



- Types of triangles
- Construction of a triangle
- Congruence of objects
- Congruence of triangles
- Similarity of objects
- Similarity of triangles

13.1 Introduction :

You have been aware in the reference of geometric concept of shapes such as rectangles, squares, circles, triangles, etc. formed by rotating pencil around the faces of solid. Let us learn about triangle in detail.

13.2 Triangle :

As you see in the figure, ABC is a triangle, with three sides $\overline{AB}$, $\overline{BC}$ and $\overline{CA}$, three vertices A, B and C and three angles $\angle ABC$, $\angle BCA$ and $\angle CAB$. Thus, we can say that a triangle is a closed simple figure bounded by three line segments, which has three vertices, three sides and three angles. It is represented by the symbol ' Δ '.

Observe to the adjacent figures and classify them based on the length of its sides.

In fig (i), we observed that the two sides of this triangle are equal therefore this type of triangle is called **isosceles triangle**.

Observe fig (ii) and conclude. In this triangle all three sides are equals, hence it is called an **equilateral triangle**.

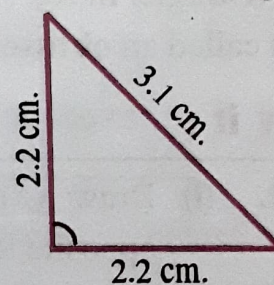
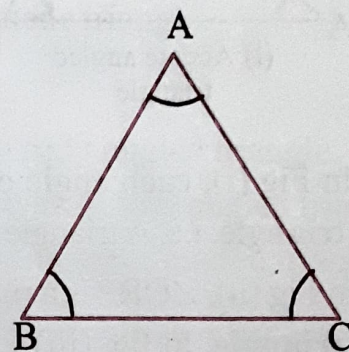


Fig. (i)

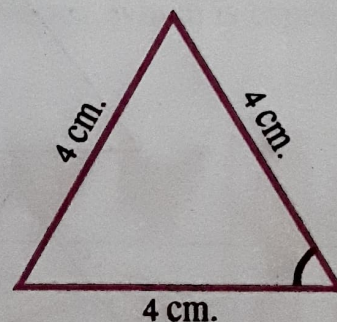


Fig. (ii)

Consider the fig (iii), there is no equality among the length of the sides of the triangle therefore this type of triangle is called **scalene triangle**.

Here, we have observe that, on the basis of sides there are three types of triangle : You have studied the angle and its types. Now we will describe the classification of triangles on the basis of angles. Let us understand with the help of following diagrams:

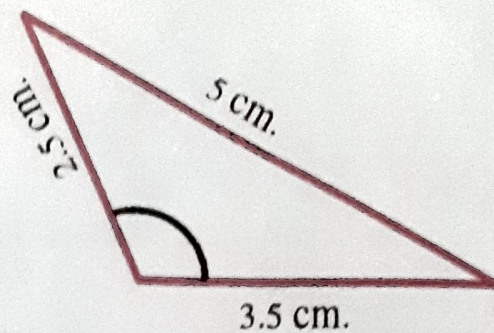
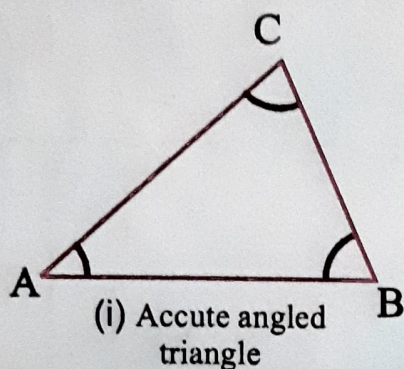
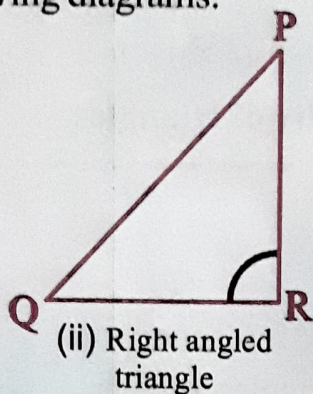


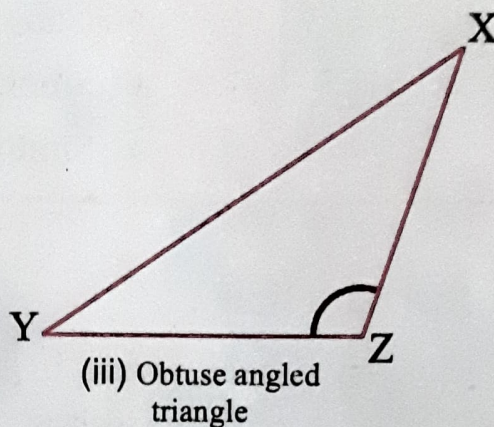
Fig. (iii)



(i) Acute angled triangle



(ii) Right angled triangle



(iii) Obtuse angled triangle

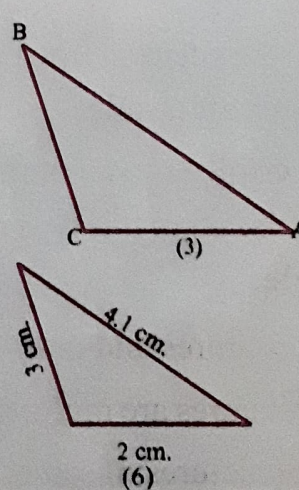
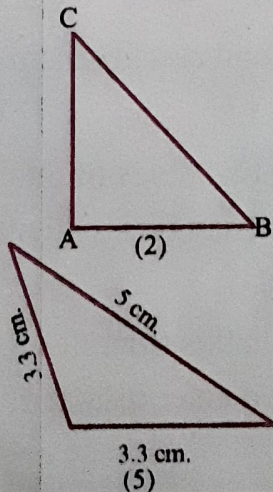
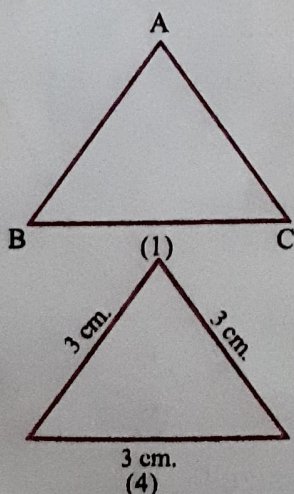
In Fig (i), each angle of $\triangle ABC$ is acute angle. This type of triangle is called **acute-angled triangle**. i.e. A triangle whose every angle is acute angle is called Acute angled triangle.

In Fig (ii), $\angle QRP$ is a right angle. A triangle whose one angle is right angle is called **right angled triangle**. In fig. (iii) $\angle XZY$ is an obtuse angle. A triangle whose one angle is obtuse angle is called an **obtuse angled triangle**.

Try it :

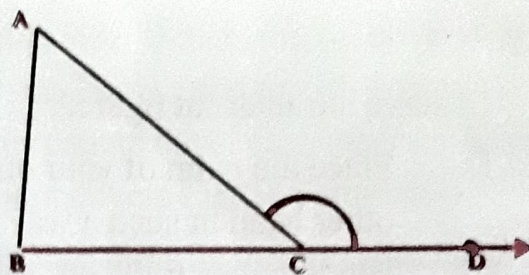
- (i) Draw $\triangle ABC$ and write the names of its components. (ii) Write the side opposite to $\angle A$. (iii) Write the angle in front of side AC.

- Classify the following triangles:



Think and do it :

Let us know about other angles of a triangle. Observe the $\angle ACD$, formed at vertex C by extending the side BC. This angle lies in exterior region of the $\triangle ABC$. This is called the exterior angle of $\triangle ABC$ formed at vertex C.



It is clear that $\angle BCA$ and $\angle ACD$ are adjacent angles. Similarly, we can construct exterior angles at vertices A and B by extending sides CA and AB respectively.

Conclusion:

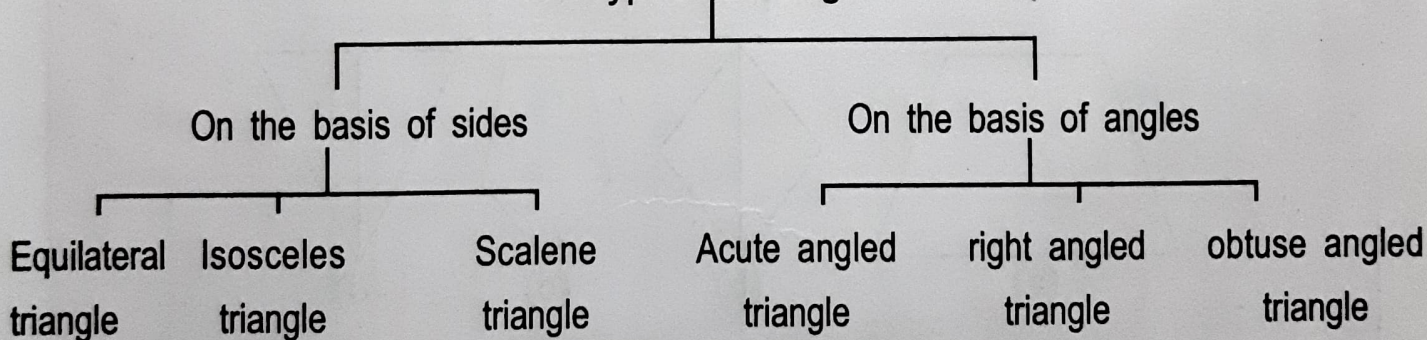
Types of triangles on the basis of sides-

- A triangle, whose all sides are equal is called an equilateral triangle.
- A triangle, whose two sides are equal is called an isosceles triangle.
- A triangle, whose all sides are distinct is called a scalene triangle.

Types of triangles on the basis of angles-

- A triangle, whose one angle is right angle, is called a right angled triangle.
- A triangle, whose one angle is obtuse angle, is called an obtuse angled triangle.
- A triangle, whose each angle is acute angle, is called an acute angled triangle.

Types of triangle



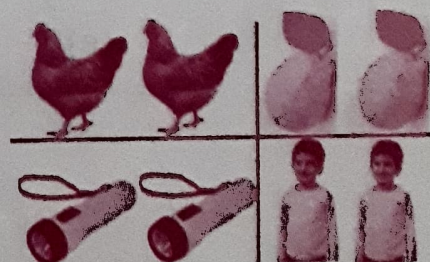
You have observed and constructed various geometric figures. In this unit you are going to learn the most important geometrical concept known as congruency, which is especially related with the congruency of triangles.

Congruency (Congruency of plane and shapes)

Try it :

Observe the figures and describe—

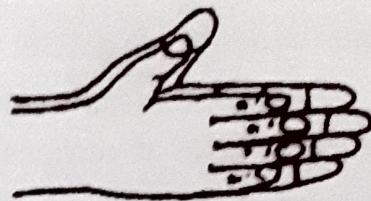
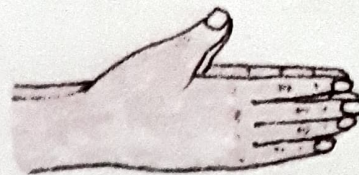
- Which figures are mutually equal in shape?
- Are the pictures of same shape, also similar in size?



Do it :

Observe the adjacent figure:

1. Place the palm of your one hand on the palm of other hand in such a way that the palms of both hands come fully on each other. Is one palm covered fully by another palm?
2. Place your palm on the palm of your other classmate and observe your palm is fully covered to other's palm or not.



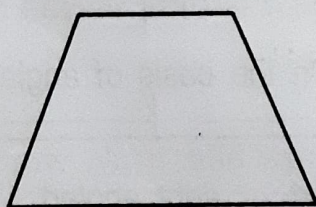
We can observe that palm of your hand does not fully cover the palm of your classmate, while with the palm of one hand, the palm of other hand is fully covered. What is its reason?

The shape and sizes of both palms of the same learner are same, so they cover each other completely.

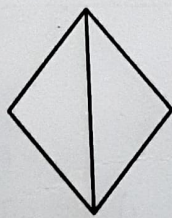
The palms of the two pupils are same in shapes, but different in sizes. So, they do not cover each other completely.

Do it :

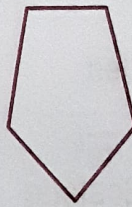
- Observe the following figures carefully and draw them on tracing paper and cut each picture separately and place it on each other.



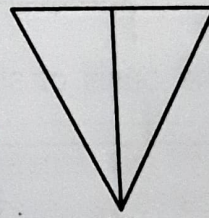
(a)



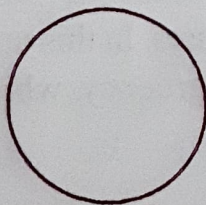
(b)



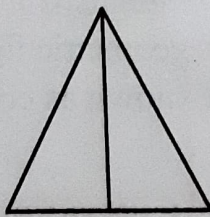
(c)



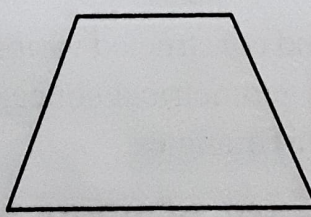
(d)



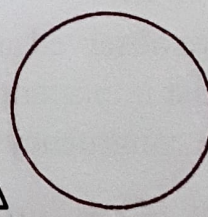
(e)



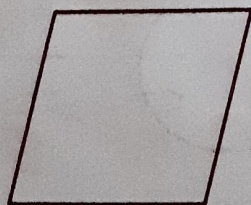
(f)



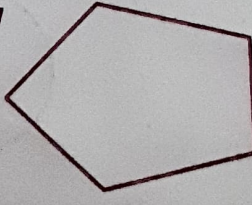
(g)



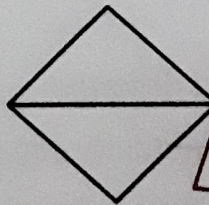
(h)



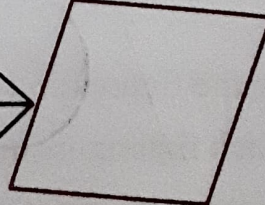
(i)



(j)



(k)



(l)

We see that Fig (a) and Fig (g) are same shape and size. Hence, Fig (a) covers Fig (g) completely when placed above it. Similarly, Fig (e) covers Fig (h) and Fig (d) covers Fig (f), completely. Fig (c) and Fig (j) seems to be same, but they cannot cover each other completely. Similarly, Fig (b) cannot covers Fig (k) and Fig (i) cannot covers Fig (l), completely.

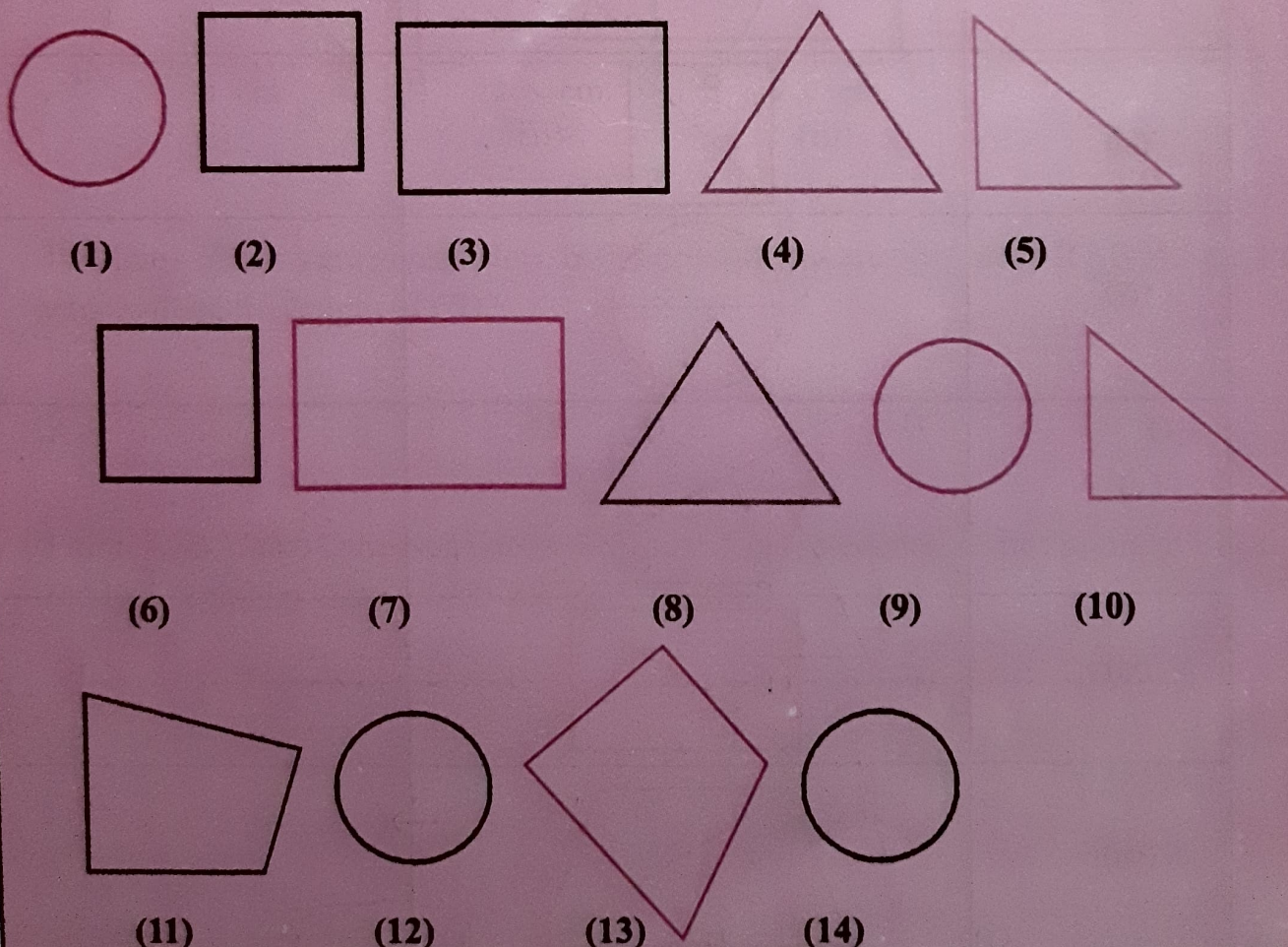
- When two figures cover each other completely, then these figures are called congruent.
- Symbol $\cong$ is read as “congruent”.

Pay Attention

- Two lines are congruent, if their lengths are same.
- If the measurements of two angles are same, so they are congruent.
- Two circles are congruent, if their radii are same.
- Those figures, whose shape and size are same, are congruent.

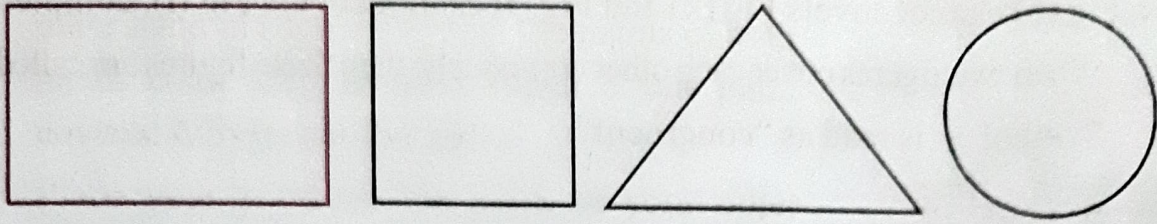
Try it :

The serial numbers of some figure are given. Sort out and write the serial numbers of congruent figures.



EXERCISE 13 (a)

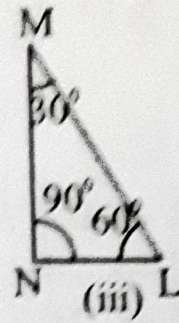
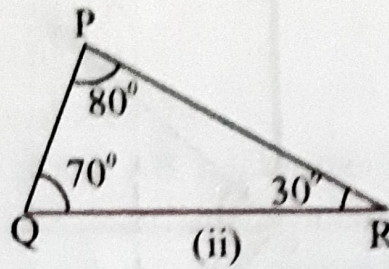
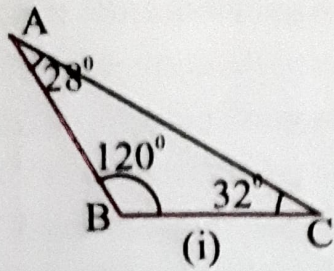
1. Cut the following figures, Fold each into two parts as that both parts are congruent to each other.



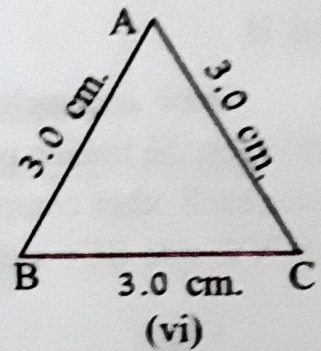
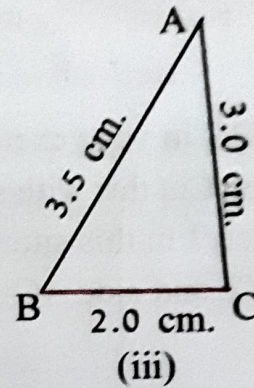
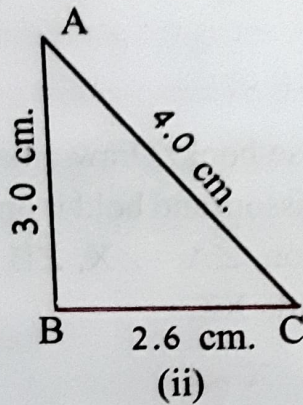
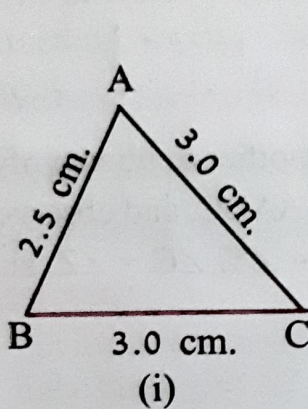
2. If the figures given below are folded along the dotted lines, then both parts of each are congruent or not ? Write answer on your exercise book yes or no in front of each.

S. No.	Figure	Yes/No
(i)		
(ii)		
(iii)		
(iv)		
(v)		
(vi)		
(vii)		

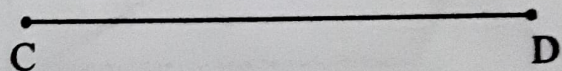
3. Classify the following triangles on the basis of their angles.



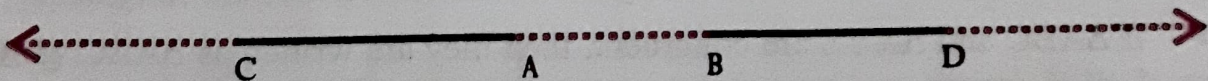
4. Classify the following triangles on the basis of their sides.



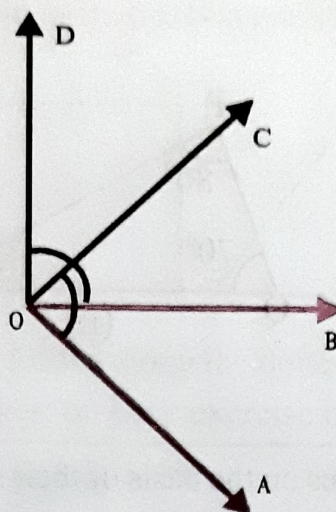
5. Two line segments are given below, both line segments are congruent. If $AB = 4.5$ cm then what will be the length of CD ?



6. Points A, B, C and D lie on a line in the figure. Line segment $CA =$ line segment BD , then the line segments CB and AD are equal or not ?



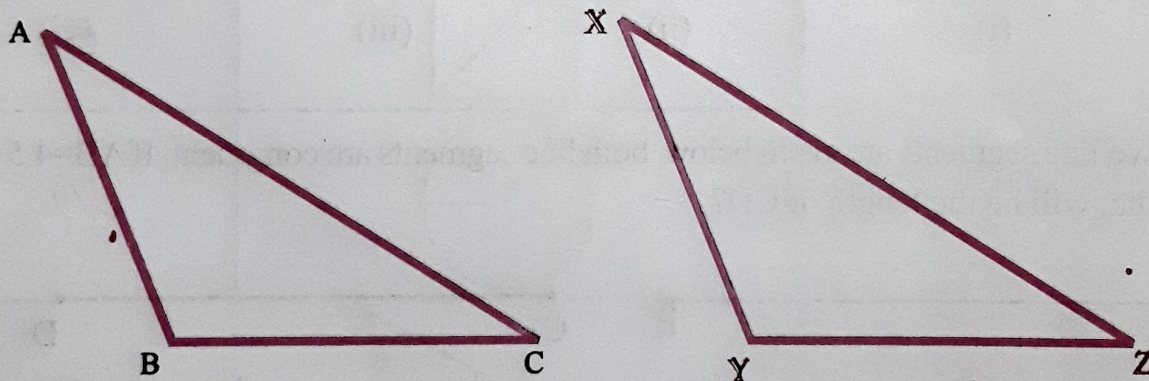
7. In the following figure, $\angle AOB = \angle COD$, then $\angle AOC = \angle BOD$?



13.3 Congruence of triangles

Do it :

Draw a triangle ABC in your exercise book. Draw an another duplicate of triangle $\triangle XYZ$ on the tracing paper. Cut this with scissors and hold it on $\triangle ABC$, and observe, is they cover each other completely? In this situation, $\angle A = \angle X$, $\angle B = \angle Y$, $\angle C = \angle Z$, side $AB =$ side XY , side $BC =$ side YZ and side $AC =$ side XZ .



We see that both figures are same in shape and size. These triangles are congruent to each other.

- If the shape and size of two triangles are same, then they are congruent.
- If $\triangle ABC$ and $\triangle XYZ$ are congruent, then they are written as $\triangle ABC \cong \triangle XYZ$.
- Those vertices, angles and sides, which covers each other completely, are called corresponding vertices, corresponding angles, corresponding sides respectively.

Describe, corresponding vertices, corresponding angles, corresponding sides of $\triangle ABC$ and $\triangle XYZ$ in the above figure.

The X is corresponding vertex of vertex A, it is written as $A \leftrightarrow X$

The Y is corresponding vertex of vertex B, it is written as $B \leftrightarrow Y$

The Z is corresponding vertex of vertex C, it is written as $C \leftrightarrow Z$

The $\angle X$ is corresponding angle of $\angle A$.

The $\angle Y$ is corresponding angle of $\angle B$.

The $\angle Z$ is corresponding angle of $\angle C$.

The XY is corresponding side of side AB, it is written as $AB \leftrightarrow XY$

The YZ is corresponding side of side BC, it is written as $BC \leftrightarrow YZ$

The XZ is corresponding side of side AC, it is written as $AC \leftrightarrow XZ$

We observe that :

If $\triangle ABC \cong \triangle XYZ$, then their corresponding angles and corresponding sides are equal.

The method of cutting a figure and putting it on another figure is called superposition. By this method, we can examine the congruency of given pictures.

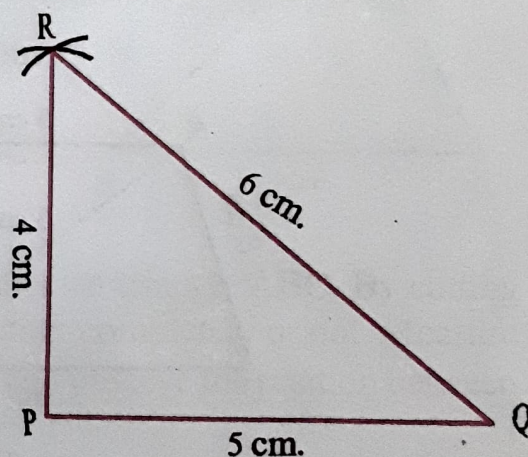
We have known about triangle and its part in this unit.

Construction of a triangle whose all three sides are given (SSS)

Construct a triangle PQR whose sides $PQ = 5$ cm, $QR = 6$ cm, $RP = 4$ cm.

Construction:

- Draw a line segment $PQ = 5$ cm.
- Take the length $QR = 6$ cm with the compass.
- Put the tip of the needle of the compass at the point Q of side PQ and draw an arc of 6 cm radius.
- Similarly, take the length $RP = 4$ cm with the compass.
- Mark an arc at Point P on side PQ by putting the needle of the compass.
- Where both the arc intersect each other, that point is denoted by R.
- Join point R with point Q and point P. This is the required triangle PQR.

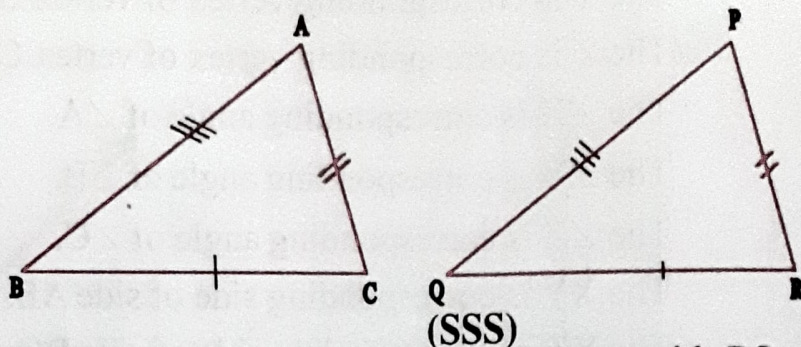


Verification of congruency

Activity:

Draw another triangle ABC by putting a tracing paper on triangle PQR. Now cut both triangles $\triangle PQR$ and $\triangle ABC$ put them over each other and observe that they cover each other completely or not. Measure, the sides of $\triangle ABC$ and observe the relation between the sides of both triangles.

- Draw $\triangle ABC$ in a paper in which $AB=5$ cm, $BC=6.0$ cm, and $CA=3$ cm.
- Draw another triangle $\triangle PQR$, in which $PQ=5$ cm, $QR=6.0$ cm, and $RP=3$ cm.
- Cut out the triangles.



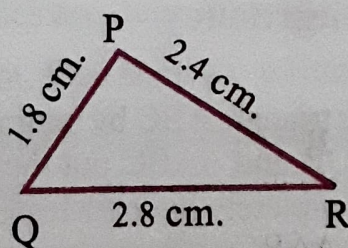
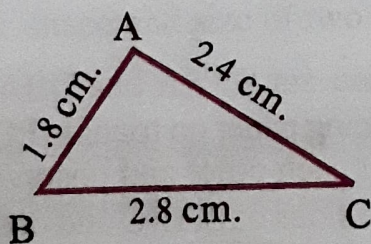
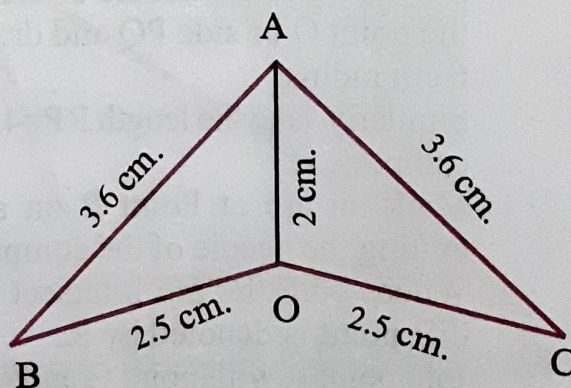
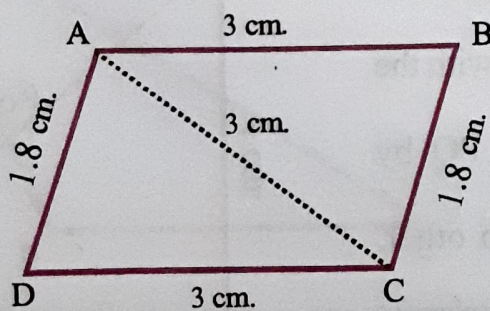
- Place one triangle on another triangle in such a way that side AB lies on side PQ , side BC lies on side QR , side CA lies on side RP .
- Does one triangle cover the other triangle completely?

If the triangles cover each other completely, then the triangles are called congruent.

If all three sides of a triangle are equal to the corresponding sides of another triangle, then both triangles are congruent. This is called side-side-side congruence or, in short, SSS congruence.

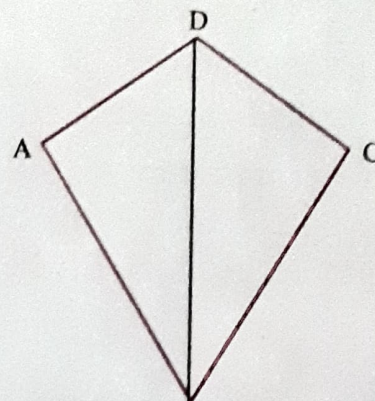
EXERCISE 13 (b)

1. Draw a triangle ABC , where $AB=6$ cm, $BC=8$ cm, $AC=4$ cm.
2. The measures of sides of the pairs of triangles are mentioned in the following figures. Tell, by using side-side-side congruence relation, which triangle is congruent to which triangle. Write your answer in symbolic language.



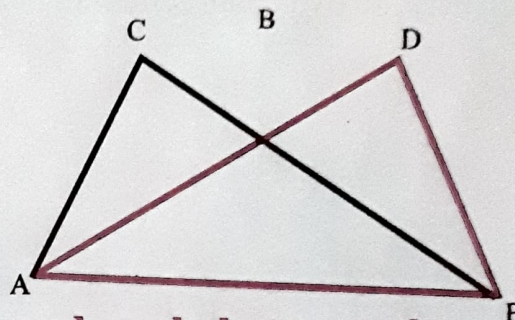
3. In the adjacent figure, $AD = DC$ and $AB = BC$

- Is $\triangle ABD \cong \triangle CBD$?
- If $\triangle ABD \cong \triangle CBD$, then write the corresponding angles and corresponding sides of them.



4. In the adjacent figure, $\triangle ABC$ and $\triangle ABD$ are the triangles drawn on same base AB . $AC = BD$ and $BC = AD$. Which of the following statement is true/false?

- $\triangle ABC \cong \triangle ABD$
- $\triangle ABC \cong \triangle ADB$
- $\triangle ABC \cong \triangle BAD$

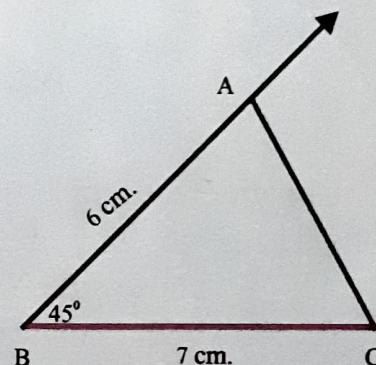


13.5 Construction of a triangle if two sides and angle between them are known (SAS)

Construct a triangle ABC , whose side $AB = 6$ cm, side $BC = 7$ cm and $\angle B = 45^\circ$.

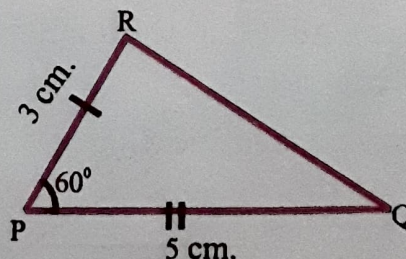
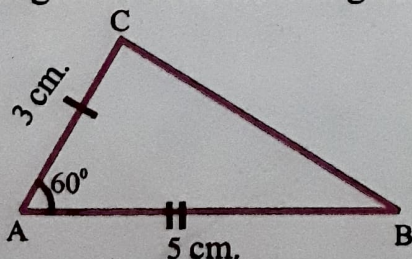
Construction:

- Draw a line segment BC of length 7 cm.
- Draw a ray making an angle of 45° at point B , with the help of protractor.
- Mark point A in this ray at a distance of 6 cm from point B .
- Join points A and C . This is the required $\triangle ABC$.



Verification of congruence:

Make another triangle PQR by putting a tracing paper on triangle ABC . By cutting $\triangle PQR$, put it on $\triangle ABC$ and observe that they cover each other completely or not. Measure the sides and angle between them of second triangle $\triangle PQR$ and observe the relation between the sides and angles of both the triangles.



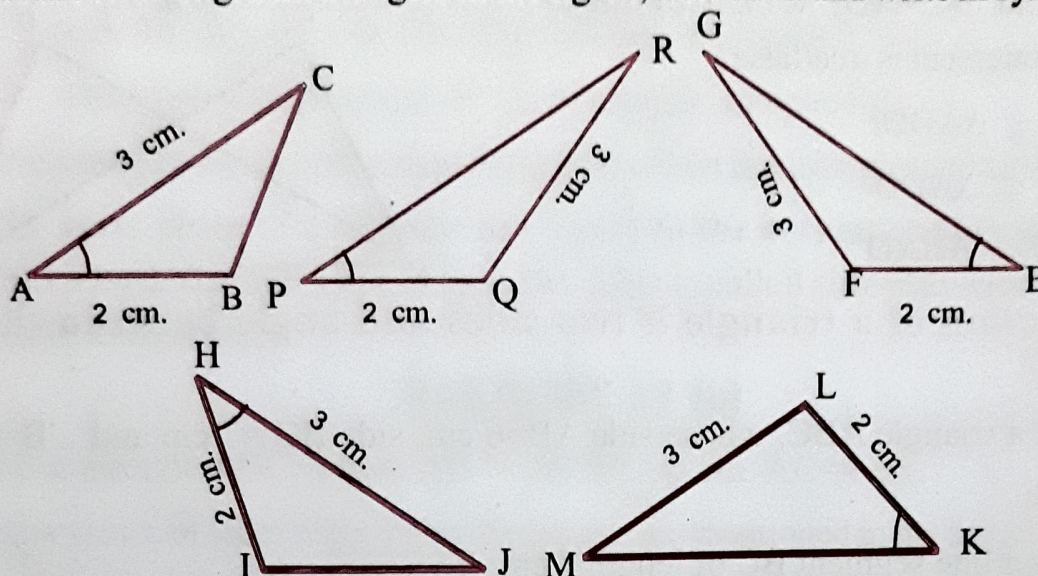
- Construct a $\triangle ABC$, whose side $AB = 3.0$ cm, side $AC = 5.0$ cm and $\angle A = 60^\circ$.
- Construct another triangle PQR , whose side $PQ = 5$ cm, side $PR = 3$ cm and $\angle P = 60^\circ$.

- Cut the triangles and put over each other. Does one triangle cover the other triangle completely? If the triangles cover each other completely, then both triangles are called congruent.

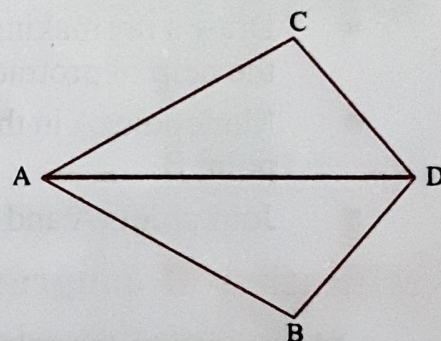
If two corresponding sides of two triangles and the corresponding angle between them are equal, then both triangles are congruent. This is called side-angle-side congruence or, in short, SAS congruence.

EXERCISE 13 (c)

1. There are two congruent triangles in the figure, Sort out it and write in symbolic language.



2. Construct a triangle $\triangle ABC$, in which side $AB=6$ cm, side $AC=6$ cm and $\angle A = 90^\circ$. Construct a triangle $\triangle XYZ$, whose side $XY=6$ cm, $\angle X = 90^\circ$ and $\angle Y = 45^\circ$. Are both triangles congruent?
3. In the adjacent figure, $AB=AC$ and $\angle DAB = \angle CAD$, then $\triangle ABD$ and $\triangle ADC$ congruent? If yes, why?
4. Construct a $\triangle ABC$, in which side $AC=4.5$ cm, side $BC=6$ cm and $\angle C = 60^\circ$.

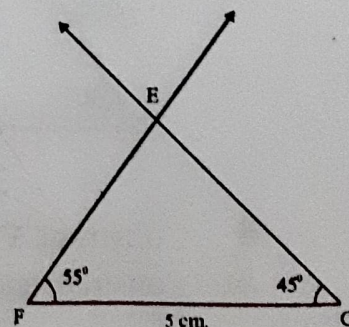


13.6 :Construction of a triangle when two angles and corresponding side containing them are known (ASA)

Construct a $\triangle EFG$, in which $FG = 5$ cm, $\angle F = 55^\circ$ and $\angle G = 45^\circ$.

Construction:

- Draw a line segment FG of length 5 cm.
- Draw a ray with the help of protractor making an angle of 55° from point F .
- Draw another ray making an angle of 45° from point G .
- Both rays intersect each other at point E .
- $\triangle EFG$ is the required triangle.

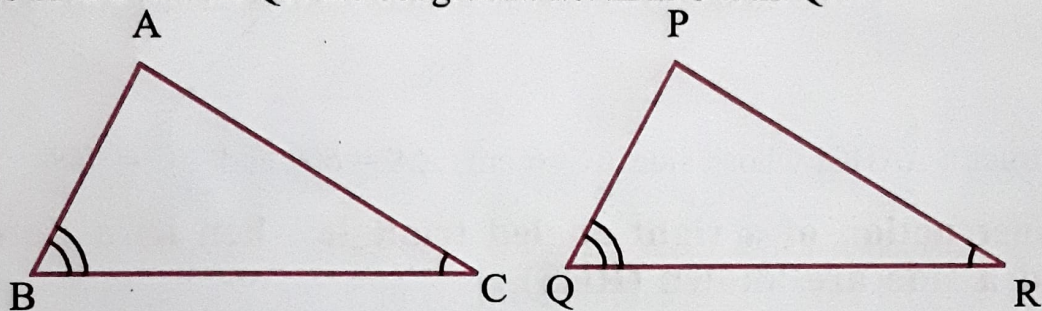


Verification of congruence:

Activity :

Draw another triangle ABC by putting a tracing paper on triangle EFG. Cut and put both triangles $\triangle EFG$ and $\triangle ABC$ over each other and observe that they cover each other completely? Measure to side BC and angles $\angle B$ and $\angle C$ of the second triangle ABC and observe what is the relation between the sides FG and BC, angles $\angle F$ and $\angle B$, $\angle B$ and $\angle C$ of both triangles?

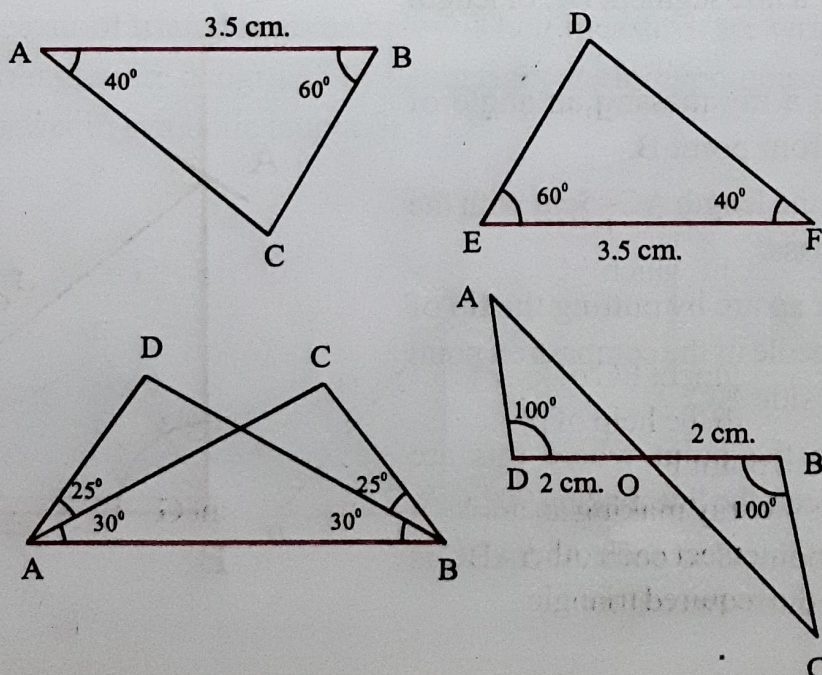
● Construct a $\triangle ABC$, whose side $BC=5.0$ cm, $\angle B = 45^\circ$ and $\angle C = 30^\circ$, construct another triangle PQR, whose side $QR = 5.0$ cm, $\angle Q = 45^\circ$ and $\angle R = 30^\circ$. Cut the triangle ABC and put over $\triangle PQR$. If triangle $\triangle ABC$ covers the other triangle PQR completely, then the triangles $\triangle ABC$ and $\triangle PQR$ are congruent. i.e. $\triangle ABC \cong \triangle PQR$



If two angles and a side of a triangle are equal to, two angles and corresponding sides of another triangle, then both triangles are congruent. This is called angle-side-angle congruency or, in short, ASA congruency.

Exercise 13 (d)

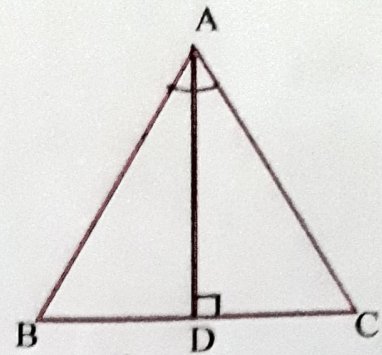
1. Which triangle is congruent to which triangle in the following triangles?



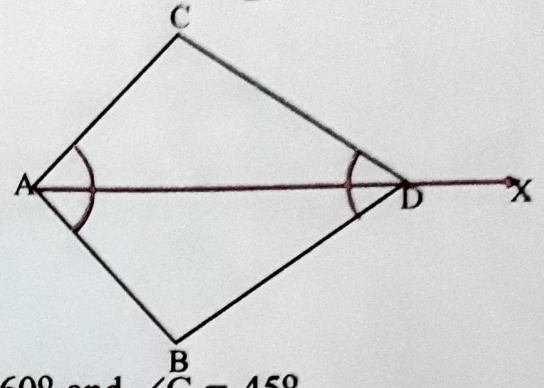
2. AD is a bisector of $\angle A$ in the figure and $AD \perp BC$

(i) Is $\triangle ABD \cong \triangle ADC$?

(ii) Is it correct to say $BD=DC$?



3. Line AX bisects the angles $\angle CAB$ and $\angle BDC$ in the figure. Describe the three facts which proves that $\triangle ABD \cong \triangle ACD$



4. Construct a $\triangle ABC$, whose side $AC=6$ cm, $\angle A = 60^\circ$ and $\angle C = 45^\circ$

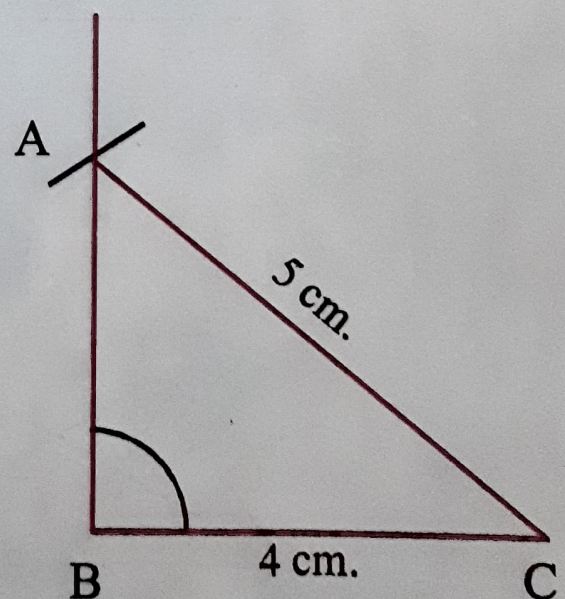
13.7 Construction of a right angled triangle when its hypotenuse and a side are known (RHS) :

Do it :

Construct a right angled $\triangle ABC$, whose side $BC=4$ cm, hypotenuse $AC=5$ cm and $\angle B = 90^\circ$.

Construction:

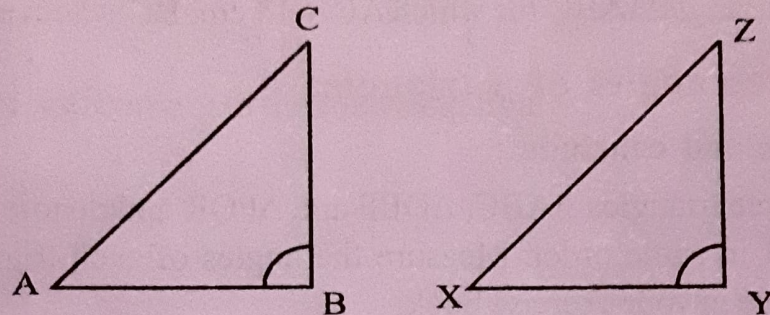
- Draw a line segment BC of length 4 cm.
- Draw a ray making an angle of 90° from point B.
- Take the length $AC=5$ cm with the compass.
- Mark an arc by putting the tip of the needle of the compass on point C of side BC.
- Write the point where this arc intersects the line making 90° as A.
- Join point C to point A. $\triangle ABC$ is the required triangle.



Verification of congruence:

Try it

- Draw a triangle $\triangle ABC$. Draw another triangle $\triangle XYZ$ by putting a tracing paper on triangle $\triangle ABC$. Cut the $\triangle XYZ$ and put it over $\triangle ABC$ and observe whether they cover each other completely? Measure the sides of both triangles and observe the relation between the sides of the triangles.

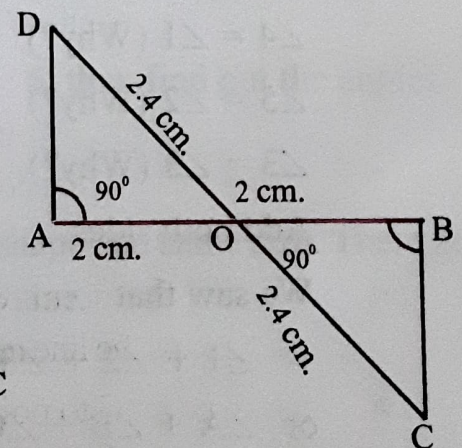
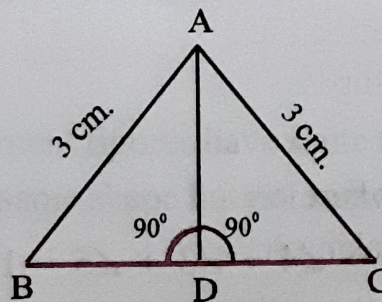
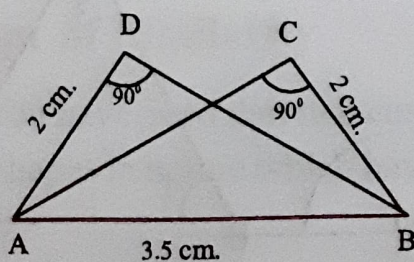


- Construct a right angled $\triangle ABC$, in which hypotenuse $AC=7$ cm, $\angle B = 90^\circ$ and side $AB=4$ cm, construct another triangle $\triangle XYZ$, in which hypotenuse $XZ=7$ cm, $ZY = 4$ cm and $\angle Y = 90^\circ$. Prove the congruence of these triangles.

If the hypotenuse and a side of a right angled triangle are equal to the hypotenuse and a side of another right angled triangle, then both triangles are congruent. This is called right angle-hypotenuse-side congruency or, in short, RHS congruency.

Exercise 13 (e)

1. There is some pair of triangles given below. Their measures are written with the sides. Find which triangles are congruent by using right angle-hypotenuse-side congruence? Write your answer in symbolic language.



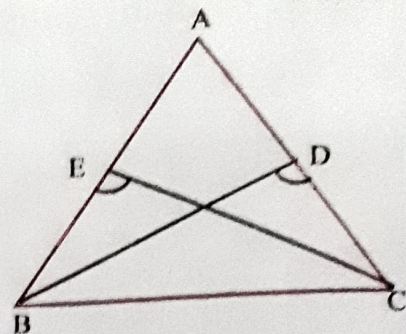
2. BD and CE are the perpendiculars, drawn on sides AC and AB of the triangle $\triangle ABC$ respectively and $BD = CE$.

(i) Is $\triangle DBC \cong \triangle ECB$?

(ii) What will be the relation between sides EB and CD?

3. Write the condition in your exercise book under which two right angled triangles are congruent.

4. Construct a triangle $\triangle ABC$ for which $AC = 13$ cm, $BC = 5$ cm and $\angle B$ is a right angle.



Sum of all three angles of a triangle:

- Do these and conclude :

Draw any three triangles $\triangle ABC$, $\triangle DEF$ and $\triangle PQR$ and denote the angles of it by $\angle 1$, $\angle 2$, and $\angle 3$ in same order. Measure the angles of each triangle and complete the following table in your exercise book.

Triangle	Name of angles			Total
	$\angle 1$	$\angle 2$	$\angle 3$	$\angle 1 + \angle 2 + \angle 3$
$\triangle ABC$				
$\triangle DEF$				
$\triangle PQR$				

Conclusion:

We see that the sum of all three interior angles of a triangle is 180° .

The sum of all three interior angles of a triangle is 180, verify it as following :

- Draw a $\triangle ABC$. Draw $BC \parallel XY$ from point A.

Denote angles by 1, 2, 3, 4 and 5 as shown in the figure.

$$\angle 4 = \angle 1 \text{ (Why?)}$$

$$\angle 5 = \angle 2 \text{ (Why?)}$$

$$\angle 3 = \angle 3 \text{ (Why?)}$$

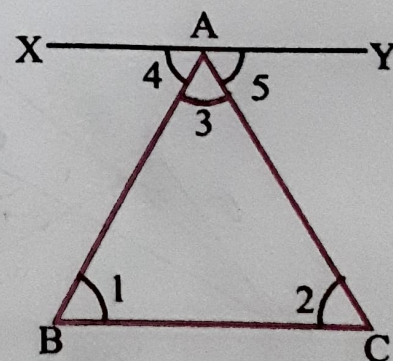
Add both sides.

We saw that

$$\angle 1 + \angle 2 + \angle 3 = \angle 4 + \angle 3 + \angle 5 = 180^\circ$$

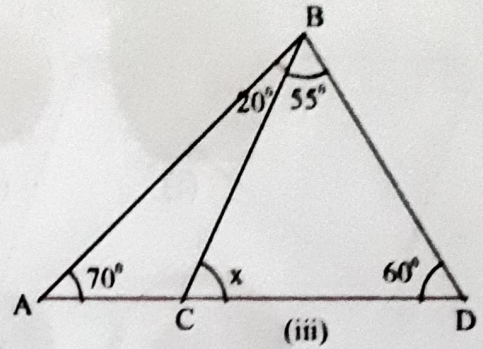
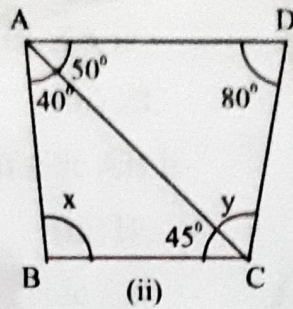
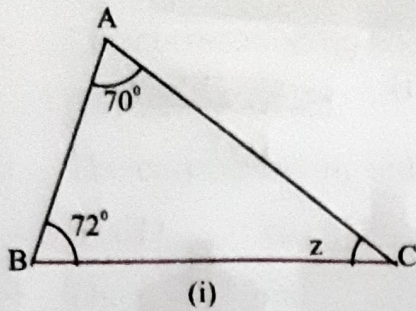
$$\text{or } \angle A + \angle B + \angle C = 180^\circ$$

The sum of all three interior angles of a triangle is 180° .

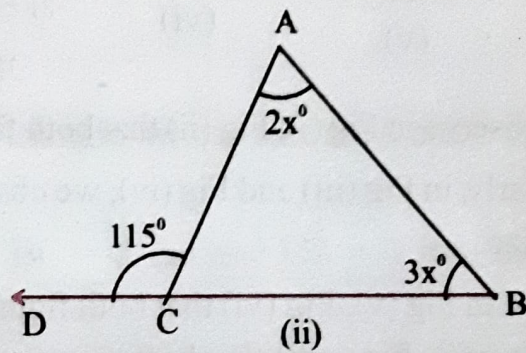
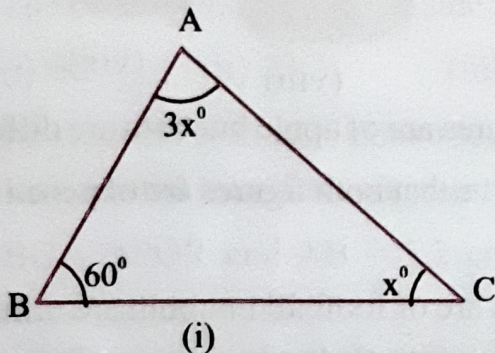


Exercise 13 (f)

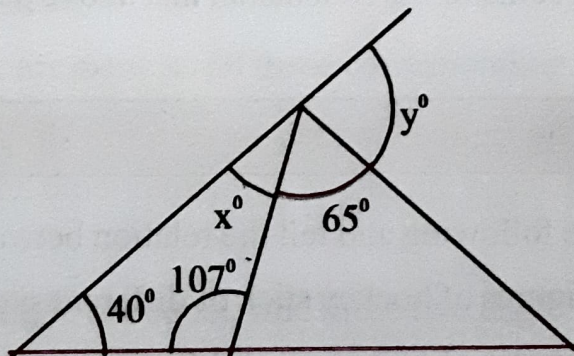
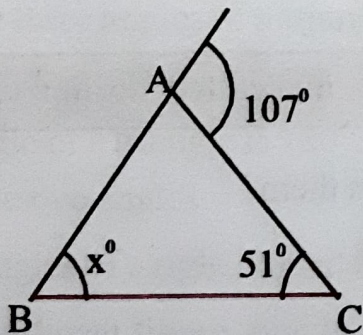
1. Find values of x , y , z in the following figures :



2. Find value of x according to the following figures:



3. Find values of x , y in the following figures:

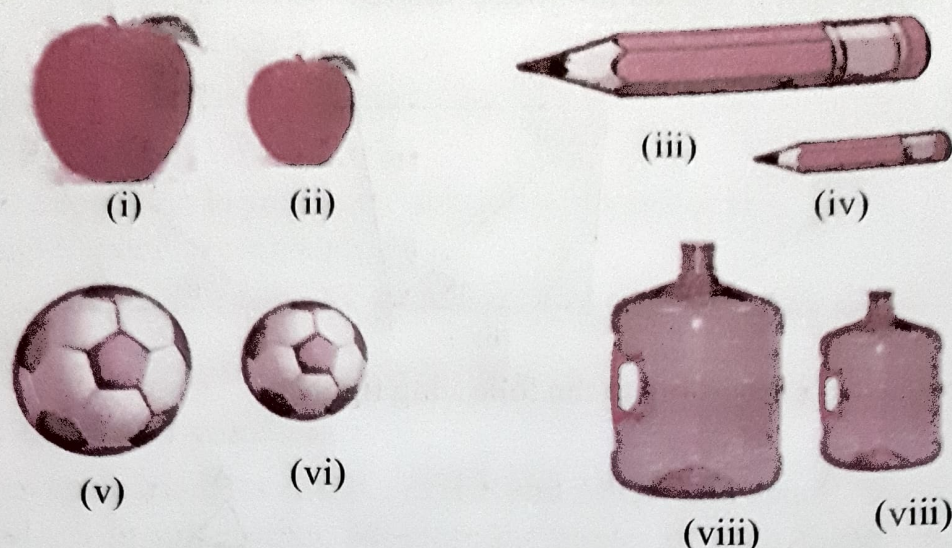


4. In $\triangle ABC$, $\angle B = 72^\circ$, $\angle C = 64^\circ$, find out $\angle A$.
 5. If the ratio among the angles of a triangle is $3 : 4 : 5$, then find out the angles.

Concept of Similarity

You have read that two congruent figures have same shape and same size. There are certain shapes in nature which have same shape but not same size.

Look carefully the following figures.



We observe in Fig (i), Fig (ii) that both figures are of apple but both are different in size.

Similarly, in Fig (iii) and Fig (iv), we observe that both figures are of pencil but both are different in size.

We see in Fig (v), Fig (vi) that both figures are of football but both are different in size.

We see in Fig (vii), Fig (viii) that both figures are of bottle but both are different in size.

Hence, we come to the conclusion that above pair of figures have same shape but have different sizes.

The figures, which have same shapes, are called similar shapes.

Look at the following and tell the relation between them?

1. Two figures of hockey stick of different size?
2. Two figures of some tree of different size?
3. We see that the shapes of all figures are same but are different in size.

Pay Attention

Two congruent figures are similar, but it is not necessary that similar figures are congruent.

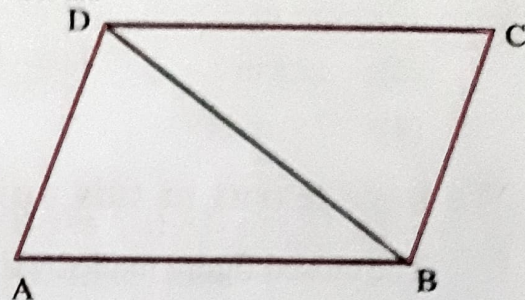
Try it:

Construct three equilateral triangles whose sides are 3 cm, 4 cm and 5 cm. Tell whether the three triangles are congruent or similar.

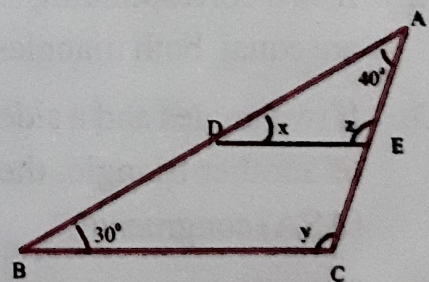
Efficiency Exercise 13

1. Choose the correct option and write on your exercise book, in the following objective question by observing the figure in which $\triangle ABD \cong \triangle CDB$:

- (i) The corresponding angle of $\angle A$ is –
 (i) $\angle A$ (ii) $\angle D$ (iii) $\angle C$
- (ii) The corresponding side of side AB is–
 (i) CD (ii) AD (iii) BC
- (iii) The corresponding side of side AD is–
 (i) CB (ii) CD (iii) BA
- (iv) The corresponding side of side DB is–
 (i) BD (ii) DC (iii) BC

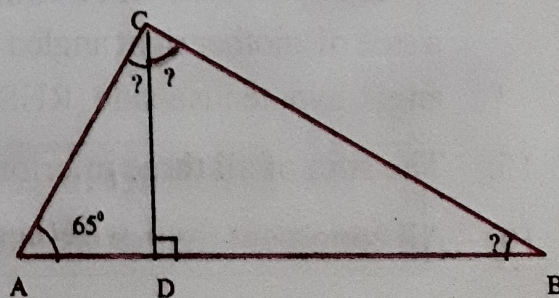


2. If all the students of class 6 construct a triangle, whose size are 4 cm, 5 cm and 6 cm, are all constructed triangles congruent?
3. If $\triangle ABC \cong \triangle PQR$ and $AB = 3.2$ cm, $BC = 5$ cm and $CA = 7$ cm, then write the measures of sides of $\triangle PQR$.
4. All the three sides of a triangle are same as all three corresponding sides of another triangle. Are both triangles congruent?
5. All the three angles of a triangle are same as all three corresponding angles of another triangle. Are both triangles always congruent?
6. An angle of a triangle is 130° , and other remaining angles are equal. Find the measures of these two angles.
7. Two angles of a right angled triangle are equal, find these two angles.
8. In the Adjcent figure, points D and E lie on the sides AB and AC of the triangle ABC such that $DE \parallel BC$, If $B = 30^\circ$, $A = 40^\circ$ then find the angles x, y, z .



9. In the adjacent figure, C is a right angle. $CD \perp AB$. $A = 65^\circ$, then find the following angles:

- (i) $\angle ACD$
 (ii) $\angle BCD$
 (iii) $\angle CBD$



Special Question: The area of a triangle is equal to that of a square whose side is 25 m. Find the length of the side of the triangle which lies at 10 m distance from the vertex:

- (1) 25 m
- (2) 55 m
- (3) 125 m
- (4) 75 m

[N.T.S. E. 2009]

Ans : (3) 125 m

We have learnt in this unit:

1. The closed figure made by line segments is called polygon.
2. The polygon made by three line segments, is called triangle.
3. A triangle is a polygon with minimum no. of sides.
4. When two figures cover each other completely, then they are called congruent.
5. The figures which have same shape and size are called congruent.
6. Two line segments are congruent, whose lengths are same.
7. If the measures of two angles are same, they are congruent.
8. If the shape and size of two triangles are same, they are congruent.
9. If $\triangle ABD$ and $\triangle XYZ$ are congruent, we write them as $\triangle ABD \cong \triangle XYZ$.
10. Those vertices, angles and sides of the congruent triangles, which covers each other completely, are called corresponding vertex, corresponding angles, corresponding sides respectively.
11. If all three sides of a triangle are equal to the corresponding sides of another triangle, both triangles are congruent. This is called side-side-side (SSS) congruency.
12. If two corresponding sides of two triangles and the corresponding angle between them are equal, both triangles are congruent. This is called side-angle-side (SAS) congruency.
13. If two angles and a side of a triangle are equal to the two angles and corresponding side of another triangle, then both triangles are congruent. This is called angle-side-angle (ASA) congruency.
14. If the hypotenuse and a side of a right angled triangle are equal to the hypotenuse and a side of another right angled triangle, then both triangles are congruent. This is called right angle-hypotenuse-side (RHS) congruency.
15. The sum of all three interior angles of a triangle is 180° .
16. All congruent figures are similar, but the similar figures need not to be congruent.

ANSWERS

Exercise 13 (a)

2. (i) Yes (ii) No (iii) Yes (iv) Yes (v) No (vi) Yes (vii) No
3. (i) Obtuse angle (ii) Acute angle (iii) Right angle
4. (i) Isosceles triangle (ii) scalene (iii) scalene (iv) Equilateral
5. $CD=4.5$ cm, 6. Yes, 7. Yes

Exercise 13 (b)

2. $\triangle ABC \cong \triangle CDA$, $\triangle AOB \cong \triangle AOC$, $\triangle ABC \cong \triangle PQR$ 3. (i) Yes (ii) $AD \leftrightarrow CD$, $AB \leftrightarrow CB$, $DB \leftrightarrow DB$, $\angle A \leftrightarrow \angle C$, $\angle CBD \leftrightarrow \angle ABD$, $\angle CDB \leftrightarrow \angle ADB$; 4. (iii) true

Exercise 13 (c)

1. $\triangle ABC \cong \triangle HIJ$, $\triangle PQR \cong \triangle EFG$ 2. Yes, 3. Yes

Exercise 13 (d)

1. $\triangle ABC \cong \triangle FED$, $\triangle ADB \cong \triangle BCA$, $\triangle ADO \cong \triangle CBO$ 2. (i) Yes, (ii) Yes, 3. $AB=AC$, $BD=CD$ and AD common.

Exercise 13 (e)

1. $\triangle ABC \cong \triangle BAD$, $\triangle ADB \cong \triangle ADC$, $\triangle AOD \cong \triangle BOC$; 2. Yes, are equal.

Exercise 13 (f)

1. (i) $z = 38^\circ$ (ii) $x = 95^\circ$, $y = 50^\circ$ (iii) $x = 65^\circ$
2. (i) $x = 30^\circ$ (ii) $x = 23^\circ$ 3. (i) $x = 50^\circ$ (ii) $x = 33^\circ$, $y = 82^\circ$
4. (i) 44° 5. 45° , 60° , 75°

Efficiency Exercise 13

1. (i) $\angle C$ (ii) side CD (iii) side BC (v) side BD . 2. Yes 3. $PQ=3.2$ cm, $QR=5$ cm, $PR=7$ cm 4. Yes 5. No 6. 25° , 25° 7. 45° 45° , 8. $x=30^\circ$, $y=z=110^\circ$ 9. (i) 25° (ii) 65° (iii) 25°

