Chapter 11
Construction

Exercise No. 11.1

Multiple Choice Questions:

1. With the help of a ruler and a compass it is not possible to construct an angle of:
(A) 37.5°
(B) 40°
(C) 22.5°
(D) 67.5°

Solution:
By using the help of a ruler and a compass, that is possible construct the angels, 90°, 60°, 45°, 22.5°, 30° etc., and its bisector of an angle. So, it is not possible to construct an angle of 40°.
Hence, the correct option is (B).

2. The construction of a triangle ABC, given that BC = 6 cm, $\angle B = 45°$ 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

Solution:
Given: BC = 6 cm and ∠B= 45°
As, we know that, the construction of a triangle is not possible, if sum of two sides is less than or equal to the third side of the triangle.

So, the difference between other two sides AB and AC should be equal to or greater then BC.
Hence, the correct option is (A).

3. The construction of a triangle ABC, given that BC = 3 cm, $\angle C = 60°$ 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

Solution:
Given, BC = 3 cm and ∠C=60°
As, we know that, the construction of a triangle is possible, if sum of two sides is greater than the third side of the triangle.

So, the difference between other two sides AB and AC should not be equal to or greater than BC.
Hence, the correct option is (D).

Exercise No. 11.2

Short Answer Questions with Reasoning:

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

1. An angle of 52.5° can be constructed.

Solution:

As, $42.5° = \frac{1}{4} \times 210°$ and an angle of $210° = 180° + 30°$ cannot be constructed with the help of ruler and compass.
Hence, the given statement is true.

2. An angle of 42.5° can be constructed.

Solution:

As, $42.5° = \frac{1}{2} \times 85°$ and an angle of 85° cannot be constructed with the help of ruler and compass.
Hence, the given statement is false.

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

Solution:
As, a triangle can be constructed, if sum of its two sides is greater than third side.
Here, BC + AC = AB = 5 cm
So, triangle ABC cannot be constructed.
Hence, the given statement is false.

4. A triangle ABC can be constructed in which BC = 6 cm, $\angle C = 30°$ and AC – AB = 4 cm.

Solution:
As, a triangle can be constructed if sum of its two sides is greater than third side.
So, in triangle ABC, AB + BC > AC
BC > AC – AB
6 > 4, which is true, so triangle ABC with given conditions can be constructed.
Hence, the given statement is true.

5. A triangle ABC can be constructed in which $\angle B = 105°$, $\angle C = 90°$ and AB + BC + AC = 10 cm.

Solution:

Given: $\angle B = 105°$, $\angle C = 90°$

We know that, sum of angles of a triangle is 180°.

$\angle A + \angle B + \angle C = 180°$

Here, $\angle B + \angle C = 105° + 90°$

$195° > 180°$ which is not true.

Therefore, a triangle ABC with given conditions cannot be constructed.

Hence, the given statement is false.

6. A triangle ABC can be constructed in which ∠B = 60°, ∠C = 45° and AB + BC + AC = 12 cm.

Solution:

We know that, sum of angles of a triangle is 180°.

$\angle A + \angle B + \angle C = 180°$

Here, $\angle B + \angle C = 60° + 45° = 105° < 180°$,

Therefore, a triangle ABC with given conditions can be constructed.

Hence, the given statement is true.

Exercise No. 11.3

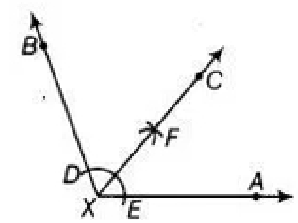
Short Answer Questions:

1. Draw an angle of 110° with the help of a protractor and bisect it. Measure each angle.

Solution:

Given: An angle AXB = 110°.

To construct: the bisector of angle AXB as follows:



Steps of construction:

1. With X as center and any radius draw an arc to intersect the rays XA and XB, say at E and D, respectively.
2. With D and E as center's and with the radius more than $\frac{1}{2}$ DE, draw arcs to intersect each other, say at F.
3. Draw the ray XF.
   So, ray XF is the required bisector of the angle BXA. On measuring each angle, get:
   $\angle BXC = \angle AXC = 55°$. [As, $\angle BXC = \angle AXC = \frac{1}{2} \angle BXA = \frac{1}{2} \times 110° = 55°$]

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

Solution:

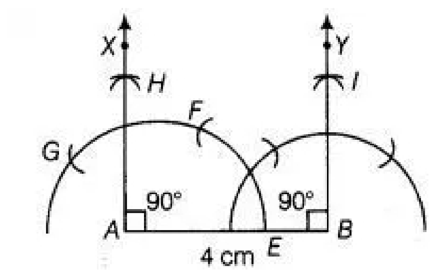
Given: A line segment AB of length 4 cm.

To construct: To draw a line perpendicular to AB through A and B, respectively.

Use the following steps of construction.

1. Draw AB = 4 cm.
2. With 4 as centre and radius more than $\frac{1}{2}$ AB, draw an arc that is intersect AB at E.

3. With E as centre and with same radius as above draw an arc which intersect previous arc at F.
4. Again, taking F as centre and with same radius as above draw an arc which intersect previous arc (obtained in step ii) at G.

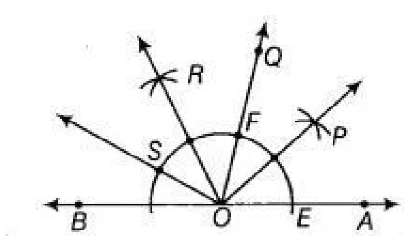


5. With G and F are centres, draw arcs which intersect each other at H.
6. Join AH . So, AX is perpendicular to AB at A. Similarly, draw BY ⊥ AB at B.
   Now, we know that if two lines are parallel, then the angle between them will be 0° or 180°. So,

∠XAB = 90° [XA ⊥ AB]
and ∠YBA = 90° [YB ⊥ AB]
∠XAB+ ∠YBA = 90° + 90° = 180°
Hence, the lines XA and YS are parallel. [It sum of interior angle on same side of transversal is 180°, then the two lines are parallel]

3. Draw an angle of 80° with the help of a protractor. Then construct angles of (i) 40° (ii) 160° and (iii) 120°.

Solution:
Steps of construction:
Given: Draw an angle of 80° say ∠QOA = 80° with the help of protractor.
Use the following steps to construct angles of:



1. With O as centre and any radius draw an arc which intersect OA at E and OO at F.
2. With E and F as centres and radius more than $\frac{1}{2}$ EF draw arcs which intersect each other at P.

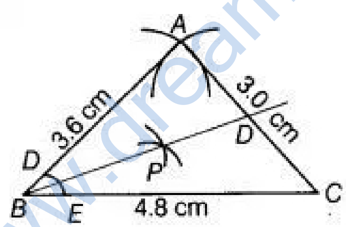
3. Join OP Since, $\angle POA = 40°$ $[40° = \frac{1}{2} \times 80°]$
4. With F as centre and radius equal to EF draw an arc which intersect previous arc obtained in step 2 at S.
5. Join OS. Thus, $\angle SOA = 160°$ $[160° = 2 \times 80°]$
6. With S and F as centre and radius more than $\frac{1}{2}$ SF draw arcs which intersect each other at R.
7. Join OR. Thus, $\angle ROA = \angle ROQ = 40° + 80° = 120°$.

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.

Solution:

To construct: a triangle ABC in which AB = 3.6 cm, AC = 3.0 cm and BC = 4. 8 cm, use the following steps.

1. Draw a line BC = 4.8 cm.
2. From B, point A is at a distance of 3.6 cm. So, having B as centre, draw an arc of radius 3.6 cm.



3. From C, point A is at a distance of 3 cm. So, having C as centre, draw an arc of radius 3 cm which intersect previous arc at A.
4. Join AB and AC. Therefore, ABC is the required triangle.

Where, angle B is smallest, as AC is the smallest side.

To direct angle B, we use the following steps.

1. With B as centre, draw an arc intersecting AB and BC at D and E, respectively.
2. With D and E as centres and draw arcs intersecting at P.
3. Joining BP, we obtain angle bisector of $\angle B$.
4. Here, $\angle ABC = 39°$

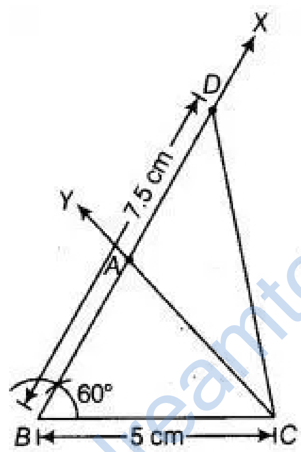
   Thus, $\angle ABD = \angle DBC = \frac{1}{2} \times 139° = 19.5°$

5. Construct a triangle ABC in which BC = 5 cm, ∠B = 60° and AC + AB = 7.5 cm.

Solution:

Given, in ΔABC, BC=5 cm, ∠B=60° and AC + AB=7.5 cm.
To construct: the triangle ABC use the following steps.

1. Draw the base BC = 5 cm.
2. At the point B make an ∠XBC = 60°.
3. Cut a line segment BD equal to AB + AC = 7.5 cm from the ray BX.



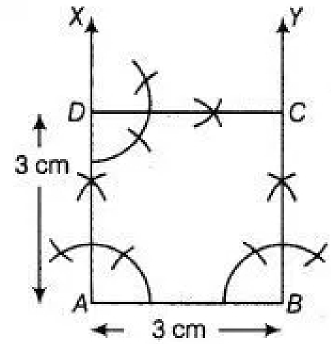
4. Join DC.
5. Make an ∠DCY = ∠BDC.
6. Let CY intersect BX at A.
   Therefore, ABC is the required triangle.

6. Construct a square of side 3 cm.

Solution:

As we know that, each angle of a square is right angle that is 90°.
To construct: a square of side 3 cm, use the following steps.

1. Take AB = 3 cm.
2. Now, draw an angle of 90° at points A and B and plot the parallel lines AX and BY at these points.
3. Cut AD and SC of length 3 cm from AX and BY, respectively.
4. Draw 90° at any one of the point C or D and join both points by CD of length 3 cm.
   Therefore, ABCD is the required square of side, 3 cm.

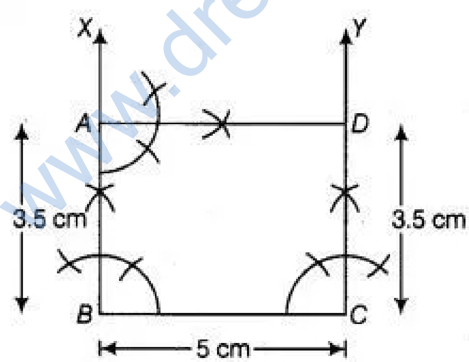


7. Construct a rectangle whose adjacent sides are of lengths 5 cm and 3.5 cm.

Solution:

As, we know that, each angle of a rectangle is right angle that is 90° and its opposite sides are equal and parallel.
To construct**:** a rectangle whose adjacent sides are of lengths 5 cm and 3.5 cm, use the 1 following steps

1. Take BC = 5 cm.
2. Draw 90° at points B and C of the line segment BC and plot the parallel lines BX and CY at these points.



3. Cut AB and CD of length 3.5 cm from BX and CY, respectively.
4. Draw an angle 90° at one of the point A or D and join both points by a line segment AD of length 5 cm.
   Therefore, ABCD is the required rectangle with adjacent sides of length 5 cm and 3.5 cm.

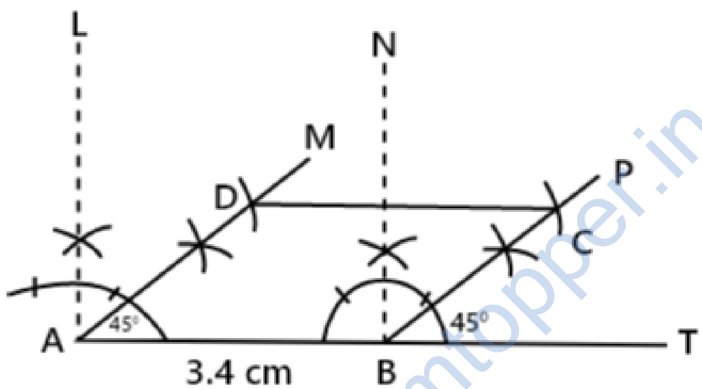
8. Construct a rhombus whose side is of length 3.4 cm and one of its angles is 45°.

Solution:

As, we know that, in rhombus all sides are equal.

To construct a rhombus whose side is of length 3.4 cm and one of its angle is 45°.

1. Taking AB = 3.4 cm.
2. AT point A and B, construct $\angle BAM = 45°$ and $\angle TBP = 45°$, 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 No. 11.4

Long Answer Questions:

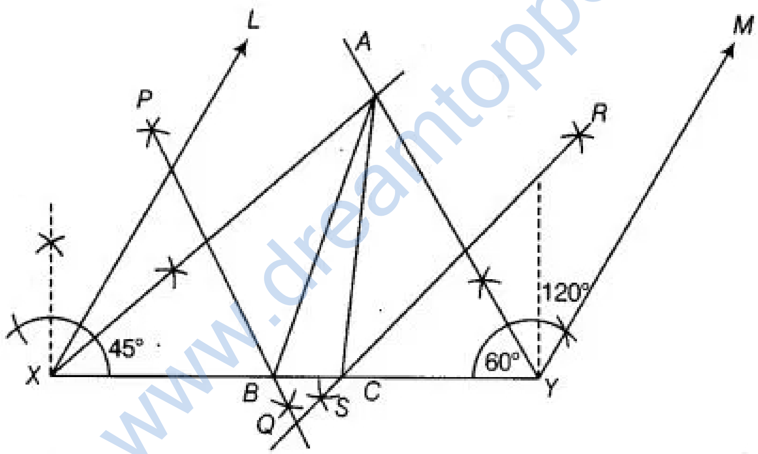
Construct each of the following and give justification:

1. A triangle if its perimeter is 10.4 cm and two angles are 45° and 120°.

Solution:
Let ABC be a triangle.
Given: Perimeter = 10.4 cm that is, AB+ BC + CA = 10.4 cm and two angles are 45° and 120°.
So, ∠B = 45° and ∠C = 120°

Now, to construct the triangle ABC use the following steps.

1. Draw XY and equal to perimeter that is, AB+ BC + CA = 10.4 cm.



2. Draw ∠LXY = ∠B = 45° and ∠MYX = ∠C = 120°.
3. Bisect ∠LXY and ∠MYX and let these bisectors intersect at a point A.
4. Draw perpendicular bisectors PQ and RS of AX and AY, respectively.
5. Let PQ intersect XY at B and RS intersect XY at C. Join AB and AC. Therefore, ABC is the required triangle.

Justification:
B lies on the perpendicular bisector PQ of AX.
Thus, AB+ BC + CA = XB+ BC + CY=XY
Again, ∠BAX = ∠AXB [As, AB = XB] …(I)

Also, ∠ABC = ∠BAX + ∠AXB [∠ABC is an exterior angle of ΔAXB]
= ∠AXB + ∠AXB [From equation (I)]

= 2 ∠AXB = ∠LXY [AX is a bisector of ∠LXB]

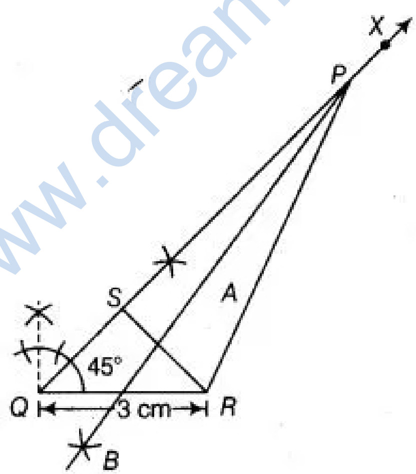
Also, ∠CAY = ∠AYC [As, AC = CY]
∠ACB =∠CAY + ∠AYC [∠ACB is an exterior angle of triangle AYC]
= ∠CAY + ∠CAY
= 2 ∠CAY= ∠MYX [AY is a bisector of ∠MYX]
Therefore, our construction is justified.

2. A triangle PQR given that QR = 3cm, ∠PQR = 45° and QP – PR = 2 cm.

Solution:

Given: in triangle PQR, QR = 3 cm, ∠PQR = 45° and QP – PR = 2 cm
As, C lies on the perpendicular bisector RS of AY.
To construct: a triangle PQR.
Use the following steps of construction.

1. Draw QR = 3 cm.
2. Make an angle XQR = 45° at point Q of base QR.
3. Cut the line segment QS = QP- PR = 2 cm from the ray QX.



4. Join SR and draw the perpendicular bisector of SR say AB.
5. Let bisector AB intersect QX at P. Join PR Thus, ΔPQR is the required triangle.

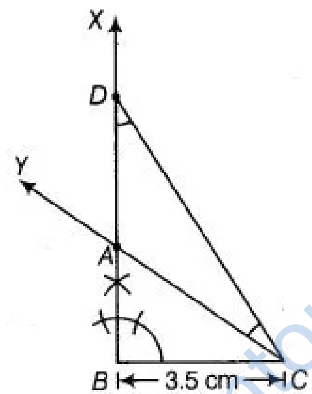
Justification:
Base QR and ∠PQR are drawn as given.
As, the point P lies on the perpendicular bisector of SR.
PS = PR
Now, QS = PQ – PS
= PQ -PR
Therefore, our construction is justified.

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

Solution:

In the right triangle ABC, given BC = 3.5 cm, ∠B = 90° and sum of other side and hypotenuse be, AB + AC = 5.5 cm.
To construct a triangle ABC use the following steps

1. Draw BC = 3.5 cm
2. Make an angle XBC = 90° at the point B of base BC.



3. Cut the line segment BD equal to AB + AC i.e., 5.5 cm from the ray XB.
4. Join DC and make an ∠DCY equal to ∠BDC.
5. Let Y intersect BX at A.
   Therefore, ABC is the required triangle.

Justification:
Base BC and ∠B are drawn as given.
In ΔACD, ∠ACD = ∠ADC [by construction]
AD = AC …(I) [sides opposite to equal angles are equal]

Now, AB = BD – AD = BD – AC [From equation (I)]
BD = AB + AC
Hence, our construction is justified.

4. An equilateral triangle if its altitude is 3.2 cm.

Solution:

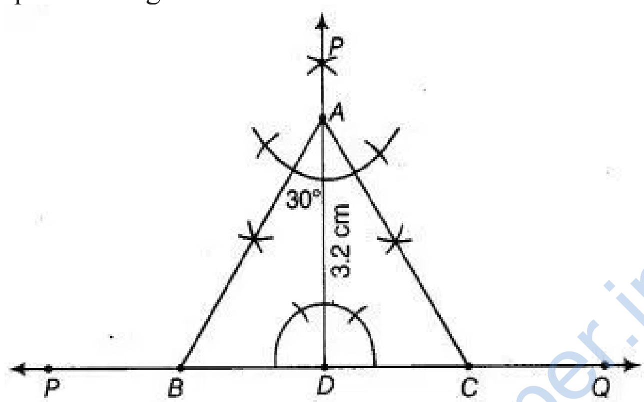
As, in an equilateral triangle all sides are equal and all angles are equal i.e., each angle is of 60°.
Given: altitude of an equilateral triangle say ABC is 3.2 cm.
To construct the triangle ABC use the following steps.

1. Draw a line PQ.

2. Take a point D on PQ and draw DE ⊥ PQ.
3. Cut AD of length 3.2 cm from DE.
4. Make angles equal to 30° at A on both sides of AD say ∠CAD and ∠BAD, where B and C lie on PQ.
5. Cut DC from PQ such that DC = BD

Join AC

Hence, ABC is the required triangle.



Justification:

Here, ∠A = ∠BAD + ∠CAD
= 30°+30°
= 60°.

Also, AD ⊥ SC

So, ∠ADS = 90°.

In triangle ABD, ∠BAD + ∠DBA = 180° [angle sum property]

30° + 90° + ∠DBA = 180° [∠BAD = 30°, by construction]

∠DBA = 60°

Also, ∠DCA = 60°

Therefore, ∠A = ∠B = ∠C = 60°

Hence, ABC is an equilateral triangle.

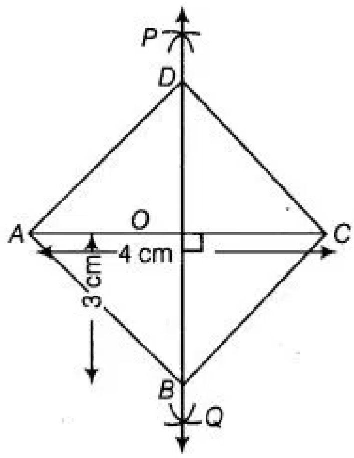
5. A rhombus whose diagonals are 4 cm and 6 cm in lengths.

Solution:

As, all sides of a rhombus are equal and the diagonals of a rhombus are perpendicular bisectors of one another. So, to construct a rhombus whose diagonals are 4 cm and 6 cm. Use the following steps.

1. Draw AC = 4 cm
2. With A and C as centres and radius more than $\frac{1}{2}$ AC draw arcs on both sides of AC to intersect each other.

3. Cut both arcs intersect each other at P and Q, then join PQ.
4. Let PQ intersect AC at the point O. So, PQ is perpendicular bisector of AC.
5. Cut off 3 cm lengths from OP and OQ, then we get points B and D.
6. Join AB, BC, CD, and DA .
   Hence, ABCD is the required rhombus.



Justification
D and B lie on perpendicular bisector of AC.
DA = DC and BA = BC …(I)
[since, every point on perpendicular bisector of line segment is equidistant from end points of line segment]
Now, ∠DOC = 90°
Also, OD = OB = 3 cm

Thus, AC is perpendicular bisector or BD.
CD = CB …(II)
AB = BC = CD = DA

Now, from equation (I) and (II):
ABCD is a rhombus.