

Module 2

GEOMETRY OF SHAPE and SIZE



What this module is about

There are different shapes around us. Everywhere you look, you see varied geometric figures. Many of these figures are called polygons. This module will help you be on familiar terms with them. You will also learn to distinguish types of triangles; knowledge of which will help you communicate ideas about real life situations.



What you are expected to learn

This module is designed to

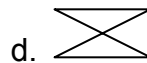
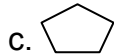
1. illustrate different kinds of polygons and identify the parts of a regular polygon;
2. differentiate convex and non-convex polygons;
3. illustrate a triangle, its basic and secondary parts and
4. classify triangles according to angles and sides.



How much do you know

Select the correct answer for each question:

1. Which of the following is a polygon?



2. A pentagon is a polygon with

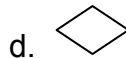
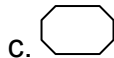
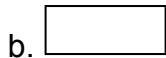
a. 4

b. 5

c. 6

d. 7 sides

3. One of the following is NOT a convex polygon. Which one is it?

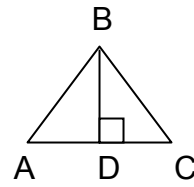


4. In $\triangle ABC$, AB, AC and BC are called

- a. sides b. interior angles c. vertices d. exterior angles

5. Using the figure at the right, BD is a /an

- a. median b. altitude
c. \angle bisector d. \perp bisector



6. In $\triangle DEF$, $m\angle E = 120$. $\triangle DEF$ is

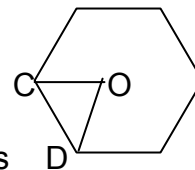
- a. acute b. right c. obtuse d. equilateral triangle

7. It is a triangle with all sides congruent

- a. scalene b. isosceles c. obtuse d. equilateral

8. The figure below is a regular hexagon. $\angle COD$ is a / an

- a. inscribed angle b. central angle
c. obtuse angle d. interior angle



9. The longest side in a right triangle is known as

- a. leg b. hypotenuse c. vertex d. base

10. In isosceles triangle ABC, $AB = BC$. AB and BC are called

- a. bases b. vertices c. hypotenuse d. legs

11. A polygon with no given number of sides can be named as

- a. dodecagon b. undecagon c. n-gon d. gon

12. The sides of a polygon is made up of

- a. segments b. rays c. lines d. planes

13. A line segment from a vertex of a triangle to the midpoint of the opposite side.

- a. altitude b. perpendicular bisector c. median d. angle bisector

14. A right triangle with congruent legs is

- a. equilateral b. isosceles c. scalene d. isosceles right triangle

15. An equilateral triangle is also isosceles. The statement is
- a. always true b. sometimes true c. never true d. can't be determined

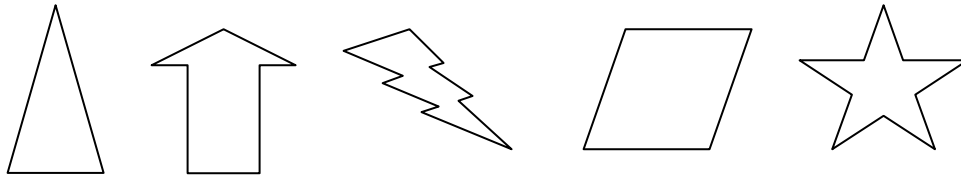


What you will do

Lesson 1

Different Kinds of Polygons and the Parts of a Regular Polygon

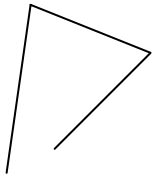
The word polygon is from 2 Greek words poly (many) and gon (sides).
The following are polygons:



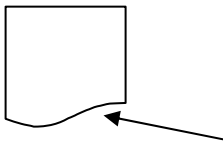
Each of the figures above is closed, made up of segments and the segments or sides intersect only at their endpoints.

A polygon is a closed figure made up of segments that intersect at their endpoints and no two consecutive segments are collinear. Each line segment is a side of the polygon and each endpoint is a vertex.

The following are NOT polygons:

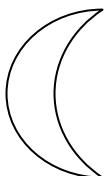


The figure is made up of segments but it is not closed

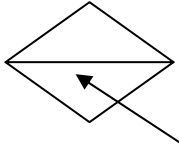


The figure is closed but not entirely made up of segments

Curved portion



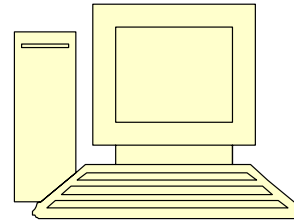
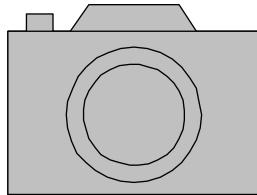
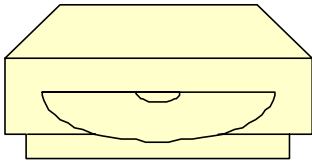
The figure is closed but it is curved



The figure is closed, made up of segments but 2 sides intersect at another segment.

The intersection should be at the endpoints only.

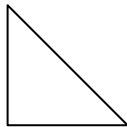
Look at the figures below. Can you identify the parts/portion that are polygons?



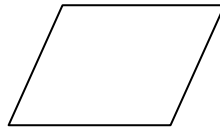
Polygons have special names depending on their number of sides.

Name of polygon	Number of sides
Triangle	3
Quadrilateral	4
Pentagon	5
Hexagon	6
Heptagon	7
Octagon	8
Nonagon	9
Decagon	10

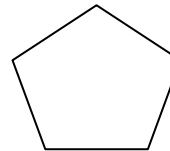
Examples:



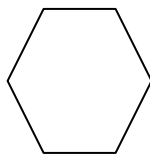
Triangle



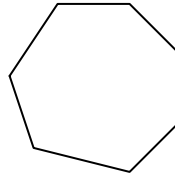
Quadrilateral



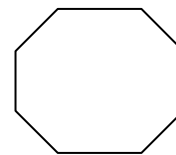
Pentagon



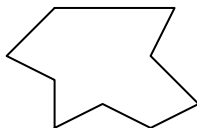
Hexagon



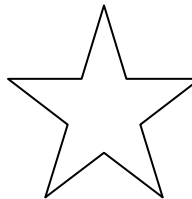
Heptagon



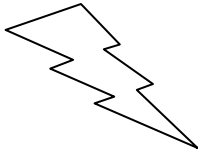
Octagon



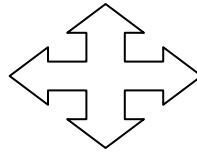
Nonagon



Decagon



11 – gon

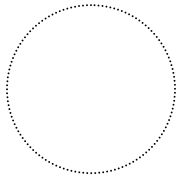


24 - gon

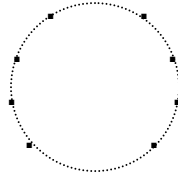
Polygons with more than 10 sides are often referred to as 11-gon, 12-gon, 13-gon and so on. When the number of sides is not given, the polygon is simply called n-gon.

Drawing Tip: To draw a polygon easily,

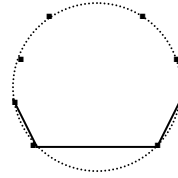
- Step 1: Lightly sketch a circle.
- Step 2: Place the points you need on the circle.
- Step 3: Then connect the points to form your polygon.
- Step 4: Erase the circle.



Step 1



Step 2



Step 3

Step 4

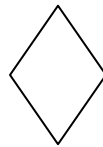
Regular Polygons:

Polygons with equal sides and equal angles are called regular polygons. Study the following illustrations:



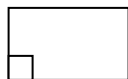
I

Equal sides
and = angles



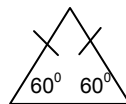
II

equal sides
not equal angles



III

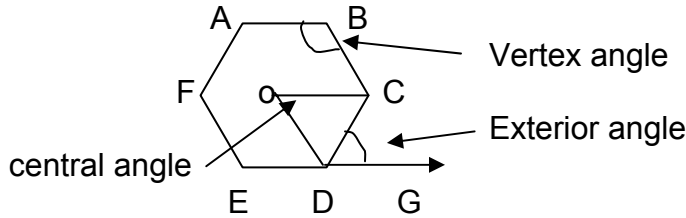
equal angles
not = sides



IV

equal sides
equal angles

Figures I and IV are regular polygons. A regular polygon has the following parts:



ABCDEF is a regular polygon. All sides are equal and all angles have the same measure.

Vertex Angle

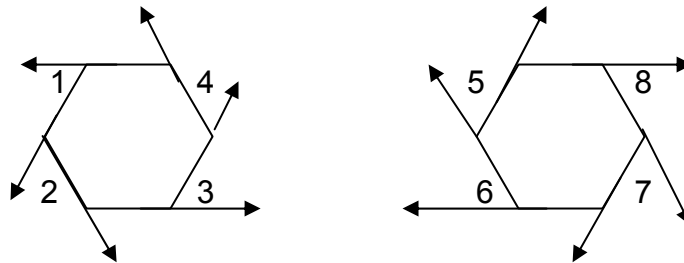
A vertex angle is an angle formed by the intersection of two sides of the polygon. $\angle B$ is a vertex angle. $\angle C$ is also a vertex angle. Can you name 4 more vertex angles? They are $\angle D$, $\angle E$, $\angle F$, and $\angle G$.

Central Angle

$\angle COD$ is a central angle because the center of the polygon is also the vertex of the angle. Name some more central angles. There are more than 6. When you name them, be sure that the middle letter is O.

Exterior Angle

If you extend one side of the polygon, you form an exterior angle. In the above figure, $\angle CDG$ is an exterior angle. Let's have some more exterior angles:

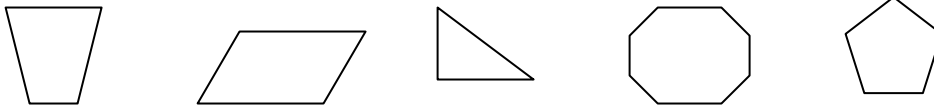


Lesson 2

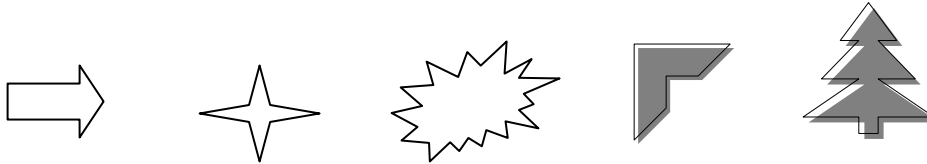
Differentiate convex and non-convex polygons

Polygons are also classified as convex and non-convex. Let's find out how they differ by studying these examples:

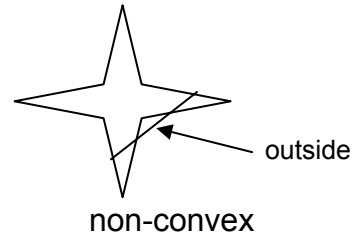
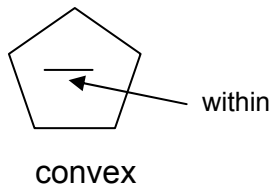
Convex Polygons:



Non-Convex Polygons:

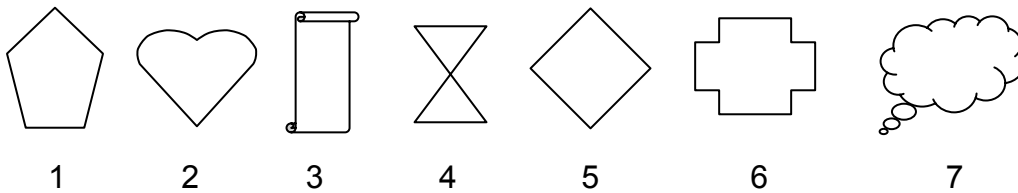


A polygon is convex if a segment joining any two interior points lies completely within the polygon.

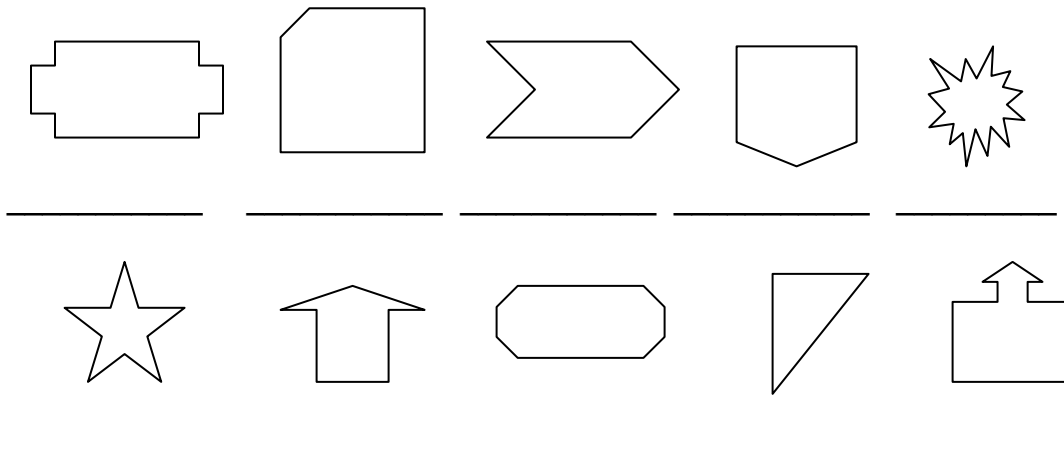


Try this out

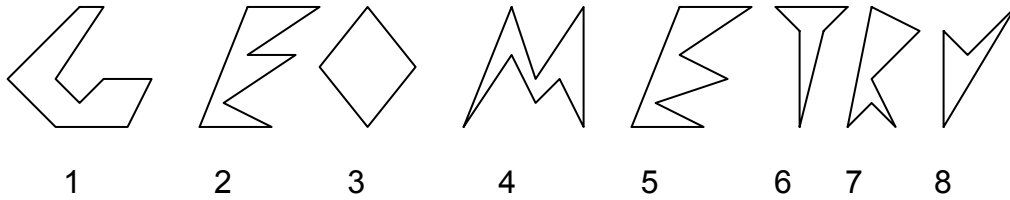
A. Which of the following is a polygon?



B. Tell whether the polygon is convex or non-convex:



C. Name the polygon:



D. If possible, draw a polygon that fits each description

1. A regular quadrilateral.
2. A non-convex pentagon
3. An equilateral octagon.
4. An equilateral nonagon.
5. A convex 15-gon



Let's summarize

1. A polygon is a closed figure made up of segments that intersect at their endpoints and no two consecutive segments are collinear.
2. Each line segment is a side of the polygon and each endpoint is a vertex.
3. Polygons are named based on the number of their sides
4. Polygons with equal sides and equal angles are called regular polygons.
5. A polygon is convex if a segment joining any two interior points lies completely within the polygon.

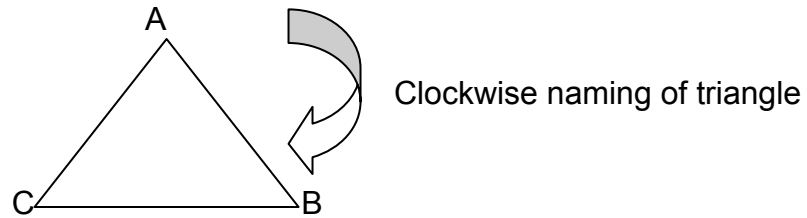
Lesson 3

A Triangle. Its Basic and Secondary Parts

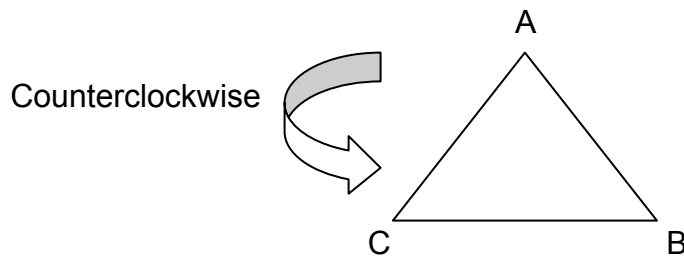
You have learned that the triangle is the simplest polygon because it has the least number of sides.

But how do we name triangles? Triangles are named by using the letters at their vertices. Starting from any vertex, go clockwise or counterclockwise.

Examples:



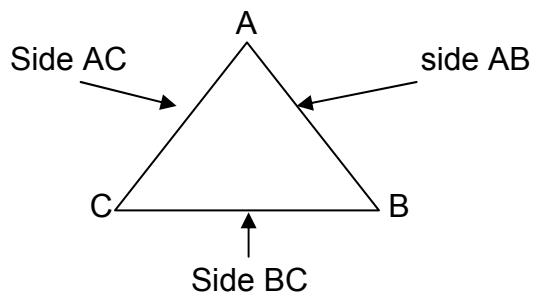
Triangle ABC is the same as $\triangle BCA$, $\triangle CAB$.



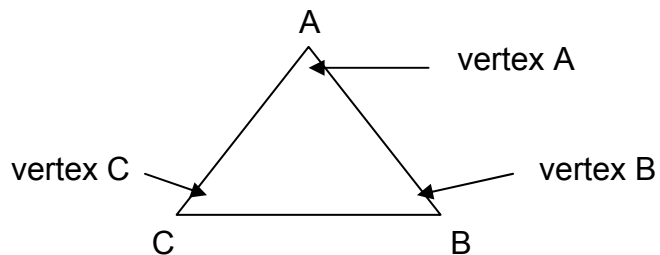
$\triangle ACB = \triangle CBA = \triangle BAC$.

The basic parts of a triangle are *sides*, *vertices* and *angles*.

1. The sides of $\triangle ABC$ are AB, BC, and AC.

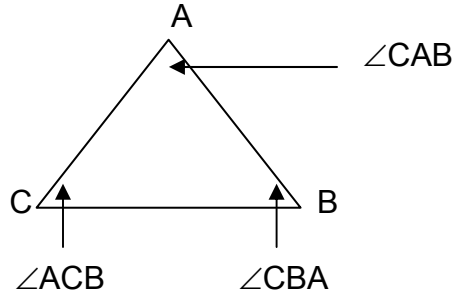


2. The vertices are the endpoints A, B, and C.

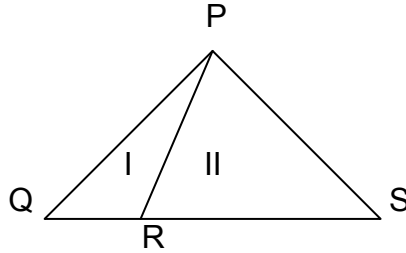


3. The angles. Can you name the 3 angles of the figure below?

They are $\angle ABC$, $\angle BCA$, and $\angle CAB$.



Name Triangle I and II in different ways and then complete the table below.

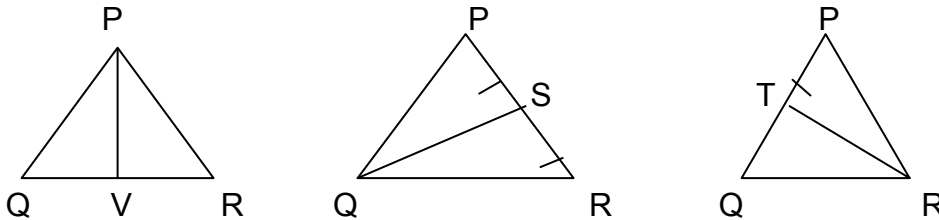


	Name	Sides	Vertices	Angles
Triangle I	ΔQPR , __, __	QP, __, __	Q, __, __	$\angle PQR$, __, __
Triangle II	ΔPSR , __, __	PS, __, __	P, __, __	$\angle PSR$, __, __

Secondary parts of a triangle

a. Median

A median is a segment whose endpoints are a vertex of a triangle and the midpoint of the opposite side. (A midpoint divides a segment into two equal segments).



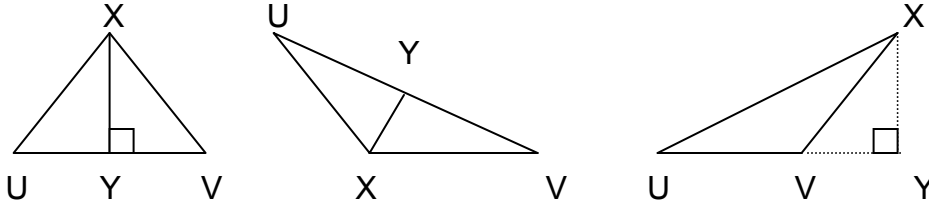
PV is a median of ΔPQR . V is the midpoint of QR.

QS is a median of ΔPQR . S is the midpoint of PR.

RT is a median of ΔPQR . T is the midpoint of PQ.

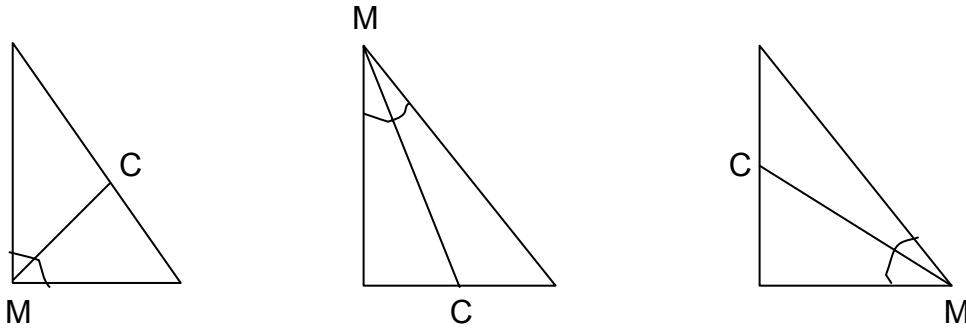
b. Altitude

An altitude is a segment from a vertex of the triangle perpendicular to the opposite side or to the line containing the opposite side. (Perpendicular means the two segments form a right angle).



In all the figures above, XY is an altitude.

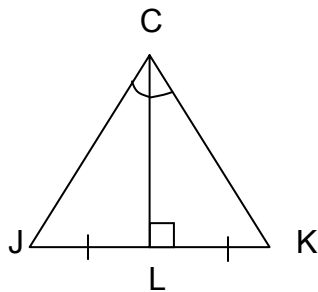
c. Angle Bisector



MC bisects angle M in all the triangles above. MC is called angle bisector.

You will notice that a triangle has 3 medians, 3 altitudes and 3 angle bisectors.

If the triangle is equilateral, the median is the same as the angle bisector and altitude. See the figure below:

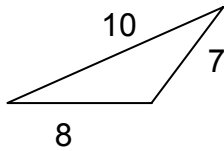


Lesson 4

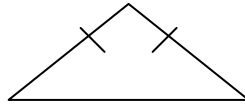
Classification of triangles according to sides and angles

Triangles are classified by their sides into 3 categories:

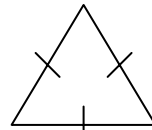
1. Scalene – all sides have different lengths
2. Isosceles – 2 sides have the same length
3. Equilateral – all 3 sides have the same length



scalene Δ



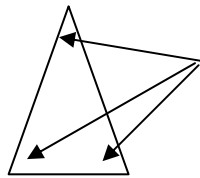
isosceles Δ



equilateral Δ

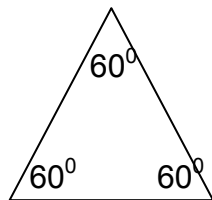
Triangles are classified by their angles into 3 categories:

1. Acute Δ - all 3 angles are acute
2. Right Δ - one angle is right
3. Obtuse Δ - one angle is obtuse

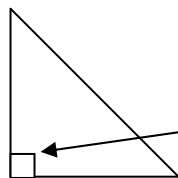


Acute Δ

All angles are acute

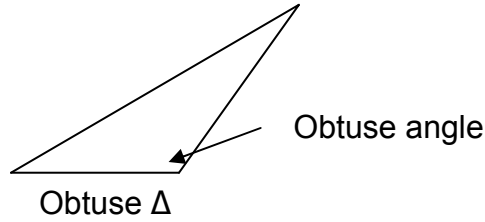


An acute triangle is **equiangular** if all 3 angles have the same measure.



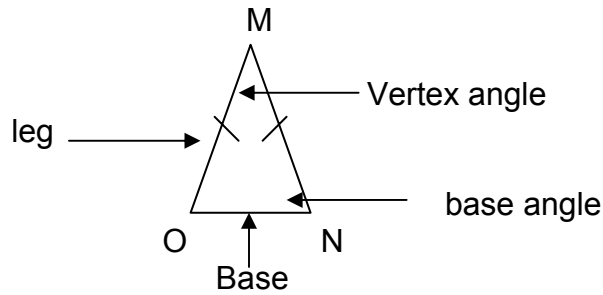
Right angle

Right Δ



Parts of special triangles:

Triangle MON is an isosceles triangle.



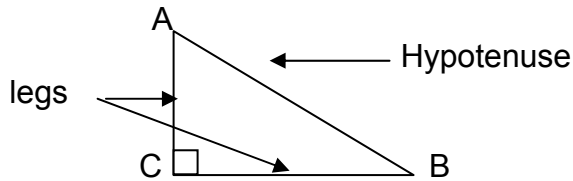
Legs – the congruent sides

Base – the third side

Vertex angle – the angle opposite the base

Base angles – the angles at the base

Triangle ACB is a right triangle



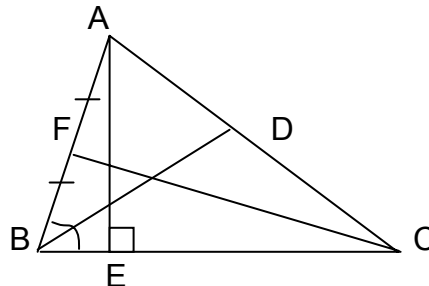
Hypotenuse – the longest side; the side opposite the right angle

Legs – the sides forming right angle

Try this out

A. Using the figure at the right, identify the following.

1. AB, AC, BC
2. C, B, A
3. AE
4. BD
5. CF



B. Match each triangle with all words that describe it:

a. scalene

b. isosceles

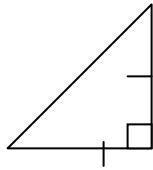
c. equilateral

d. acute

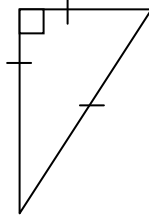
e. right

f. obtuse

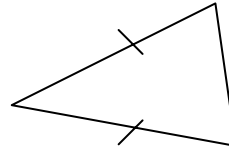
g. equiangular



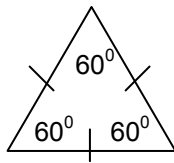
(1)



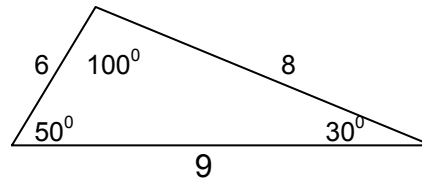
(2)



(3)



(4)



(5)

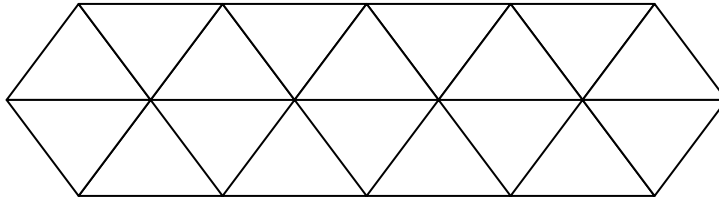
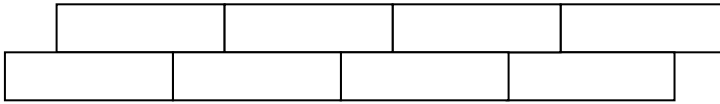
C. Tell if each statement is true or false. Draw a figure to justify your answer.

1. A triangle can be isosceles and acute.
2. A triangle can have two obtuse angles.
3. A triangle can be obtuse and scalene.
4. A right triangle can be equilateral.
5. A triangle can be right and isosceles.
6. A triangle can have two right angles.
7. A triangle can have at most 3 acute angles.
8. A triangle can have at least one (1) acute angle.
9. An equilateral triangle is also an acute triangle.
10. An equiangular triangle can never be a right triangle.

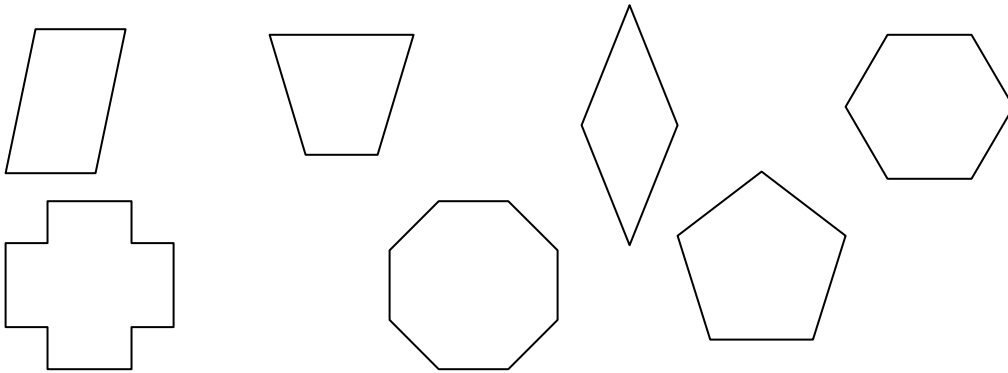
Tessellations

A tessellation is a design in which congruent copies of a figure are arranged to fill the plane in such a way that no figures overlap and there are no gaps.

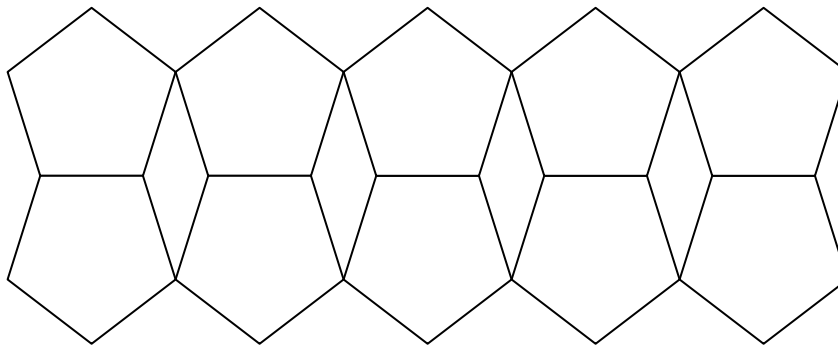
Examples:



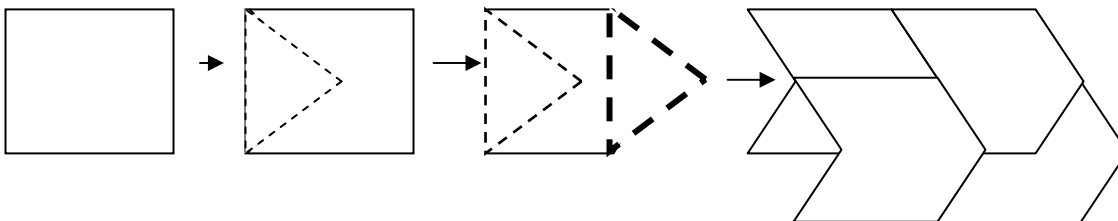
Try to make a tessellation for each figure below. Which figure could not be used for tessellation?



You can also combine figures to make a tessellation:



To make an original pattern for a tessellation, start with a parallelogram. Make congruent changes on one or both pairs of sides:





Let's summarize

1. The basic parts of a triangle are sides, angles and vertices while the secondary parts are median, altitude and angle bisector.
2. A median is a segment whose endpoints are a vertex of a triangle and the midpoint of the opposite side.
3. An altitude is a segment from a vertex of the triangle perpendicular to the opposite side or to the line containing the opposite side.
4. Triangles are classified according to sides and angles.
 - a. Scalene – all sides have different lengths
 - b. Isosceles – 2 sides have the same length
 - c. Equilateral – all 3 sides have the same length
 - d. Acute Δ - all 3 angles are acute
 - e. Right Δ - one angle is right
 - f. Obtuse Δ - one angle is obtuse



What have you learned

Select the correct answer for each question:

1. Which of the following is a polygon?



a



b



c



d

2. A heptagon is a polygon with

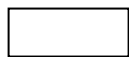
a. 4

b. 5

c. 6

d. 7 sides

3. One of the following is NOT a convex polygon. Which one is it?



a



b



c



d

4. In ΔABC , A, C and B are called

a. sides

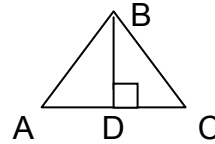
b. interior angles

c. vertices

d. exterior angles

5. Using the figure at the right, BD is a /an

- a. median
- b. altitude
- c. \angle bisector
- d. \perp bisector



6. In $\triangle DEF$, $m\angle E = 90$. $\triangle DEF$ is

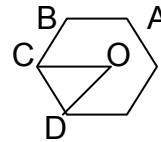
- a. acute
- b. right
- c. obtuse
- d. equilateral triangle

7. It is a triangle with all angles congruent

- a. scalene
- b. isosceles
- c. obtuse
- d. equiangular

8. $\angle CBA$ is a

- a. inscribed angle
- b. central angle
- c. obtuse angle
- d. vertex angle



9. The longest side in a right triangle is known as

- a. leg
- b. hypotenuse
- c. vertex
- d. base

10. In isosceles triangle ABC, $AB = BC$. AB and BC are called

- a. bases
- b. vertices
- c. hypotenuse
- d. legs

11. A polygon with no given number of sides can be named as

- a. dodecagon
- b. undecagon
- c. n-gon
- d. gon

12. The sides of a polygon is made up of

- a. segments
- b. rays
- c. lines
- d. planes

13. A line segment from a vertex of a triangle to the midpoint of the opposite side.

- a. altitude
- b. perpendicular bisector
- c. median
- d. angle bisector

14. A right triangle with congruent legs is

- a. equilateral
- b. isosceles
- c. scalene
- d. isosceles right triangle

15. An isosceles triangle is also equilateral. The statement is

- a. always true
- b. sometimes true
- c. never true
- d. can't be determined



Answer Key

How much do you know

1. C
2. B
3. A
4. A
5. B
6. C
7. D
8. B
9. B
10. D
11. C
12. A
13. C
14. D
15. A

Try this out

Lesson 2

A.

1. Polygon
2. not
3. not
4. not
5. Polygon
6. Polygon
7. not

B.

1. non-convex
2. convex
3. non-convex
4. convex
5. non-convex
6. non-convex
7. non-convex
8. convex
9. convex
10. non-convex

C.

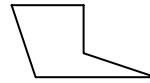
1. Nonagon
2. Heptagon
3. Quadrilateral
4. Octagon
5. Heptagon
6. Pentagon
7. Hexagon
8. Quadrilateral

D.

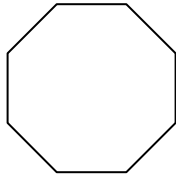
1. Draw a square



2. Any 5-sided polygon that is not convex



- 3.



4. – 5. Refer to the drawing tip

Try this out

Lesson 4

A.

1. Sides
2. Vertex / vertices
3. altitude
4. angle bisector
5. median

B.

1. isosceles right triangle
2. scalene right triangle
3. isosceles acute triangle
4. equilateral / equiangular
5. scalene obtuse triangle

C.

1. true
2. false

3. true
4. false
5. true
6. false
7. true
8. false
9. true
10. true

What have you learned

1. B
2. D
3. C
4. C
5. B
6. B
7. D
8. D
9. B
10. D
11. C
12. A
13. C
14. D
15. C