

# 11

## Constructions

### EXERCISE 11.1

1. With the help of a ruler and a compass it is not possible to construct an angle of:

- (a)  $37.5^\circ$       (b)  $40^\circ$       (c)  $22.5^\circ$       (d)  $67.5^\circ$

**Sol.** With the help of a ruler and a compass it is not possible to construct an angle of  $40^\circ$ .

Hence, (b) is the correct answer.

2. The construction of a triangle ABC, given that  $BC = 6$  cm,  $\angle B = 45^\circ$  is not possible when difference of AB and AC is equal to:

- (a) 6.9 cm      (b) 5.2 cm      (c) 5.0 cm      (d) 4.0 cm

**Sol.** We are given  $BC = 6$  cm and a base angle  $\angle B$ , the difference between other two sides AB and AC should not be equal to or greater than BC. Hence, the correct answer is (a) 6.9 cm.

3. The construction of a triangle ABC, given that  $BC = 3$  cm,  $\angle C = 60^\circ$  is possible when difference of AB and AC is equal to:

- (a) 3.2 cm      (b) 3.1 cm      (c) 3 cm      (d) 2.8 cm

**Sol.** The correct answer is (d) 2.8 cm.

### EXERCISE 11.2

Write True or False in each of the following. Give reasons for your answer.

1. An angle of  $52.5^\circ$  can be constructed.

**Sol.** Since,  $52.5^\circ = \frac{1}{4} \times 210^\circ$  and  $210^\circ = 180^\circ + 30^\circ$  which can be constructed.

Hence, the given statement is correct.

2. An angle of  $42.5^\circ$  can be constructed.

**Sol.** Since  $42.5^\circ = \frac{1}{2} \times 85^\circ$  and  $85^\circ$  cannot be constructed by using ruler and compass.

3. A triangle ABC can be constructed in which  $AB = 5$  cm,  $\angle A = 45^\circ$  and  $BC + AC = 5$  cm.

**Sol.** Since sum of two sides of a triangle is always greater than the third side, so we can not construct a triangle in which  $AB = BC + AC$ .

4. A triangle can be constructed in which  $BC = 6$  cm,  $\angle C = 30^\circ$  and  $AC - AB = 4$  cm.

**Sol.** Because  $AC - AB (= 4 \text{ cm}) < BC (= 6 \text{ cm})$ . i.e.,  $AC < AB + BC$  or  $AB + BC > AC$  which is true.

Hence, the given statement is true.

5. A triangle can be constructed in which  $\angle B = 105^\circ$ ,  $\angle C = 90^\circ$  and  $AB + BC + AC = 10 \text{ cm}$ .

**Sol.** The given statement is false, because  $\angle B + \angle C = 105^\circ + 90^\circ = 195^\circ > 180^\circ$ .

6. A triangle ABC can be constructed in which  $\angle B = 60^\circ$ ,  $\angle C = 45^\circ$  and  $AB + BC + AC = 12 \text{ cm}$ .

**Sol.** The given statement is true, because  $\angle B + \angle C = 60^\circ + 45^\circ = 105^\circ < 180^\circ$ .

### EXERCISE 11.3

1. Draw an angle of  $110^\circ$  with the help of a protractor and bisect it. Measure each angle.

**Sol. Given:** An angle  $ABC = 110^\circ$

**Required:** To draw the bisector of  $\angle ABC$

**Steps of construction:**

1. With B as centre and a convenient radius draw an arc to intersect the rays BA and BC at P and Q respectively.

2. With centre P and a radius greater than half of PQ, draw an arc.

3. With centre Q and the same radius (as in step 2), draw another arc to cut the previous arc at R.

4. Draw ray BR. This ray BR is the required bisector of  $\angle ABC$ .

2. Draw a line segment AB of length 4 cm. Draw a line perpendicular to AB through A and B respectively. Are these lines parallel?

**Sol. Given:** A line segment AB of length 4 cm.

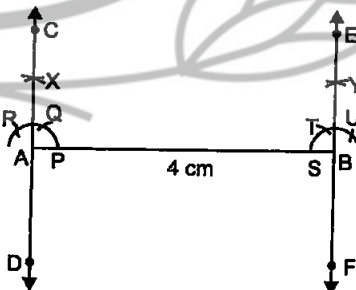
**Required:** To draw perpendicular to AB through A and B, respectively.

**Steps of construction:**

1. Draw  $AB = 4 \text{ cm}$ .

2. With A as centre and any convenient radius, draw an arc, cutting AB at P.

3. With P as centre and the same radius, draw an arc cutting the arc drawn in step 2 at Q.



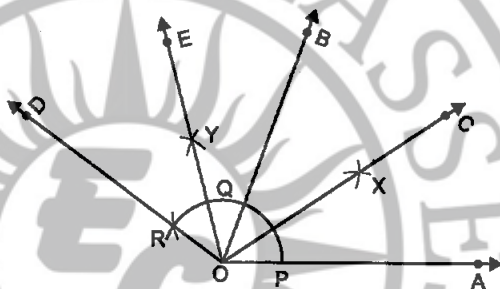
4. With Q as centre and the same radius as in steps 2 and 3, draw an arc, cutting the arc drawn in step 3 at R.
5. With Q as centre and the same radius, draw an arc.
6. With R as centre and the same radius, draw an arc, cutting the arc drawn in step 5 at X.
7. Draw OX and produce it to C and D.
8. Now, repeat the steps from 2 to 7 to draw the line EF perpendicular through B.

Yes, these lines are parallel because sum of the interior angles on the same side of the transversal is  $180^\circ$

3. Draw an angle of  $80^\circ$  with the help of protractor. Then construct angles of (i)  $40^\circ$ , (ii)  $160^\circ$  and (iii)  $120^\circ$ .

**Sol. Steps of Construction:**

1. Draw a ray OA.
2. With the help of a protractor, construct  $\angle BOA = 80^\circ$
3. Taking O as centre and any suitable radius, draw an arc to intersect rays OA and OB at points P and Q respectively.



4. Bisect  $\angle BOA$  as done in Q1. Let ray OC be the bisector of  $\angle BOA$ , then  $\angle ROA = \frac{1}{2} \angle BOA = \frac{1}{2} \times 80^\circ = 40^\circ$ .
5. With Q as centre and radius equal to PQ, draw an arc to cut the extended arc PQ at R. Join OR and produce it to form ray OD, then  $\angle DOA = 2\angle BOA = 2 \times 80^\circ = 160^\circ$ .
6. Bisect  $\angle DOB$  as in Q1. Let OE be the bisector of  $\angle DOB$  is then

$$\begin{aligned} \angle EOA &= \angle EOB + \angle BOA = \frac{1}{2} \angle DOB + \angle BOA \\ &= \frac{1}{2} (80^\circ) + 80^\circ = 40^\circ + 80^\circ = 120^\circ \end{aligned}$$

4. Construct a triangle whose sides are 3.6 cm, 3.0 cm and 4.8 cm. Bisect the smallest angle and measure each part.

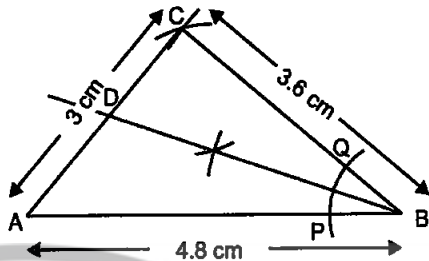
**Sol. Steps of Construction:**

**Step1:** Draw a line  $AB = 4.8$  cm.

**Step 2:** Now, take radius of 3 cm and center 'A' draw an arc. And take radius of 3.6 cm and center 'B' draw an arc that intersect our previous arc at 'C'.

Step 3: Join CA and CB we get required triangle ABC.

Now, we measure all internal angles and we get  $\angle ABC$  is smallest angle, So, we bisect  $\angle ABC$ .



Step 4: Take any radius (Less than half of AB) and center 'B' draw an arc that intersect our line AB at P and line BC at Q.

Step 5: With same radius and centre 'P' and 'Q' draw arcs which intersect at 'R'.

Step 6: Join BR and extend BR that line intersect AC at 'D'.

Now, we can easily measure each angle with the help of protractor.

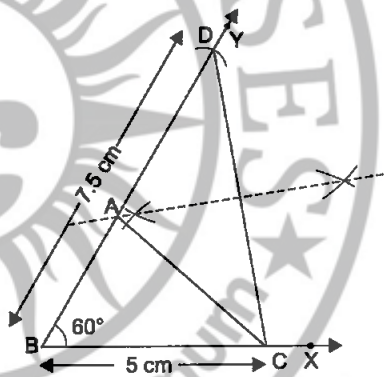
5. Construct a triangle ABC in which  $BC = 5$  cm,  $\angle B = 60^\circ$  and  $AC + AB = 7.5$  cm.

**Sol. Given:** In  $\triangle ABC$ ,  $BC = 5$  cm,  $AC + AB = 7.5$  cm and  $\angle B = 60^\circ$

**Required:** To construct  $\triangle ABC$

**Steps of Construction:**

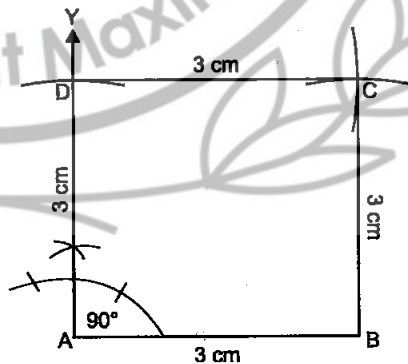
1. Draw a ray BX and cut off a line segment  $BC = 5$  cm from it.
2. At B, construct  $\angle XBY = 60^\circ$ .
3. With B as centre and radius  $= 7.5$  cm, draw an arc to meet BY at D.
4. Join CD.
5. Draw the perpendicular bisector of CD, intersecting BD at A.
6. Join AC. Then, ABC is the required triangle.



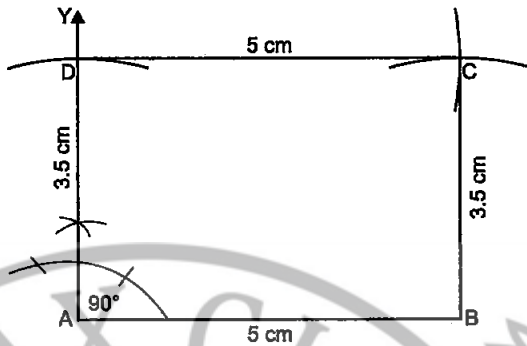
6. Construct a square of side 3 cm.

**Sol. Steps of construction.**

1. Take  $AB = 3$  cm.
2. At A, draw  $AY \perp AB$ .
3. With A as centre and radius  $= 3$  cm, describe an arc cutting AY at D.
4. With B and D as centres and radii equal to 3 cm, draw arcs intersecting at C.
5. Join BC and DC. ABCD is the required square.



7. Construct a rectangle whose adjacent sides are of lengths 5 cm and 3.5 cm.

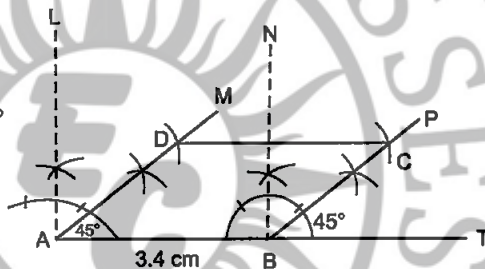


**Sol. Steps of construction:**

1. Take  $AB = 5$  cm.
  2. Draw  $AY \perp AB$ .
  3. With A as centre and radius = 3.5 cm, describe an arc cutting AY at D.
  4. With D as centre and radius 5 cm, describe an arc and with B as centre and radius 3.5 cm, describe another arc intersecting the first arc at C.
  5. Join BC and DC. ABCD is the required rectangle.
8. Construct a rhombus whose side is of length 3.4 cm and one of its angle is  $45^\circ$ .

**Sol. Steps of construction:**

1. Take  $AB = 3.4$  cm.
2. At A and B, construct  $\angle BAM = 45^\circ$  and  $\angle TBP = 45^\circ$  respectively.
3. From AM cut off  $AD = 3.4$  cm and from BP cut off  $BC = 3.4$  cm
4. Join AD, DC and BC. ABCD is the required rhombus.

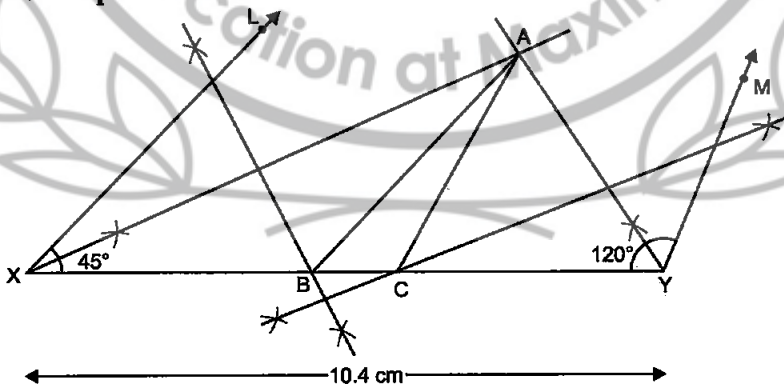


**EXERCISE 11.4**

Construct each of the following and give justification:

1. A triangle if its perimeter is 10.4 cm and two angles  $45^\circ$  and  $120^\circ$ .

**Sol. Steps of Construction:**



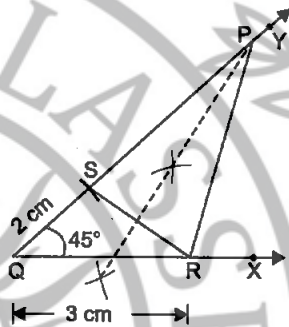


1. Draw  $XY = 10.4$  cm.
2. Draw  $\angle LXY = 45^\circ$  and  $\angle MYX = 120^\circ$ .
3. Draw angle bisector of  $\angle LXY$ .
4. Draw angle bisector of  $\angle MYX$  such that it meets the angle bisector of  $\angle LXY$  at point A.
5. Draw the perpendicular bisector of AX such that it meets XY at B.
6. Draw the perpendicular bisector of AY such that it meets XY at C.
7. Join AB and AC.

Thus, ABC is the required triangle.

2. A triangle PQR given that  $QR = 3$  cm,  $\angle PQR = 45^\circ$  and  $QP - PR = 2$  cm

1. Draw a ray QX and cut off a line segment  $QR = 3$  cm.
2. At Q, construct  $\angle YQR = 45^\circ$ .
3. From QY, cut off  $QS = 2$  cm.
4. Join RS.
5. Draw perpendicular bisector of RS to meet QY at P.
6. Join PR. Then PQR is the required triangle.



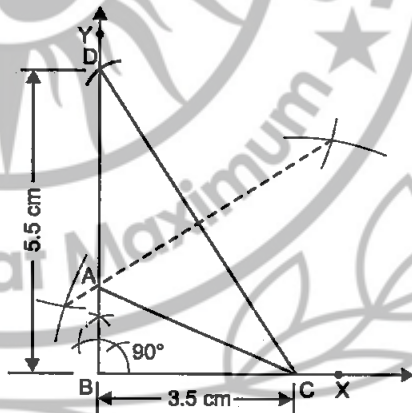
3. A right triangle when one side is 3.5 cm and sum of other sides and the hypotenuse is 5.5 cm.

**Sol. Given:** In  $\triangle ABC$ , base  $BC = 3.5$  cm, the sum of other side and hypotenuse i.e.,  $AB + AC = 5.5$  cm and  $\angle ABC = 90^\circ$ .

**Required:** Construct the  $\triangle ABC$ .

**Steps of Construction:**

1. Draw a ray BX and cut off a line segment  $BC = 3.5$  cm from it.
2. Construct  $\angle XBY = 90^\circ$ .
3. From BY cut off a line segment  $BD = 5.5$  cm.
4. Join CD.
5. Draw the perpendicular bisector of CD intersecting BD at A.
6. Join AC. Then, ABC is the required triangle.



**Sol. Steps of Construction:**

1. Draw a line  $l$ .

2. Mark any point D on the line  $l$ .

3. At point D, draw  $\vec{DX} \perp l$  and

cut  $DA = 3.2$  cm from  $\vec{DX}$ .

4. At the point A, construct AB and AC which meets the  $l$  at points B and C respectively such that

$$\angle DAB = 30^\circ \text{ and } \angle DAC = 30^\circ$$

Then  $\triangle ABC$  is the required equilateral triangle

because  $\angle ABC = 180^\circ - (90^\circ + 30^\circ) = 60^\circ$

$$\angle ACB = 180^\circ - (90^\circ + 30^\circ) = 60^\circ$$

and  $\angle BAC = 30^\circ + 30^\circ = 60^\circ$ .

5. A rhombus whose diagonals are 4 cm and 6 cm in lengths.

**Sol. Steps of construction:**

1. Take  $AC = 6$  cm.
2. Draw  $BD$  the right bisector of  $AC$ .
3. Cut off  $MB = MD = 2$  cm.
4. Join  $AB, BC, CD$  and  $DA$ .

Hence,  $ABCD$  is the required rhombus.

