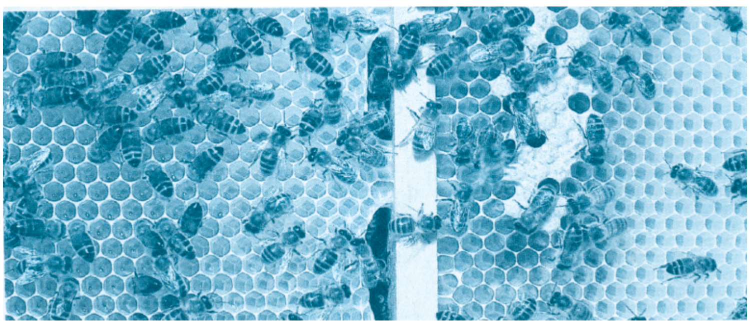
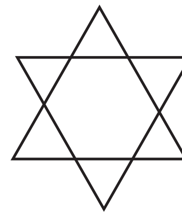
23 Rectilinear Plane Figures

By studying this chapter you will be able to get a good understanding of the

- ★ classification of triangles according to the sides.
- ★ classification of triangles according to the angles.
- ★ classification of polygons according to the shape.



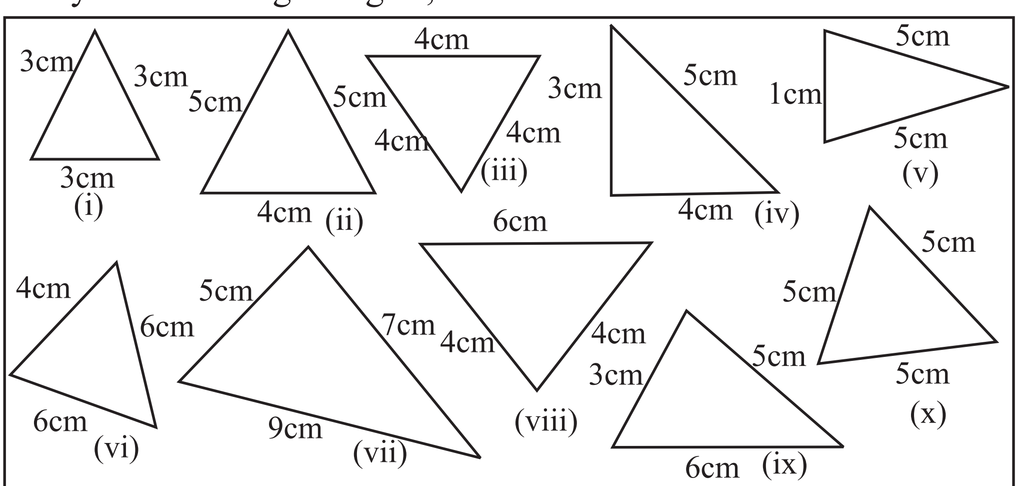


23.1 Classification of triangles according to the sides

You learned in Grade 6 that a closed plane figure made up of three straight line segments is a triangle. Similary, we know that these line segment are the sides of the triangle and the points at which the sides meet are the vertices of the triangle.

Activity 23.1

Study the following triangles, well.



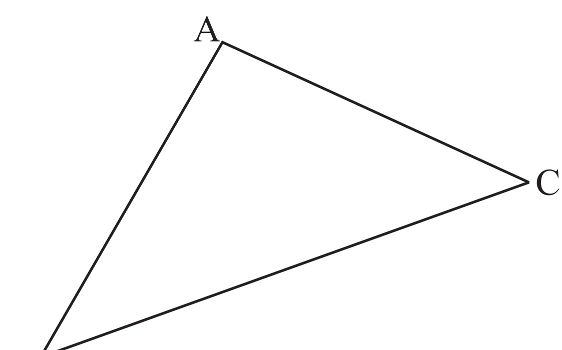
★ Considering the length of the sides of each triangle, separate the triangles on the page 83 into three groups indicating the relevant number of each triangle.

★ Discuss the characteristics of the triangles in each group.

★ Accordingly, propose a suitable name for each group.

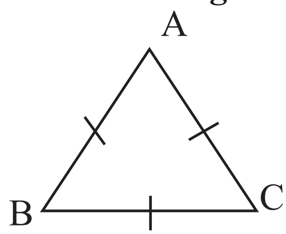
You would have discovered that the triangles (i), (iii) and (x) belong to one group, (ii), (v), (vi) , (viii) to another and(iv), (vii), (ix) to another according to the length of the sides. Now let us list the characteristics of the triangles in each group as follows.

Number of the triangle	Characteristics
(i) , (iii) and (x)	The three sides are equal in length.
(ii) , (v) , (vi) and (viii)	Only two sides are equal in length.
(iv) , (vii) , and (ix)	The three sides are different in length.



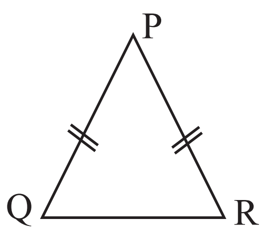
'A', 'B', and 'C' are vertices and AB, BC and CA are the sides of the above triangle. By measuring the sides AB, BC and CA, find to which group the triangle ABC belongs.

Triangles in which all three sides are equal in length are known as **equilateral triangles.**



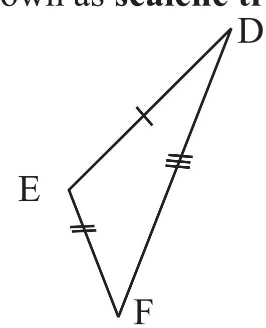
ABC is an equilateral triangle. It is shown in the figure that the three sides are equal.

Triangles in which only two sides are equal are known as **isosceles triangles.**



PQR is an isosceles triangle. It is shown in the figure that only the sides PQ and PR are equal in length and that the other side is of a different length.

Triangles in which all the three sides are unequal in length are known as **scalene triangles.**

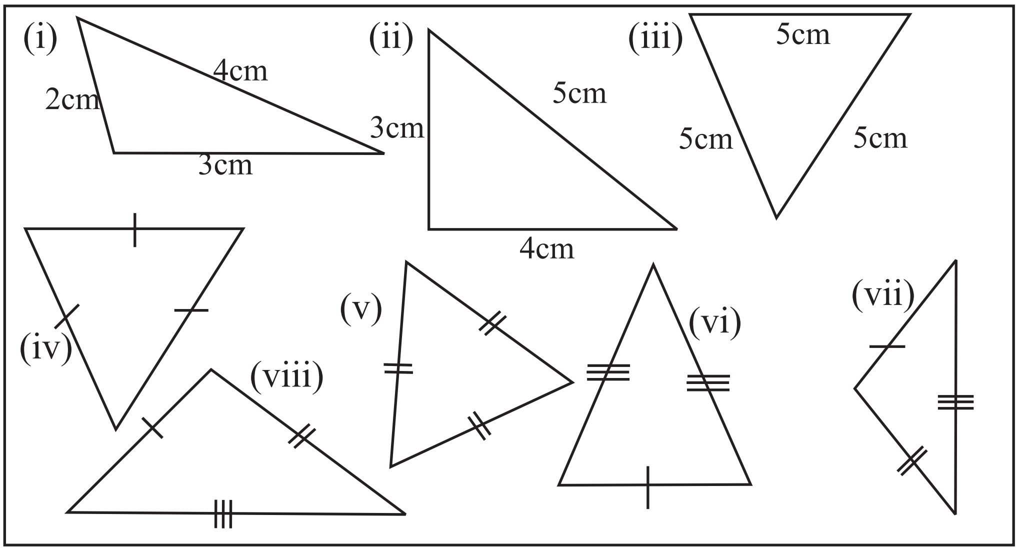


DEF is a scalene triangle. It is shown in the figure that the three sides of it are unequal.

- ★ If all three sides of a triangle are equal in length, that triangle is called an **equilateral triangle.**
- ★ If only two sides of a triangle are equal in length, that triangle is called an **isosceles triangle.**
- ★ If all three sides of a triangle are unequal in length that triangle is called a **scalene triangle.**

Exercise 23.1

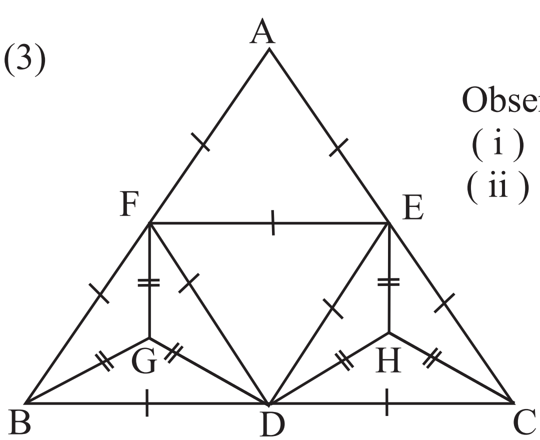
(1) Group the following triangles as equilateral triangles, isosceles triangles and scalene triangles based on the given data.



(2) The following are triangles of which the length of the three sides are given. Write in front of the measurements which type of a triangle it is.

(i) 5 cm , 2 cm , 4 cm
(ii) 8.5 cm , 7 cm , 4 cm
(iii) 4.5 cm , 4.5 cm , 3 cm
(iv) 6 cm , 7.5 cm , 8 cm
(v) 3.5 cm , 3.5 cm , 3.5 cm

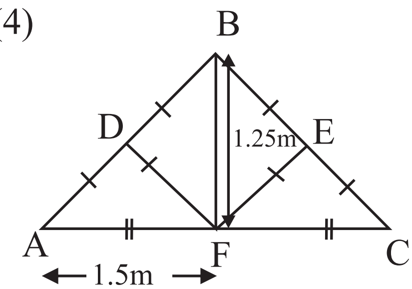
(3)



Observe the given figure and name,
(i) equilateral triangles.
(ii) isoscele triangles in this figure.

Name the equal sides in each triangle.

(4)



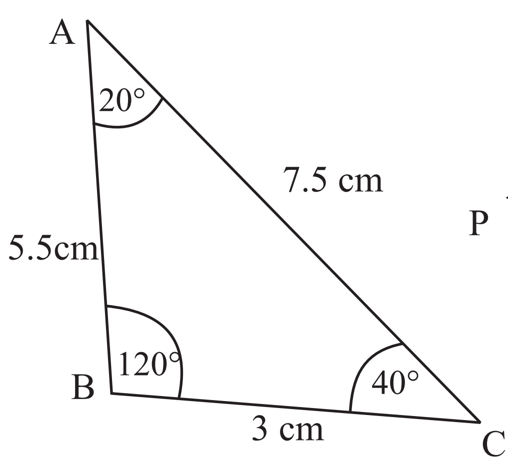
This is the figure of the cross section of the roof of a house supported by iron bars. In the triangle ABC, 'D', 'E' and 'F' are the midpoints of AB, BC and CA respectively.The length of EF is $\frac{2}{3}$ of the length CA. ADF and FEC are isosceles triangles. Considering the given information, find the total length of iron bars needed for this.

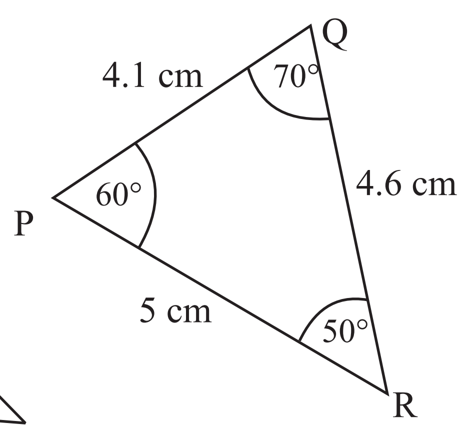
(5) List out the situations where triangular shapes can be seen in the environment. Mention to which type of triangle each belongs according to the sides.

(6) Construct a picture suitable for a wall decoration by using triangles, classified according to the sides.

23.2 Classification of triangles according to the angles

Pay attention to the measurements given in the following triangles.





Can they be classified into two groups if the lengths of the sides are considered? According to what you have learned so far both these triangles belong to the group of scalene triangles.

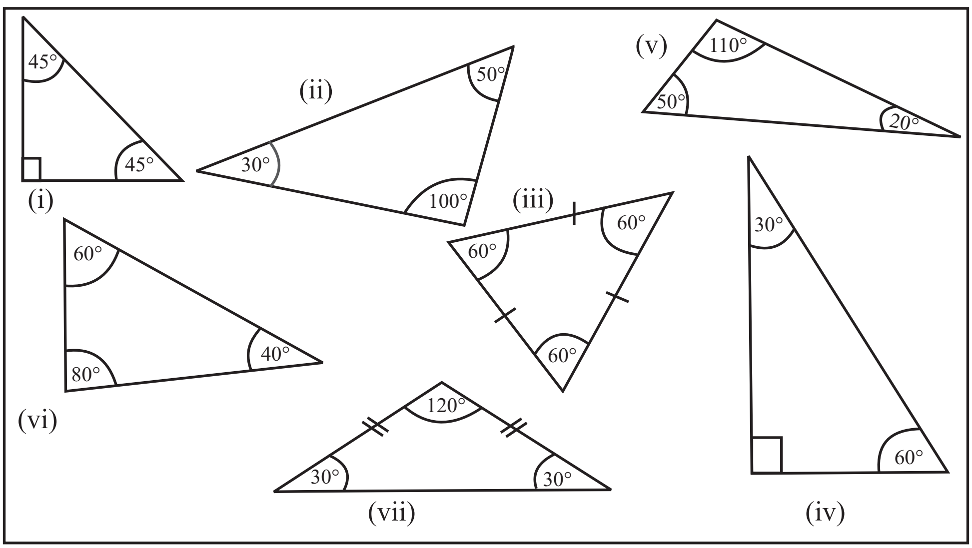
Now find out whether the triangles can be separated into two groups by considering the angles.

According to the figure on page 87 the magnitude of the angles of the triangle ABC are 120^0, 40^0 and 20^0 and the magnitude of the angles of the triangle PQR are 60^0, 70^0, and 50^0. Accordingly, it can be seen that triangle ABC has one angle greater than 90^0 and two angles of magnitude less than 90^0. But it is clear that in the triangle PQR all the three angles are of magnitude less than 90^0.

Activity 23.2

Now engage in this discovery.

Study the following triangles well.



★ Classify the triangles into three groups by considering the largest angle in each.

★ What can be said about the largest angle of a triangle in each group?

★ Propose a suitable name for each group.

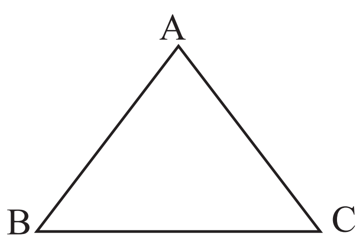
It is clear that according to the magnitude of the angles, triangles (i), (iv) can be separated into one group, (ii), (v), (vii) into another group and (iii) and (vi) into the other group.

Now let us tabulate the properties of the triangles in each group as follows.

Number of the triangle	Properties
(iii) and (vi)	The value of the largest angle is less than 90^0.
(i) and (iv)	Largest angle is 90^0.
(ii) , (v) and (vii)	Largest angle is greater than 90^0.

Let us find suitable names for each of the above groups, based on the properties mentioned.
Now we are going to group triangles according to the largest angle of the triangle.

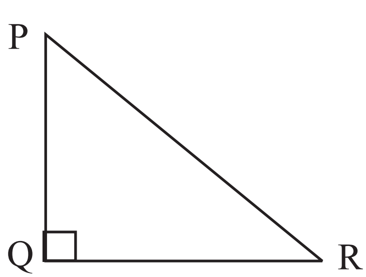
You have learned in Grade 6 that an angle less than 90^0 is an acute angle, an angle of 90^0 is right angle and an angle greater than 90^0 is an obtuse angle.



ABC is an acute angled triangle if $B\hat{A}C$, $A\hat{B}C$ and $A\hat{C}B$ are angles less than 90^0 or acute angles.

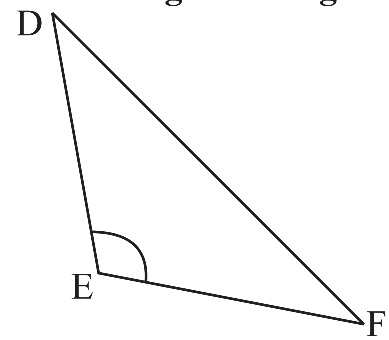
A triangle with the largest angle an acute angle is known as an **acute-angled triangle**.

A triangle having as the largest angle a right angle is known as a **right- angled triangle.**



In the triangle PQR, $P\hat{Q}R = 90^0$ and $Q\hat{P}R$ and $Q\hat{R}P$ are acute-angles. Triangle PQR is a right- angled triangle.

A triangle having as the largest angle an obtuse angle is known as an **obtuse - angled triangle.**

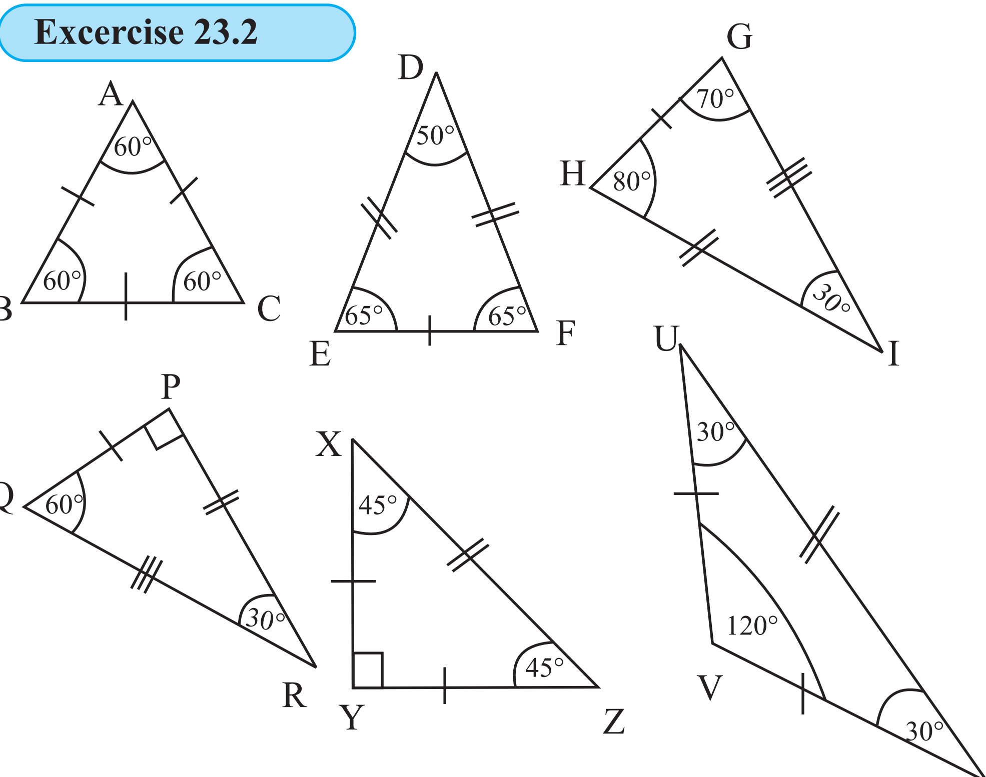


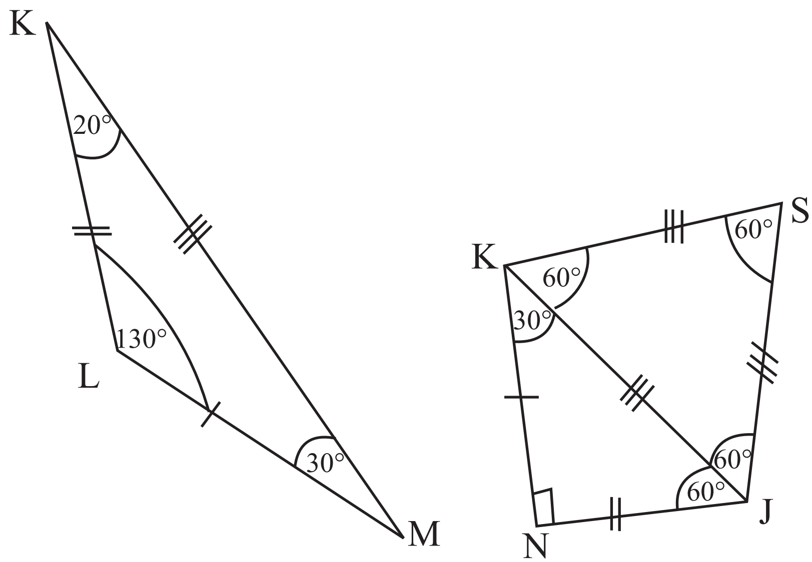
DEF is an obtuse - angled triangle. Here $D\hat{E}F$ is an obtuse angle and $E\hat{D}F$ and $E\hat{F}D$ are acute angles.

- ★ If all the angles of a triangle are acute angles, it is an **acute-angled triangle.**
- ★ If one angle of a triangle is a right angle, it is a **right -angled triangle.**
- ★ If one angle of a triangle is an obtuse angle, it is an **obtuse-angled triangle.**

Excercise 23.2

1.





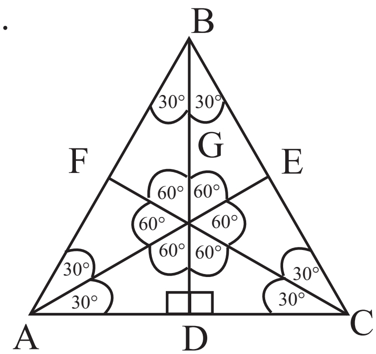
Select and write the following from the triangles given above.

(i) Equilateral, isosceles and scalene triangles.
(ii) Acute - angled, right- angled and obtuse-angled triangles.
(iii) The triangles relevant to the empty cages of the table given below.

If such triangles cannot be selected from the given triangles draw triangles with such properties. Otherwise keep the cage empty.

	Acute-angled triangles	Obtuse - angled triangles	Right-angled triangles
Equlateral triangles			
Isosceles triangles			
Scalene triangles			

2.



Name the,

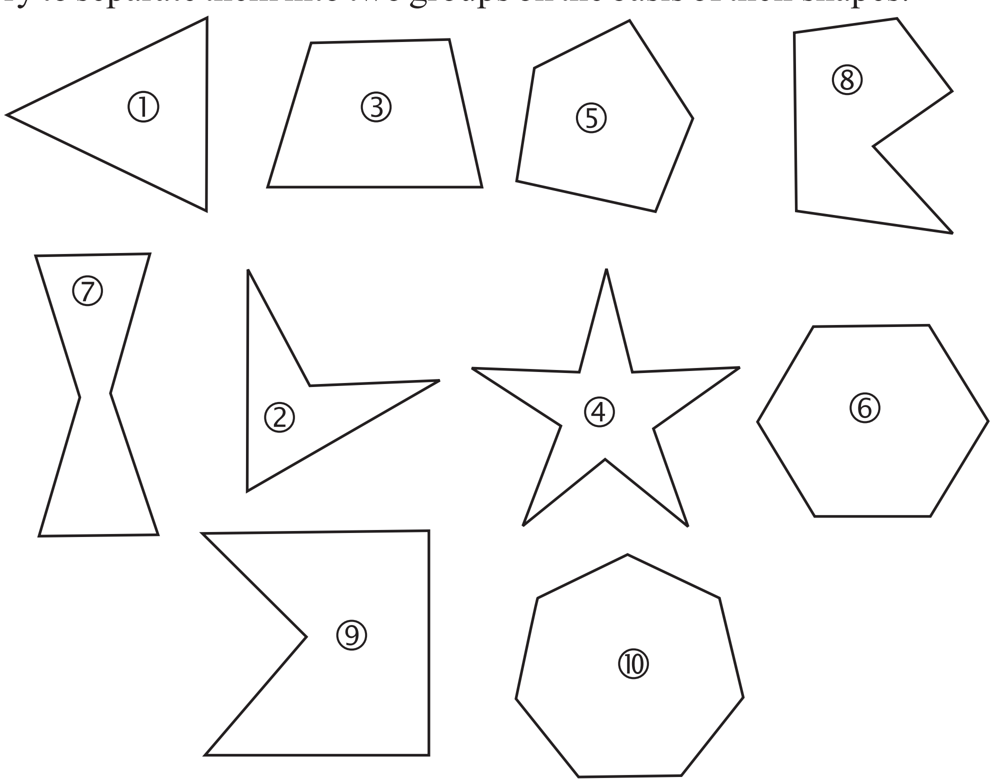
(i) acute - angled triangles
(ii) right - angled triangles
(iii) obtuse - angled triangles
this figure has. What is the largest angle in each?

23.3 Classification of Polygons

A closed plane figure bounded by three or more line segments is called a **polygon**.

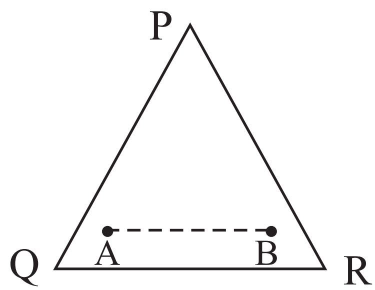
Activity 23.3

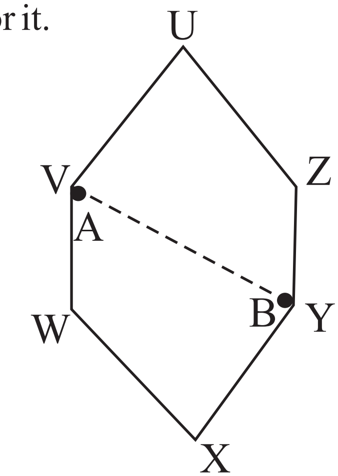
Look at the following polygons.
Try to separate them into two groups on the basis of their shapes.



Consider the groups you have separated the polygons into 1,3,5,6 and 10 could be in one group and 2, 4, 7, 8 and 9 in another group. If that is so, you are correct. Now let us find the reason for it.

Convex Polygons



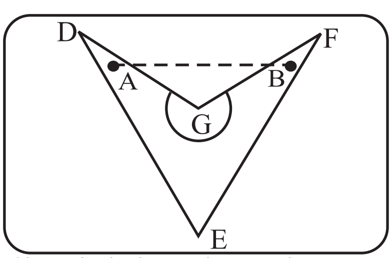


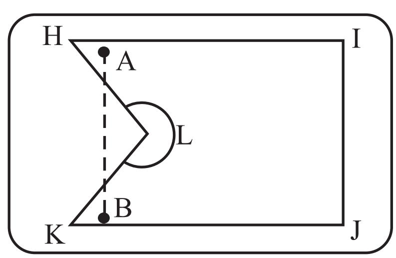
The line joining the points ‘A’ and ‘B’ will not go out of the above polygons.

If a line joining any two points marked inside a certain polygon does not go out of it, that polygon is known as a **convex polygon.**

Accordingly, the polygons PQR and UVWXYZ are convex polygons.

Concave Polygons





The line joining the points ‘A’ and ‘B’ goes out of the polygon.

If there are two points inside the polygon such that the straight line joining them goes out of the polygon, then that polygon is known as a **concave polygon.**

Accordingly the polygons DEFG and HIJKL on page 93 are concave polygons.

> **For your attention .....**
> There are no reflex angles as interior angles in a convex polygon, but there are reflex angles as interior angles in a concave polygon.

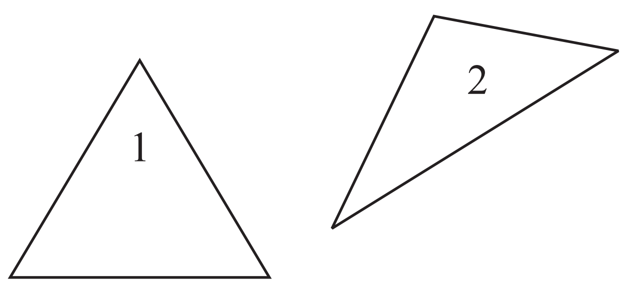
Regular Polygons

You know that a closed plane figure bounded by straight line segments is known as a polygon. Out of these polygons which are convex and concave, let us study further about convex polygons.

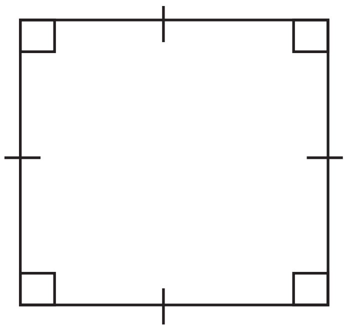
The polygon with the least number of sides is the triangle. It has three sides. A polygon with four sides is a **"quadrilateral"** and a polygon with five sides is a **"pentagon".**

Activity 23.4

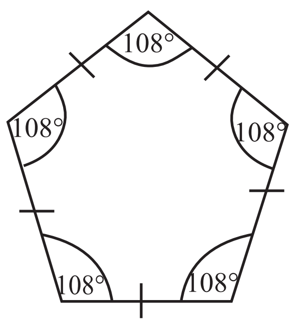
Study the following two triangles well and measure their angles and sides. Accordingly, what can you say about the lengths and the magnitude of the angles of each of the triangles?



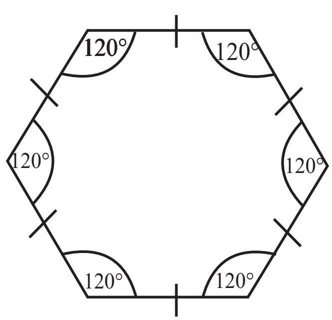
You will agree that the length of the sides of the first triangle are equal to each other and the magnitude of the angles too are equal. Similary you will see that in the second triangle the length of the sides and the magnitude of the angles are different from one another. The triangle in which all the sides are equal and all the angles are equal is a regular triangle. The value of one of its angles is 60^0. Remember that you used the name **"equilateral triangle"** for such a triangle.



As seen in this figure, the polygon with all four sides equal and all four angles equal is a regular quadrilateral and the special name **square** is used for it. The magnitude of an interior angle of this is 90^0.



The polygon having five equal sides and five equal angles is a **regular pentagon**. The value of an interior angle of this is 108^0.

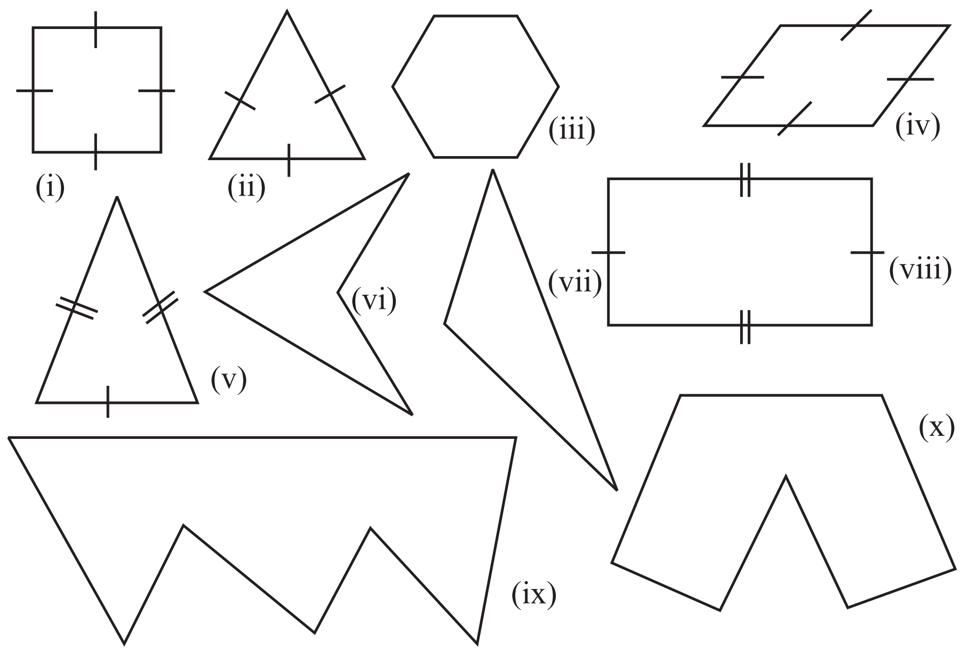


The polygon having six equal sides, and six equal angles is a **regular hexagon.** The value of each interior angle of this is 120^0.

A polygon having all sides equal to one another and all angles equal to one another is called a **regular polygon.**

Exercise 23.3

(1) Select concave polygons and convex polygons out of the following polygons.



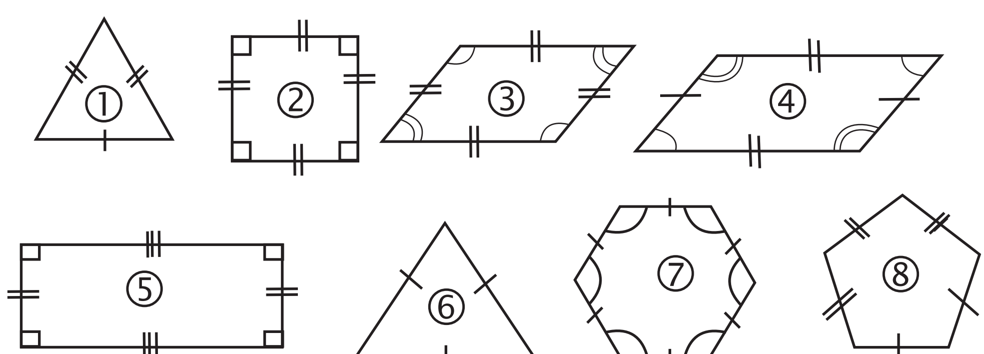
(2) What is the polygon having the least number of sides?

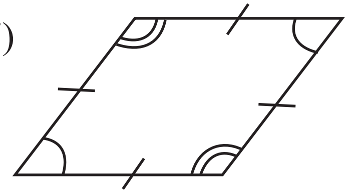
(3) Write the special names of a few polygons having four sides.

(4) List out occasions when shapes of convex/concave polygons are used in day-to-day life.

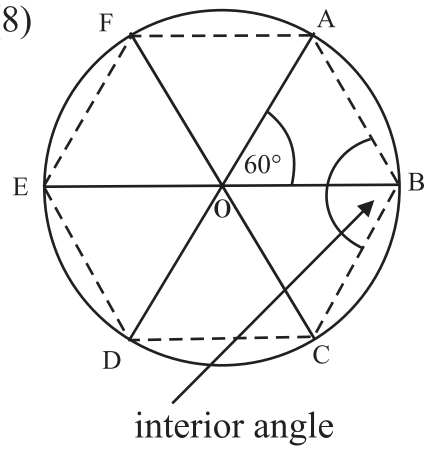
(5) What are the main characteristics of a regular polygon?

(6) Select the regular polygons out of the following convex polygons.



(7) 

Is this convex polygon a regular quadrilateral? Give reasons for your answer.

(8) 

Draw a circle of radius 4 cm as shown in the figure. Name the centre as 'O' and draw angles of 60^0 around 'O'. (Use the protractor for this)

★ Now join 'A', 'B', 'C', 'D', 'E', 'F' in order and obtain the plane figure ABCDEF.

★ Measure the lengths of the sides and the values of the interior angles of the polygon ABCDEF and decide whether it is a regular polygon.

★ Propose a suitable name for it.

(9) List out the occasions when regular polygons are used in day- to-day activities.

(10) Get together with the pupils in the class and construct shapes using regular polygons.
(Eg: Octagonal Vesak lantern)

Summary

★ In an equilateral triangle all three sides are equal in length.

★ In an isosceles triangle two sides are equal in length and the other side is of a different length.

★ In a scalene triangle all the three sides are unequal in length.

★ In an acute - angled triangle all the angles are acute.

★ In a right- angled triangle one angle is a right angle and the other two angles are acute angles.

★ In an obtuse - angled triangle one angle is an obtuse angle and the other two angles are acute angles.

★ In a convex polygon when any two points inside it are joined by a straight line, that line will not go out of the polygon.

★ In a concave polygon when some points inside it are joined by a straight line, that line will go out of the polygon.

★ In a regular polygon, all the sides are equal in length and all the angles are equal.

★ Equilateral triangles, squares, regular pentagons, regular hexagons are examples for regular polygons.