UNIT 7 GEOMETRY

7.1 Angles

7.1.1 Recall an angle and recognize acute, right, obtuse, straight and reflex angle
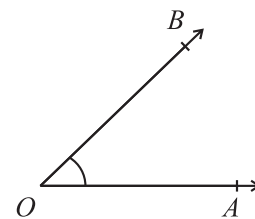
We have learnt about an angle and its different types in previous classes. However we recall these concepts.

Angle

We have learnt in grade 4 that an angle is formed by two distinct rays with the same endpoint.
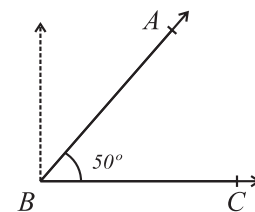
The common endpoint is called the vertex. The figure to the right is of an angle O, AOB or BOA. The symbol for an angle is $\angle$.
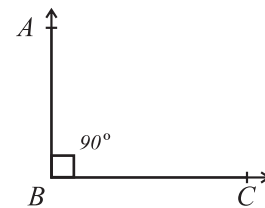
Acute Angle

The angle ABC given on the right side is an acute angle because its measure is less than 90º i.e; $m\angle ABC < 90º$.
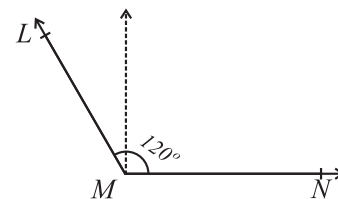
Right Angle

$\angle ABC$ is a right angle because the measure of $\angle ABC$ is equal to 90º. i.e.
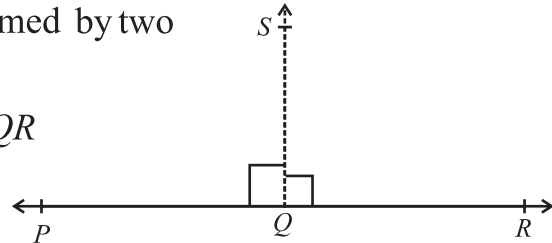$$m\angle ABC = 90º$$

Obtuse Angle

$\angle LMN$ is an obtuse angle because its measure 120º is greater than 90º and less than 180° i.e. $m\angle LMN > 90º$

Straight Angle

$\angle PQR$ is a straight angle which is formed by two adjacent right angles PQS and SQR.
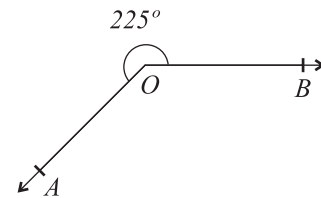
$$m\angle PQR = m\angle PQS + m\angle SQR$$
$$= 90 + 90$$
$$= 180º$$

It is clear from the figure that $\overrightarrow{QP}$ and $\overrightarrow{QR}$ are two rays in opposite directions with common point Q as vertex.
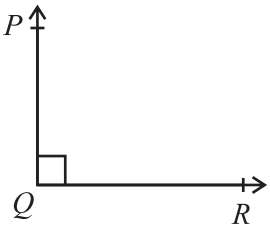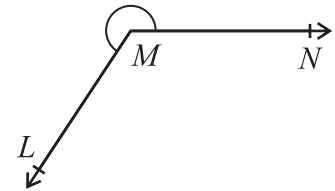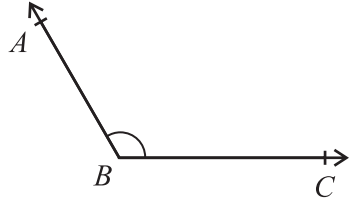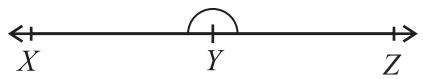
Reflex Angle

$\angle AOB$ is a reflex angle because its measure is 225º which is greater than 180º and less than 360º.

Exercise 7.1

1. Identify and write under each angle its type.

(i)	(ii)
_____	_____

(iii)	(iv)
_____	_____

(v)	(vi)
_____	_____

(vii)

P
Q　　　R

_____

(viii)

M　　　　N
L

_____

(ix)

A
B　　　C

_____

(x)

X　　　Y　　　Z

_____

7.1.2 Draw Acute and Obtuse angles of different measures using Protractor

Draw an Acute Angle

Draw an angle of measure 40º.

Steps of Construction:

(i)　　Draw a ray QR

(ii)　　Place the straight edge of the protractor such that its central point O falls on Q and the ray joining the central point to the mark 0 coincides with ray QR.

(iii)　　Read the protractor from the inner side where its 0 mark lies on the ray QR.

(iv)　　Mark a point P near the circular edge marked 40º as given in the figure.

(v)　　Remove the protractor and draw the ray QP as shown in the figure.

(vi)　　Thus $m\angle PQR = 40º$ is the required acute angle.
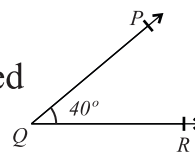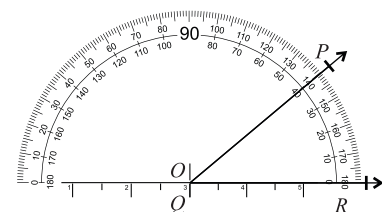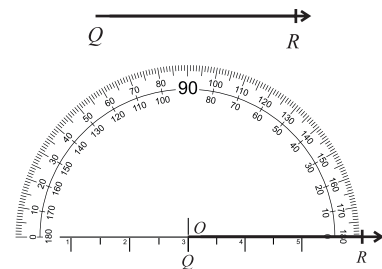
Draw an Obtuse Angle

Draw an angle of measure 130°.

Steps of Construction

(i)   Draw a ray *MN*.

(ii)   Place the straight edge of the protractor such that its central point *O* falls on *M* and the ray joining the central point to the mark 0 coincides with ray *MN*.
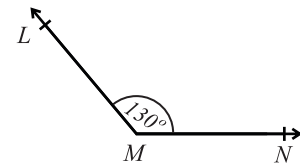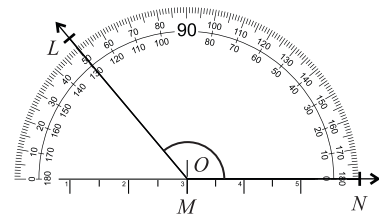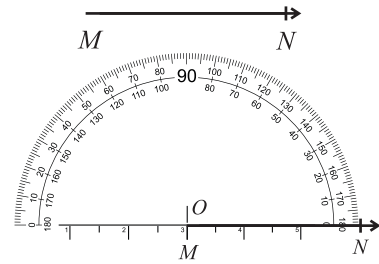
(iii)   Read the protractor from the inner scale where its zero (0) mark lies on the ray *MN*.

(iv)   Mark a point *L* near the edge marked 130° as shown in the figure.

(v)   Remove the protractor and draw the ray as shown in the adjoining figure.

(vi)   Thus, $m\angle LMN = 130°$ is the required obtuse angle.

7.1.3 Draw an angle equal in measure to a given angle

Steps of Construction

(i)   Measure the given angle *ABC* with the help of a protractor that is $m\angle ABC = 50°$. We have to draw an angle equal in measure of given angle i.e. 50°. We proceed further as under.

(ii)   Draw a ray *QR* with *Q* as the initial point (vertex).

(iii)   Place the centre of the protractor on *Q* and adjust it such that its straight edge or base line coincide with ray *QR*.
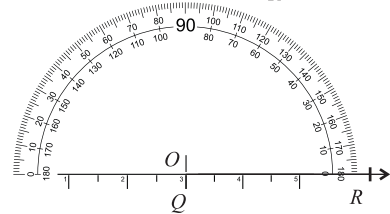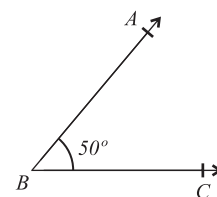
(iv)   Start from zero (0) and read the inner scale till we reach the mark 50.

(v)   Mark a point *P* against the mark 50.

(vi)   Remove the protractor and draw the ray *QP*.

(vii)   Thus, $m\angle PQR = 50^o$ which is the required angle equal in measure to the given angle.

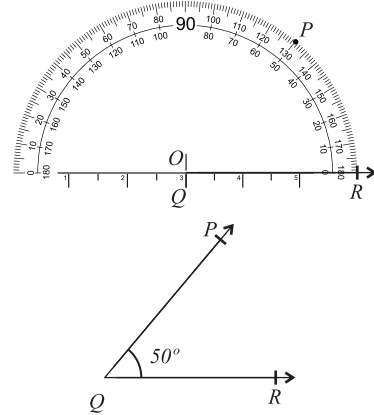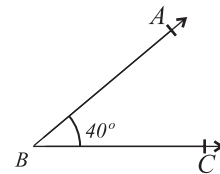# 7.1.4 Draw an angle twice in measure to a given angle.

Steps of Construction

(i)   Measure the given angle *ABC* with the help of a protractor $m\angle ABC = 40^o$.

We have to draw an angle twice in measure of the given angle i.e the measure will be $2 \times 40° = 80°$.

To draw an angle of measure 80° with the help of a protractor, we proceed further as below.

(ii)   Draw a ray *QR* with *Q* as the initial point.

(iii)   Place the centre of the protractor on *Q* such that its baseline coincide with ray *QR*.

(iv)   Start from 0 and read the inner scale till we reach the mark 80.

(v)   Mark a point *P* against the mark 80.

(vi)   Remove the protractor and draw the ray *QP*.
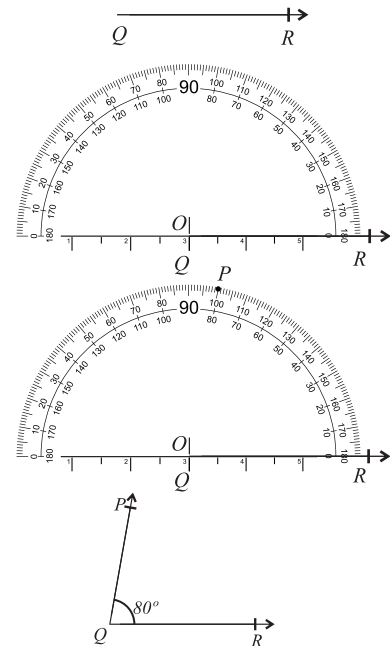
Thus, $m\angle PQR = 80^o$ is the required angle twice in measure to the given angle *ABC*.

7.1.5 Draw an angle equal in measure to the sum of two angles
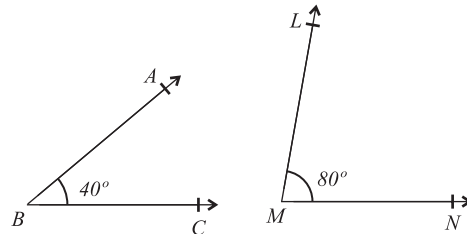
Steps of Construction

(i)　　Measure the given angles *ABC* and *LMN* with the help of protractor and and note that $m\angle ABC = 40°$ and $m\angle LMN = 80°$.

The sum of measures of the given angles is $40° + 80° = 120°$.

We have to draw an angle equal in measure to the sum of measures of two given angles i.e, $120°$. We proceed further as below.

(ii)　　Draw a ray *QR* with *Q* as the initial point.

(iii)　　Place the centre of the protractor on *Q* such that its baseline coincides with ray *QR*.
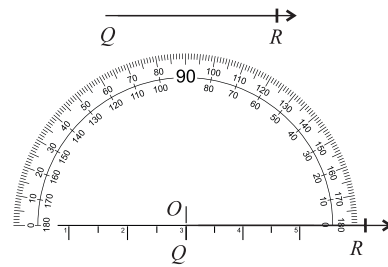
(iv)　　Start from zero and read the inner scale till we reach at the mark $120°$.
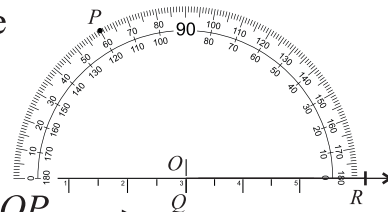
(v)　　Mark a point *P* near the mark $120°$.

(vi)　　Remove the protractor and draw the ray *QP*.
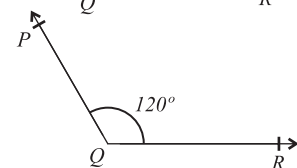
Thus, $m\angle PQR = 120°$ is the required angle equal in measure to the sum of two given angles.

7.1.6 Construction of Angles

We have to construct a right angle, a straight angle and a reflex angle. We shall construct these angles one by one.

Right Angle

Construct an angle whose measure is 90°.
Steps of construction:
(i)　　Draw a ray *MN*.

(ii)   Place a protractor on *MN* such that its central
         point *O* falls on *M* and the ray joining the
         central point to the mark zero coincides with
         the ray *MN*.

(iii)   Read the protractor from the inner side where
         zero mark lies on the ray *MN* till we reach the
         mark 90º.

(iv)   Mark a point *L* near the mark 90º as shown in
         the figure.

(v)   Remove the protractor and draw the ray *ML* as
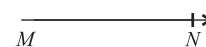   given in the figure.

Thus, $m\angle LMN = 90^\circ$ is the required right angle.

Straight Angle

Construct an angle of measure 180º.

Steps of Construction:

(i)   Draw a ray *QR*.

(ii)   Place a protractor on *QR* such that its central
         point falls on *Q* and the ray joining the central
         point to the mark zero coincides with the ray
         QR.

(iii)   Read the protractor from the inner side where
         zero mark lies on the ray *QR* till we reach the
         mark 180º.

(iv)   Mark a point *P* near the mark 180º as shown in
         the figure.

(v)   Remove the protractor and draw the ray *QP* as
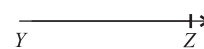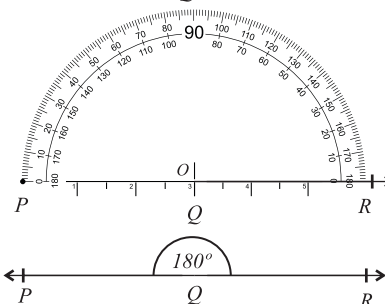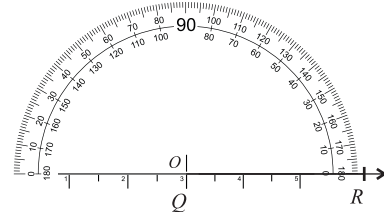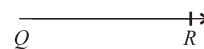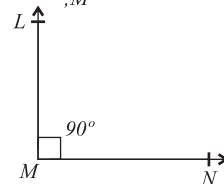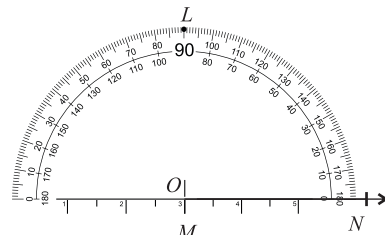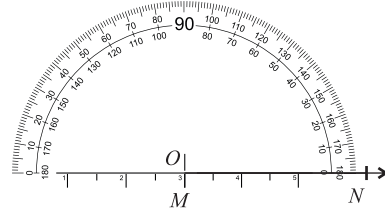   given in the figure,

Thus, $m\angle PQR = 180^\circ$ is the required straight angle.

Reflex Angle

Construct an angle of measure 210º. Now, 210º = 180º + 30º

Steps of Construction:

(i)   Draw a ray *YZ*.

(ii)   Place a protractor on $\overrightarrow{YZ}$ such that its central point O to fall on Y and the ray joining the central point to mark zero(0) coincides with the ray YZ.

(iii)   Read the protractor from the outer side where its zero mark lies on the ray YZ till the mark 30º.

(iv)   Mark a point X near the mark 30º as given in the figure. The angle will become $180º + 30º = 210º$.

(v)   Remove the protractor and draw the ray YX as shown in the figure.
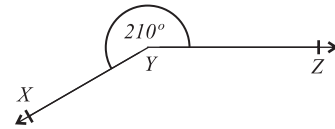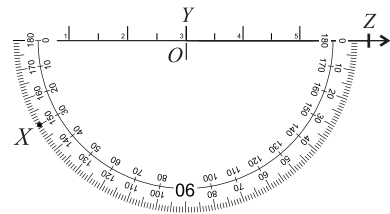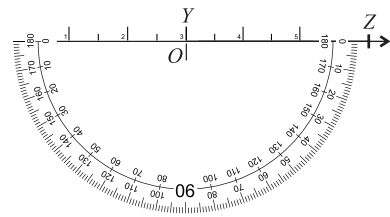
Thus, $m\angle XYZ = 210º$ is the required reflex angle.

Reflex angles of different measures can be drawn in the same manner.

7.2   Triangles

7.2.1 Definition of a Triangle

A triangle is a simple closed figure having three sides and three angles.

In the given triangle ABC:

(i) A, B and C are the vertices.

(ii) $\overline{AB}, \overline{BC}$ and $\overline{CA}$ are the three sides.

(iii)   Three angles are $\angle ABC, \angle BCA$ and $\angle BAC$. The symbol used for a triangle is $\triangle$. So $\triangle ABC$ means triangle ABC. The triangle can be written in any one of six ways as $\triangle ABC, \triangle CBA, \triangle BAC, \triangle CAB, \triangle BCA$ and $\triangle ACB$.
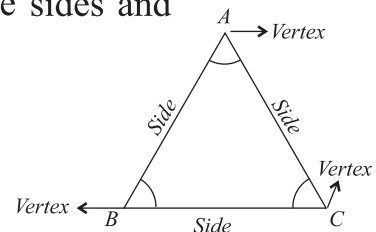
It may be noted that the order of the vertices does not matter while writing the name of a triangle.

Remember that:

The number of angles is equal to the number of sides of a triangle.

7.2.2 Definition of triangle with respect to their sides

(i)　Equilateral Triangle

An equilateral triangle is a triangle in which all the three sides are equal in length.

The triangle given on the right side is an equilateral triangle because its all three sides are equal i.e. $m\overline{AB} = m\overline{BC} = m\overline{CA}$
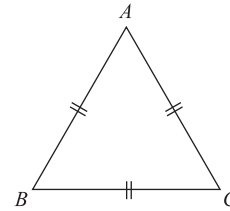
(ii)　Isosceles Triangle

An isosceles triangle is a triangle in w h ı˙c h any two sides are equal in length.

The figure on the right side is an isosceles triangle ABC because its two sides are equal in length i.e. $m\overline{AB} = m\overline{AC}$
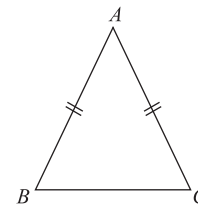
(iii)　Scalene Triangle

A scalene triangle is a triangle in which all the sides are of different lengths.

The figure on the right side is a scalene triangle because none of its side is equal in length to any other side i.e.

$m\overline{PQ}$, $m\overline{QR}$ and $m\overline{PR}$ are not equal.
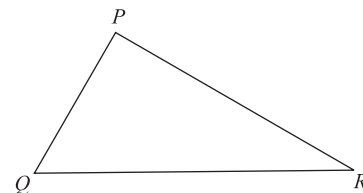
7.2.3 Definition of triangles with respect to their Angles

(i)　Acute Angled Triangle

An acute angled triangle is a triangle with all three angles are acute angles (less than 90°).

In the figure on the right side is an acute angled triangle because its all three angles are acute.
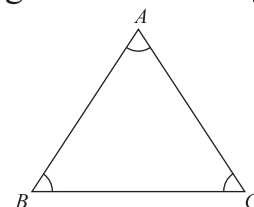
(ii)　Obtuse Angled Triangle

An obtuse angled triangle is a triangle with one obtuse angle (greater than 90º).

$\triangle ABC$ is an obtuse angled triangle because its one angle is obtuse angle i.e. $m\angle B = 120º$ (greater than 90º). We know that no triangle can have more than one obtuse angle because a triangle must have the sum of all three angles as 180º.
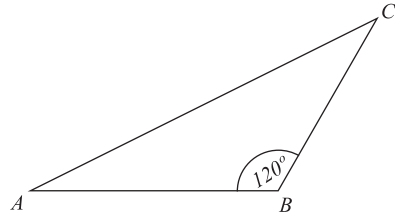
(iii)　Right Angled Triangle

A right angled triangle is a triangle in which one angle is 90º.

In the given figure $\triangle ABC$ is a right angled triangle because its one angle B is a right angle i.e.　$m\angle B = 90º$.
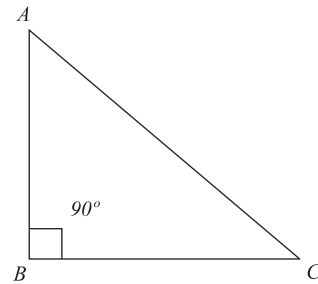
7.2.4 Construction of triangles when three sides are given

(i)　Equilateral Triangle

Example:

Draw an equilateral triangle PQR whose measure of each side is $3cm$.

Solution:

Steps of Construction:

(i)　　Draw a line segment $PQ = 3cm$.

(ii)　　Taking P as centre draw an arc of radius $3cm$ over $\overline{PQ}$.

(iii)　　Taking Q as centre, draw an arc of

radius $3cm$ over $\overline{PQ}$ which cuts the first arc at point R.

(iv)   Join R with P and Q one by one.

Thus, $\triangle PQR$ is the required equilateral triangle.

(ii)   Isosceles Triangle

Example

Draw an Isosceles triangle LMN with measure of its two sides as 3cm each and measure of third side is 4cm.

Solution

Steps of Construction:

(i)   Draw a line segment LM such that $m\overline{LM}=4cm$.

(ii)   Taking L as centre, draw an arc of radius $3cm$ over $\overline{LM}$.

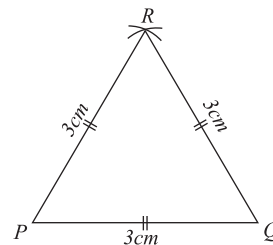(iii)   Taking M as centre, draw another arc of radius $3cm$ over $\overline{LM}$, which cuts the first arc at point N.

(iv)   Join N with L and M one by one.
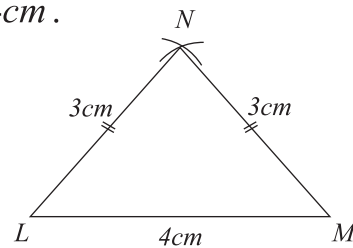
Thus, $\triangle LMN$ is the required isosceles triangle.

(iii)   Scalene Triangle

Example   Draw a scalene triangle ABC with measure of its sides as $m\overline{AB}=4.5cm$, $m\overline{BC}=4cm$ and $m\overline{AC}=3cm$.

Solution

Steps of Construction:

(i)   Draw a line segment $AB=4.5cm$.

(ii)   Taking A as centre, draw an arc of radius $3cm$ over $\overline{AB}$.

(iii)   Taking B as centre, draw another arc of radius 4cm over $\overline{AB}$, which cuts the previous arc at point C.

(iv)   Join C with A and B one by one.

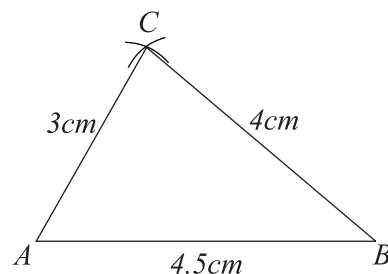Thus, $\triangle ABC$ is the required scalene triangle.

Exercise 7.2

1.   Construct the following triangles.

(i) $m\overline{AB} = 6cm, \quad m\overline{BC} = 4cm, \quad m\overline{CA} = 5cm$

(ii) $m\overline{PQ} = 4.5cm, m\overline{QR} = 5cm, \quad m\overline{PR} = 4.5cm$

(iii) $m\overline{LM} = 5cm, \quad m\overline{MN} = 4.5cm, m\overline{LN} = 4cm$

(iv) $m\overline{AB} = 5cm, \quad m\overline{BC} = 6cm, \quad m\overline{CA} = 4.5cm$

(v) $m\overline{PQ} = 6cm, \quad m\overline{QR} = 4cm, \quad m\overline{PR} = 5cm$

(vi) $m\overline{LM} = 6cm, \quad m\overline{MN} = 4cm, \quad m\overline{NL} = 5cm$

7.3   Quadrilateral

A closed plane figure with four sides is known as a quadrilateral. It has also four angles and four vertices.
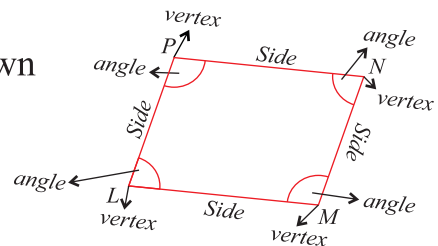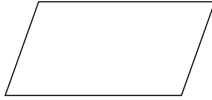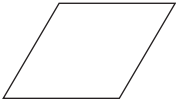
7.3.1 Recognize the Kinds of Quadrilateral

Following are the different kinds of quadrilateral.

(i)   Square   (ii)   Rectangle   (iii)   Kite

(iv)   Parallelogram   (v)   Rhombus   (vi)   Trapezium

Activity 1:　Match the name of each kind of quadrilateral with its figure.

Figure	Name	Figure	Name
▢	Kite	▱	Rectangle
◇	Rhombus	▭	Parallelegram
▱	Square	⏢	Trapezium

Activity 2:　Write the particular name under each kind of quadrilateral.

_____　　　　　　　_____

_____　　　　　　　_____

_____　　　　　　　_____
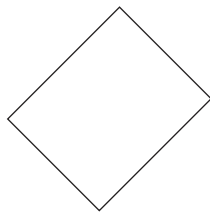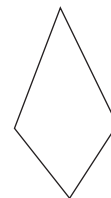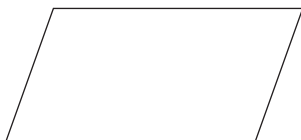
7.3.2 Construction of Square and Rectangle

Square

We know that a square has four equal sides and each angle is of 90º

Example

Construct a square with length of each side 2.5*cm.*

Solution

Steps of Construction:

(i)   Draw a line segment *LM* = 2.5*cm.*

(ii)   Construct an angle of 90º with the help of a protractor at the point *L* and at the point *M.*

(iii)   Taking *L* as centre, draw an arc of radius 2.5*cm* which cuts the vertical $\overrightarrow{LP}$ at point *O.*

(iv)   Taking *M* as centre, draw an arc of radius 2.5*cm* which cuts the vertical $\overrightarrow{MQ}$ at point *N.*

(v)   Join the point *O* with point *N.*
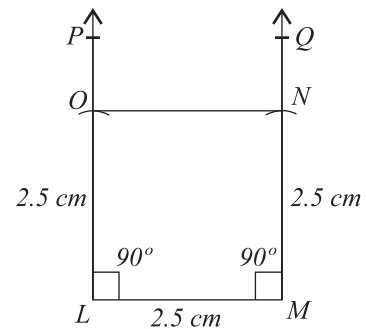
Thus, *LMNO* is the required square.

Rectangle

In a rectangle each two opposite sides are equal in length and measure of each angle is of 90º.

Example

Construct a rectangle having length 4*cm* and width 3*cm*.

Solution

Steps of Construction

(i)   Draw a line segment $AB = 4cm$

(ii)   Construct an angle of 90° at point *A* with the help of a protractor.

(iii)   Similarly draw an angle of 90° at point *B*.

(iv)   Taking point *A* as centre, draw an arc of 3*cm* which cuts $\overrightarrow{AF}$ at point *D*.

(v)   Taking point *B* as centre, draw an arc of 3*cm* which cuts $\overrightarrow{BE}$ at point *C*.

(vi)   Join point *C* with point *D*.
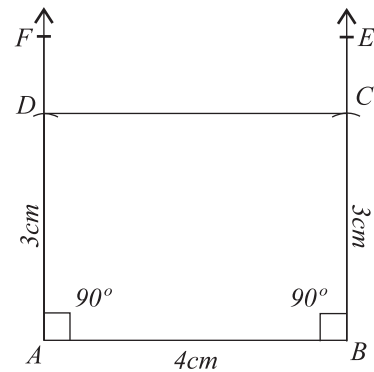
Thus, *ABCD* is the required rectangle.

Exercise 7.3

1.   Construct the following squares with the help of ruler, protractor and compasses whose length of a side is given below.

(i)   2*cm*   (ii)   2.5*cm*   (iii)   3*cm*

2.   Construct rectangles with the help of compasses, ruler and protractor with the following measurement.

(i)   Length 6*cm*, Breadth 4*cm*   (ii)   Length 4*cm*, Breadth 2*cm*

(iii)   Length 5*cm*, Breadth 3*cm*   (iv)   Length 7*cm*, Breadth 5*cm*

Review Exercise 7

1.   Four possible options have been given. Encircle the correct one.

i.   A triangle whose all the three sides are equal in length is called:

(a)   a scalene triangle   (b)   an isosceles triangle

(c)   an acute angled triangle   (d)   an equilateral triangle

ii.   An angle equal to 180º is known as:

(a)   a straight angle   (b)   a reflex angle

(c)   a right angle   (d)   an obtuse angle

iii.   A triangle whose all the three angles are acute is called:

(a)   a scalene triangle   (b) a right angled triangle

(c)   an obtuse angled triangle   (d) an acute angled triangle

iv.   An angle greater than 180º and less then 360º is called:

(a)   a right angle   (b)   an obtuse angle

(c)   a straight angle   (d)   a reflex angle

v.   An angle equal to 90º is known as:

(a)   a right angle   (b)   an obtuse angle

(c)   an acute angle   (d)   a reflex angle

vi.   An angle less than 90º is called:

(a)   a right angle   (b)   an obtuse angle

(c)   an acute angle   (d)   a reflex angle

vii.   A triangle whose one angle is a right angle is called:

(a)   an acute angled triangle   (b) an obtuse angled triangle

(c)   a right angled triangle   (d) a scalene triangle

viii. A triangle whose all the three sides are different in measure is called:

(a)   an equilateral triangle   (b) an isosceles triangle

(c)   an acute angled triangle   (d) a scalene triangle

ix. An angle greater than 90º and less than 180º is known as:

(a)   an acute angle   (b)   an obtuse angle

(c)   a right angle   (d)   a reflex angle

x. A triangle whose two sides are equal in length is called:

(a)   an equilateral triangle   (b)   an acute angled triangle

(c)   an isosceles triangle   (d)   a scalene triangle

2.   Draw the following:

(i)   An acute angle   (ii)   An obtuse angle

(iii) A reflex angle   (iv)   A straight angle
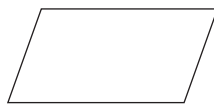
(v)   A right angle

3.   Define the following:

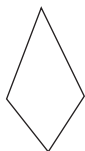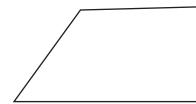(i)   An equilateral triangle   (ii)   A scalene triangle

(iii) An isosceles triangle   (iv)   An acute angle triangle

(v)   An obtuse angled triangle   (vi)   A right angled triangle

4.   Construct a square whose measure of one of its sides is 2.5cm.

5.   Construct a rectangle whose length is 4cm and width is 3cm.

6   Recognize and write the name under each figure given below.

Summary

- An angle is formed by two distinct rays with the same endpoint.
- The angle whose measure is less than 90º is an acute angle.
- The angle whose measure is equal to 90º is a right angle.
- The angle whose measure is greater than 90º and less than 180º is an obtuse angle.
- An angle formed by two adjacent right angles is a straight angle.
- An angle which is greater than 180º and less than 360º is reflex angle.
- A triangle whose all three sides are equal is an equilateral triangle
- A triangle whose measures of any two sides are equal is an isosceles triangle.
- A triangle whose all sides are of different lengths is a scalene triangle.
- An acute angled triangle is a triangle whose all three angles are acute.
- An obtuse angled triangle is a triangle having one obtuse angle.
- A triangle having one angle 90º is a right angled triangle.
- A closed plane figure with four sides or edges is a quadrilateral.
- Different kinds of quadrilateral are:

(i)	square	(ii)	rectangle
(iii)	kite	(iv)	parallelogram
(v)	rhombus	(vi)	trapezium