw any line segment AB = 5 cm.
2. With A as centre and radius 5 cm draw an arc.
3. With B as centre and radius 5 cm draw an arc to cut the previous arc at C.
4. Join AC and BC. Then ABC is the required triangle.

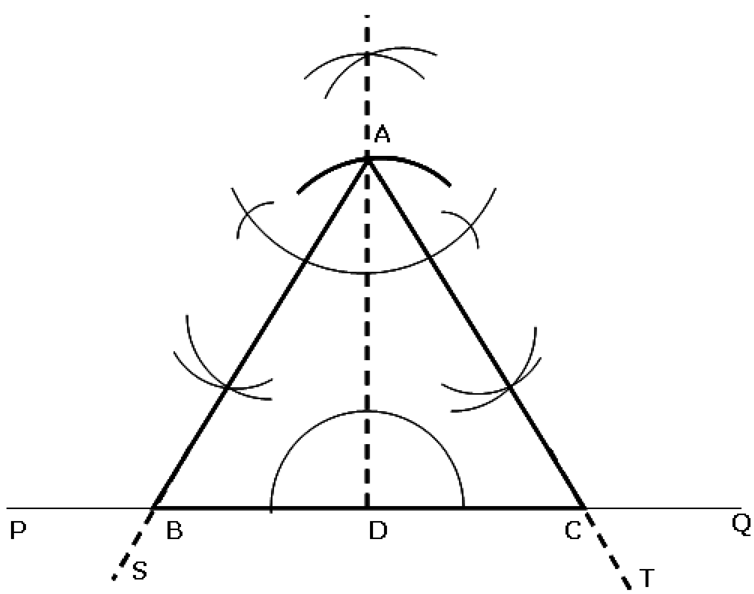


8. To construct an equilateral triangle when its altitude is given.

E.g.: Construct an equilateral triangle whose altitude is 4 cm.

Steps of Construction:

1. Draw any line segment PQ.
2. Take an point D on PQ and At D, construct perpendicular DR to PQ. From DR, cut off DA = 4 cm.
3. At A, construct $\angle DAS = \angle DAT = \frac{1}{2} \times 60^\circ = 30°$ on either side of AD. Let AS and AT meet PQ at points B and C respectively. Then, ABC is the required equilateral triangle.



9. Construction of a triangle, given its Base, Sum of the other Two sides and one Base Angle.

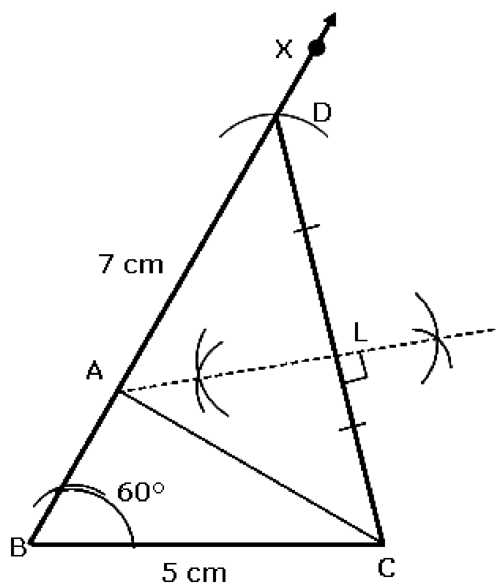
E.g Construct a triangle with base of length 5 cm, the sum of the other two sides 7 cm and one base angle of 60°.

Given: In ΔABC, base BC = 5 cm, AB + AC = 7 cm and ∠ABC = 60°

Required : To construct the ΔABC.

Steps of Construction:

1. Draw BC = 5 cm.
2. At B, construct ∠CBX = 60°
3. From BX, cut off BD = 7 cm.
4. Join CD.
5. Draw the perpendicular bisector of CD, intersecting BD at a point A.
6. Join AC. Then, ABC is the required triangle.



10. Construction of a triangle, Given its Base, Difference of the Other Two Sides and one Base Angle.

Eg: Construct a triangle with base of length 7.5 cm, the difference of the other two sides 2.5 cm, and one base angle of 45°

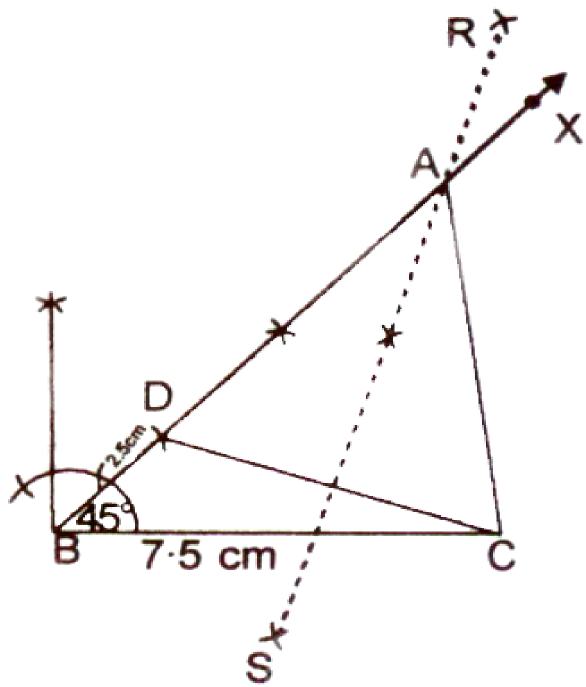
Given : In ΔABC, base BC = 7.5 cm, the difference of the other two sides, AB – AC or AC – AB = 2.5 cm and one base angle is 45°.

Required : To construct the ΔABC,

CASE (i) AB – AC = 2.5 cm.

Steps of Construction:

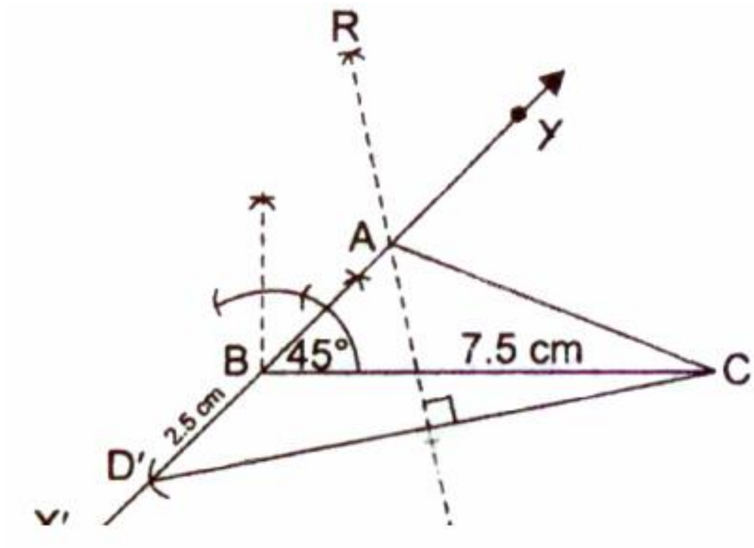
1. Draw BC = 7.5 cm.
2. At B, construct ∠CBX = 45°.
3. From BX, cut off BD = 2.5 cm.
4. Join CD.
5. Draw the perpendicular bisector RS of CD intersecting BX at a point A.
6. Join AC. Then, ABC is the required triangle.



CASE (ii) AC – AB = 2.5 cm

Steps of Construction:

1. Draw BC = 7.5 cm.
2. At B, construct ∠CBX = 45° and produce XB to form a line XBX'.
3. From BX', cut off BD' = 2.5 cm.
4. Join CD'.
5. Draw perpendicular bisector RS of CD' intersecting BX at a point A.
6. Join AC. Then, ABC is the required triangle.



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11. Construction of a Triangle of Given Perimeter and Base Angles.

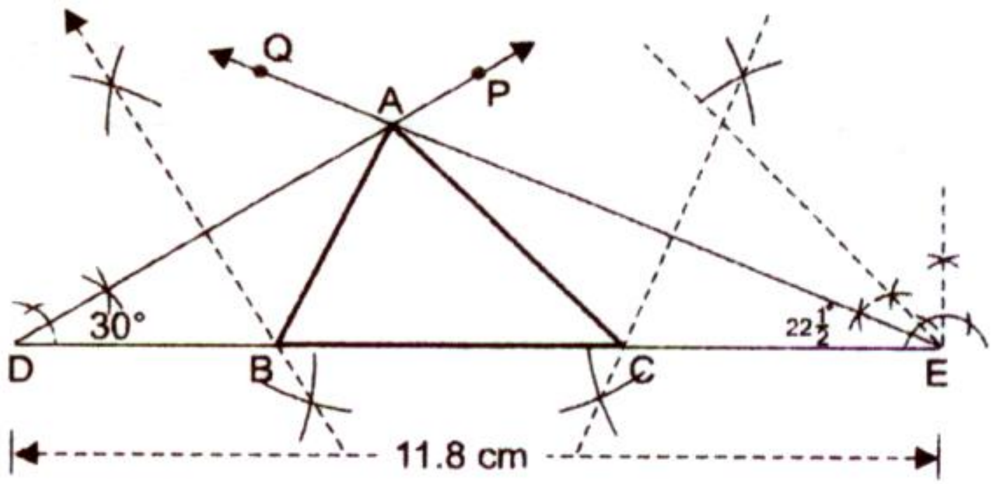
Construct a triangle with perimeter 11.8 cm and base angles 60° and 45°.

Given : In ΔABC, AB+BC+CA = 11.8 cm, ∠B = 60° & ∠C = 45°.

Required : To construct the ΔABC.

Steps of Construction:

1. Draw DE = 11.8 cm.
2. At D, construct ∠EDP = $\frac{1}{2}$ of 60° = 30° and at E, construct ∠DEQ = $\frac{1}{2}$ of 45° = $22\frac{1}{2}°$.
3. Let DP and EQ meet at A.
4. Draw perpendicular bisector of AD to meet DE at B.
5. Draw perpendicular bisector of AE to meet DE at C.
6. Join AB and AC. Then, ABC is the required triangle.


Q
A
P
30°
$22\frac{1}{2}$°
D
B
C
E
11.8 cm