Chapter- 15

Geometry

STUDY NOTES

In this chapter, you will be able to :

- **Point, line segment, line and ray**
- **Define/explain simple geometrical concepts- angles, measuring angles, types of angles, intersecting, parallel and perpendicular lines, triangles, quadrilaterals and circles.**
- **Measure and draw angles using protractor.**
- **Draw perpendicular and parallel lines.**
- **Recognise the different types of triangles and quadrilaterals.**
- **Properties of a triangle**
- **Area of a triangles**
- **Symmetry**

POINT, LINE SEGMENT, LINE, RAY :

An impression made by a sharp tip of a pencil represents a **point**.

A point determines a location.

It is usually represented by a capital letter.

. **P**

Corner of the page of your book is an example of a point.

A **line segment** is a straight path between two points.

It has two end-points and a definite length.

The line segment is called **line segment AB or $\overline{AB}$.**

We can also name this **line segment as BA or $\overline{BA}$.**

Side of a square and a rectangle, edge of a cube and cuboid are examples of the line segment.

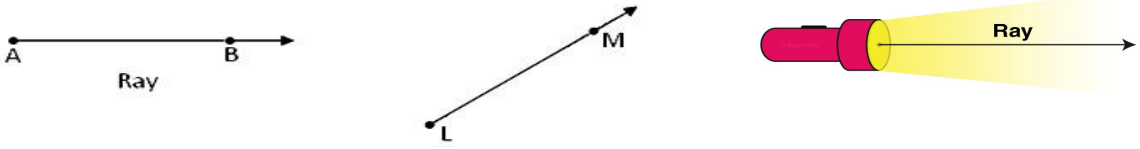
A line segment extending endlessly on both sides is called a **line.**

It does not have a beginning or an end.

Draw a line segment AB and extend AB on both sides. Put two arrow marks on either end.This represents a line $\overleftrightarrow{AB}$.

The axis of earth is an example of a line.

A **ray** is a part of line which extends endlessly in one direction only.



In figure-1 A is the initial point.The ray stretches in the direction AB.

This represents a ray $\overrightarrow{AB}$.

In figure-2 L is the initial point.The ray stretches in the direction LM.

This represents a ray $\overrightarrow{LM}$.

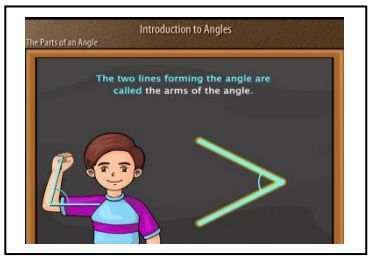
BASIS FOR COMPARISON	LINE	LINE SEGMENT
Meaning	Line can be described as, a one dimensional figure in geometry, that goes on endlessly.	A line segment implies a straight line which passes through two points.
Symbol	⟷	—
End points	No end points.	It has two end points.
Length	Indefinite	Definite
Drawn on paper	No	Yes

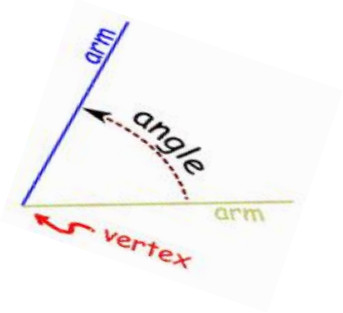
ANGLES :

When two rays meet at a point, an **angle** is formed.It is marked by a small curve.

The points where the two rays meet is called the **vertex.**

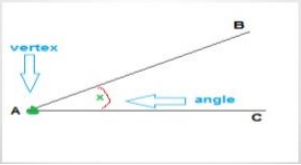
The rays form the **arms of the angle.**





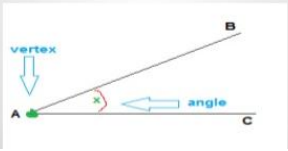
NAMING ANGLES :

There are different ways to name angles. One way is to use the ∠ symbol followed by three letters. From the diagram below you see ∠BAC. The first and third letters indicate points on the two arms. The letter in the middle is the vertex. The first and third letters can be switched because they measure the same angle. For example, ∠BAC is the same as ∠CAB.



Another way to label the angle is by using the ∠ symbol with the only the vertex point. The angle would be called ∠A.

Finally, the last way to label the angle would be by using the ∠ symbol followed by the letter or number between the angle. This would be ∠x.



MEASURING OF AN ANGLE :

The standard unit for measuring an angle is the **degree.**

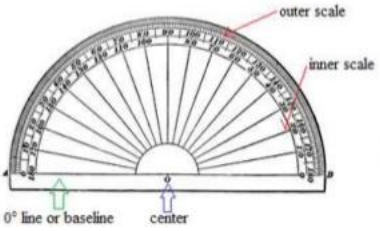
The mathematical symbol for degree is ^{0} .

To measure an angle in degrees, we use a **protractor.**

HOW TO USE A PROTRACTOR

A protractor has two scales:

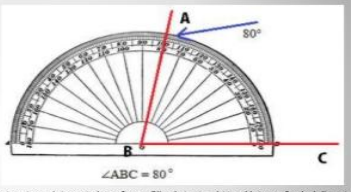
- The outer scale reads from 0° to 180° reading from left to right.
- The inner scale reads from 0° to 180° reading from right to left.



MEASURING ANGLES

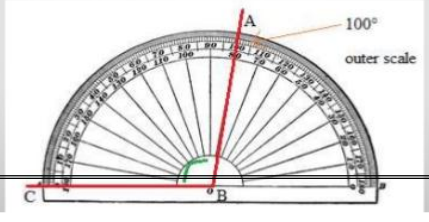
To measure ∠ABC:

1. Place the center of the protractor on the vertex B.
2. Adjust the 0° line or baseline of the protractor so that it lines up with line BC.
3. Since the angle is acute and the 0° line or baseline was used from the right, you will take the reading from the inner scale.

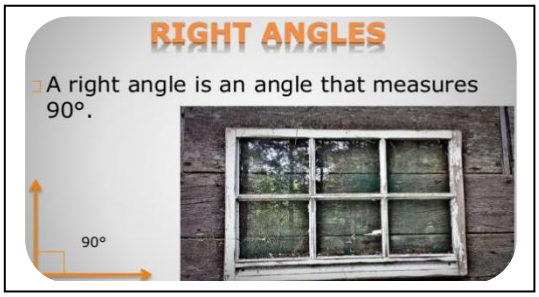


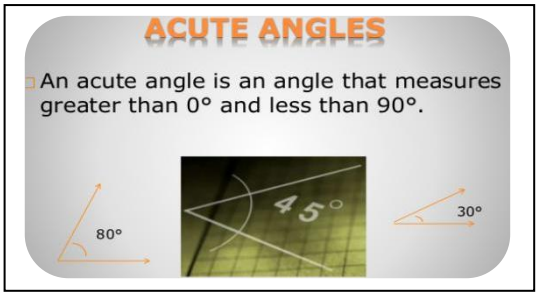
Protractor picture taken from Clip Art etc. http://etc.usf.edu/clipart/

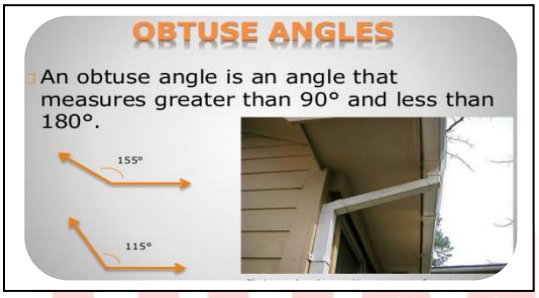
If an angle is facing the other direction and the 0° line or baseline was used on the left, the outer scale will be used. Since it is on the left and you know the angle is obtuse, reading from left to right the measurement is 100°.

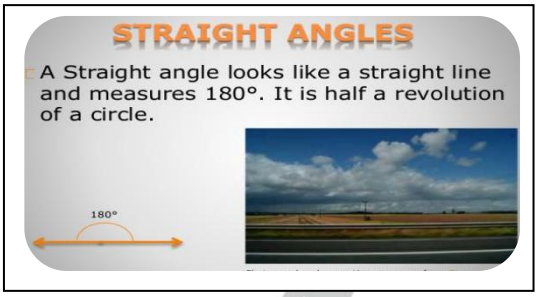


TYPES OF ANGLES :







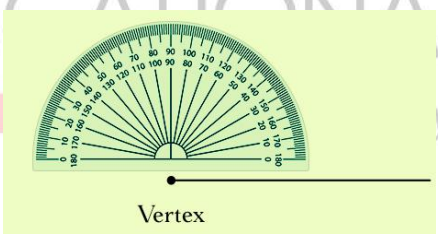


DRAWING ANGLES :

Drawing an angle using a protractor is very simple. All you need is a pencil, a sheet of paper (ruled/unruled), and a ruler (optional). Let's start.

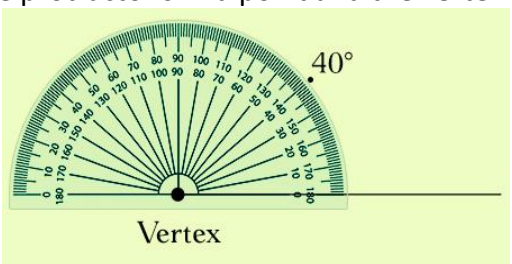
STEP 1

Draw a line segment (having two vertices) or ray (with one vertex). Do remember to properly mark the vertex upon which the proposed angle would be drawn. This will help you to easily spot it through the protractor.



STEP 2

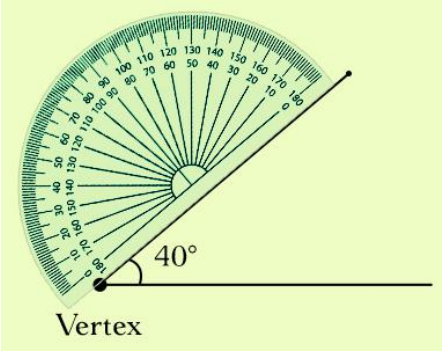
Decide the degree of your angle. Once decided, place the protractor over the marked vertex, such that the protractor's mid point and the vertex are aligned .



STEP 3

Once aligned, hold the protractor steady, and mark the desired angle with a point. To measure an angle you'll have to begin with 0° (the angle of your line), and count upwards till you see the value of your desired angle. Most protractors have reversible readings, which means you can begin with zero on both sides.

However, in case there's only one-way reading (from 0 to 180), and you wish to start from the higher side; treat 180 as 0, 170 as 10, 160 as 20, 150 as 30, and so on.



STEP 4

Once you have marked your desired angle, join the vertex (used to draw the angle), and the marked point. You could either achieve this by using a ruler or the straight edge of the protractor. That's it! You've successfully drawn an angle using your protractor.

TYPES OF LINES :

Any two lines in a plane either intersect at one point or are parallel.

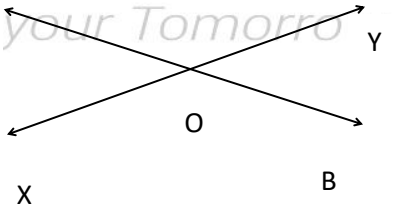
Intersecting lines

Two distinct lines meeting at a point are called intersecting lines.

Line AB and XY meet at a point O.

We say that they **intersect** at O.

AB and XY are **intersecting lines**.



Real-Life Examples of inersecting Lines

Parallel Lines

When two straight lines don't meet or intersect at any point, even at infinity, then they are parallel to each other.

Suppose two lines PQ and RS are parallel then it is represented as PQ||RS.

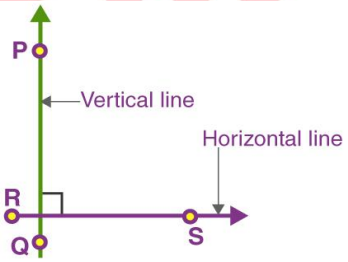
Two lines are parallel if they do not intersect each other.

Real-Life Examples of Parallel Lines :

The distance between two parallel lines is always the same.

Perpendicular Lines

A line is said to be perpendicular to another line if the two lines intersect at a right angle. Perpendicular lines are denoted by the symbol of (⊥). This property of being perpendicular is the relationship between two lines which meet at a right angle (90 degrees).

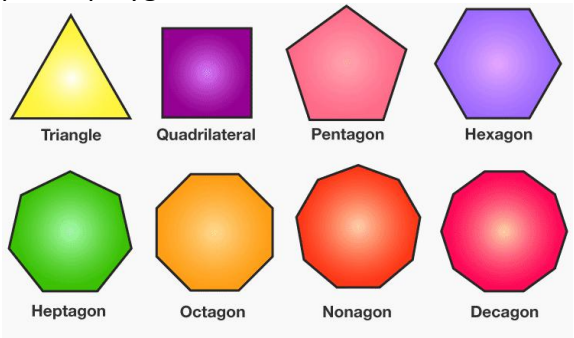


If PQ and RS are two lines which are perpendicular to each other, then it is represented as PQ ⊥ RS.

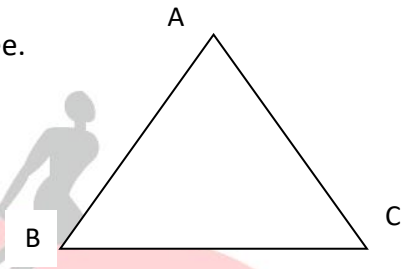
Real-Life Examples of Perpendicular Lines

POLYGONS

A closed shape with any number of straight sides is a **polygon.**
Here are some types of polygons.



Three-sided polygons are called **triangles**. ''Tri'' means three.

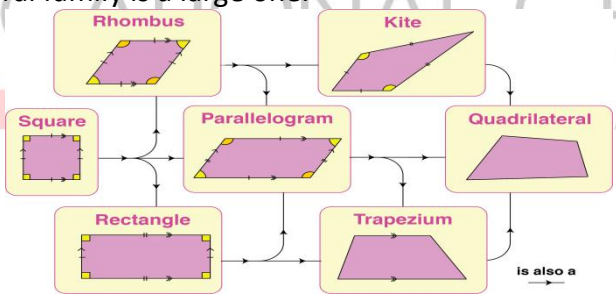


The triangle A, B, C is written as △ABC.
The symbol △ stands for a triangle.
A triangle has 3 sides, 3 angles and 3 vertices.
The sides of △ABC are AB, BC and AC.
The vertices are A, B and C.
The angles are ∠ABC, ∠ACB and ∠BAC.

A four-sided polygon is a **quadrilateral**. ''Quad'' means four.
A quadrilateral has 4 sides, 4 angles and 4 vertices.

Types of quadrilaterals:

The quadrilateral family is a large one.



Rectangle :

All angles are right angles.
Opposite sides are parallel.
Opposite sides are equal.

Square :

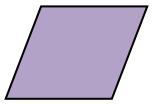
All angles are right angles.
Opposite sides are parallel.
All sides are equal.

Parallelogram :

Opposite sides are parallel.
Opposite sides are equal.

Rhombus :

Opposite sides are parallel.
All sides are equal.



Trapezium :

The trapezium a type of quadrilaterals, with exactly one pair of parallel sides.

Properties of a triangle :

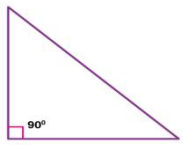
The properties of the triangle are:

- The sum of all the angles of a triangle(of all types) is equal to 180°.
- The sum of the length of the two sides of a triangle is greater than the length of the third side.
- In the same way, the difference between the two sides of a triangle is less than the length of the third side.
- The side opposite the greater angle is the longest side of all the three sides of a triangle.

Types of a triangle :

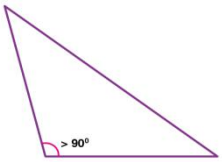
Right-Angled Triangle

In a **right-angled triangle**, one of the angle is equal to 90° or right angle.



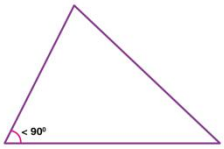
Obtuse-Angled Triangle

A triangle with one obtuse angle (more than 90°) is called an **obtuse-angled triangle.**



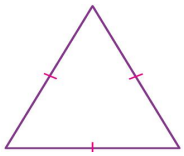
Acute-angled triangled

A triangle with all three acute angles (less than 90°) is called an **aute-angled triangle**.



Equilateral Triangle

A triangle with its three sides equal is called an **equilateral triangle.**

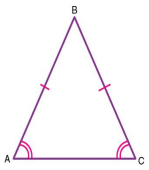


Due to this all the internal angles are of equal degrees,

i.e. each of the angles is 60°.

Isosceles Triangle

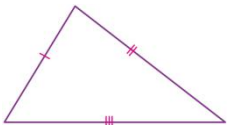
In an **isosceles triangle**, two sides have equal length.



The two angles opposite to the two equal sides are also equal to each other.

Scalene Triangle

A triangle having all sides of different length is a **scalene triangle.**



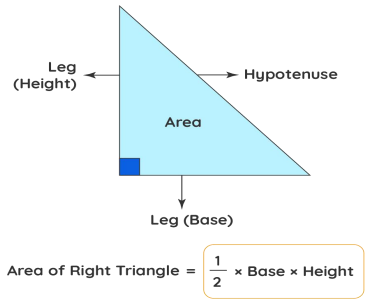
Due to this, the three angles are also different from each other.

AREA OF TRIANGLES $A = \pi r^2$

Only we will learn how to find the area of a triangle

Area of a right angled triangle = $\frac{1}{2}$ × Base × Height

Example :



Base of the triangle = 5 cm

Height of the triangle = 12 cm

Area of the triangle = $\frac{1}{2}$ × 5 × 12 = 30 cm^2

SYMMETRY :

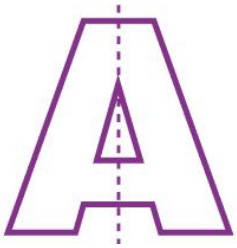
Symmetry Math definition states that “symmetry is a mirror image”. It is a balanced and proportionate similarity found in two halves of an object, that is, one-half is the mirror image of the other half. And a shape that is not symmetrical is referred to as asymmetrical. Symmetric objects are found all around us, in nature, architecture, and art.

Line of Symmetry

The imaginary line or axis along which you fold a figure to obtain the symmetrical halves is called the line of symmetry. It basically divides an object into two mirror-image halves. The line of symmetry can be vertical, horizontal or diagonal. There may be one or more lines of symmetry.

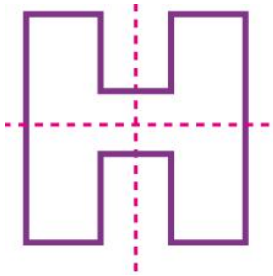
1 Line Symmetry

Figure is symmetrical only about one axis. It may be horizontal or vertical. The word ATOYOTA has one axis of symmetry along the axis passing through Y.



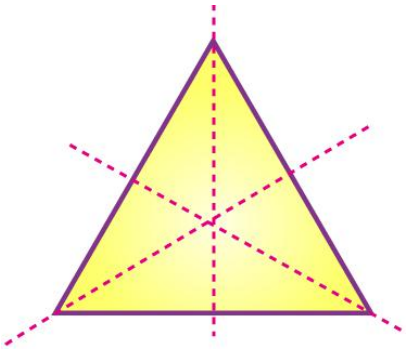
2 Lines Symmetry

Figure is symmetrical with only about two lines. The lines may be vertical and horizontal lines as viewed in the letters H and X. Thus, we can see here two lines symmetry.



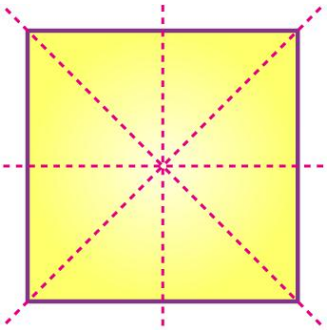
3 Lines Symmetry

An example of three lines of symmetry is an equilateral triangle. Here, the mirror line passes from the vertex to the opposite side dividing the triangle into two equal right triangles.



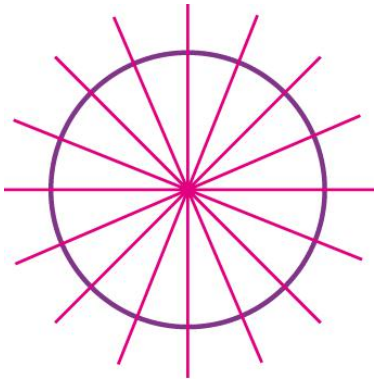
4 Lines Symmetry

Four lines of symmetry can be seen in a square, that has all the sides equal.



Infinite lines

Some figures have not one or two, but infinite lines passing through the centre, and the figure is still symmetrical. Example: a circle.



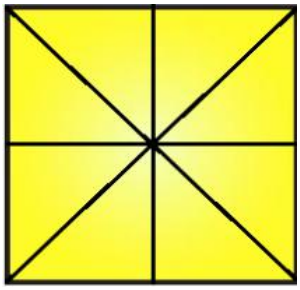
How Many Lines of Symmetry are There in Parallelograms?

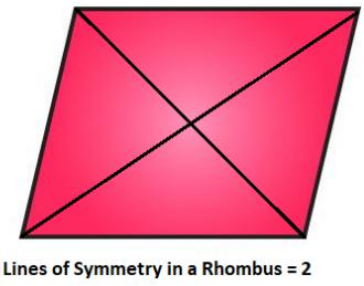
Different parallelograms have different numbers of symmetry lines.

Square = 4

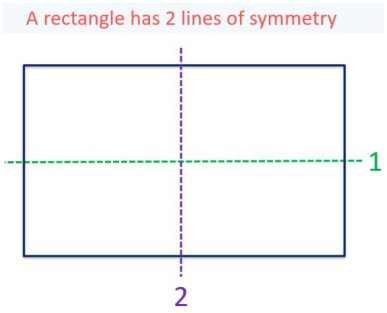
Rectangle = 2

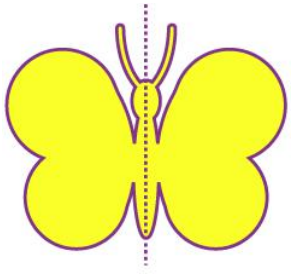
Rhombus = 2

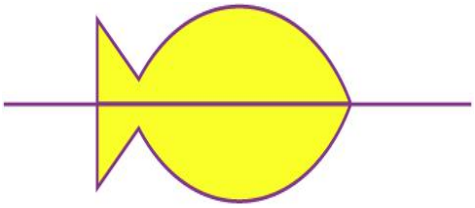




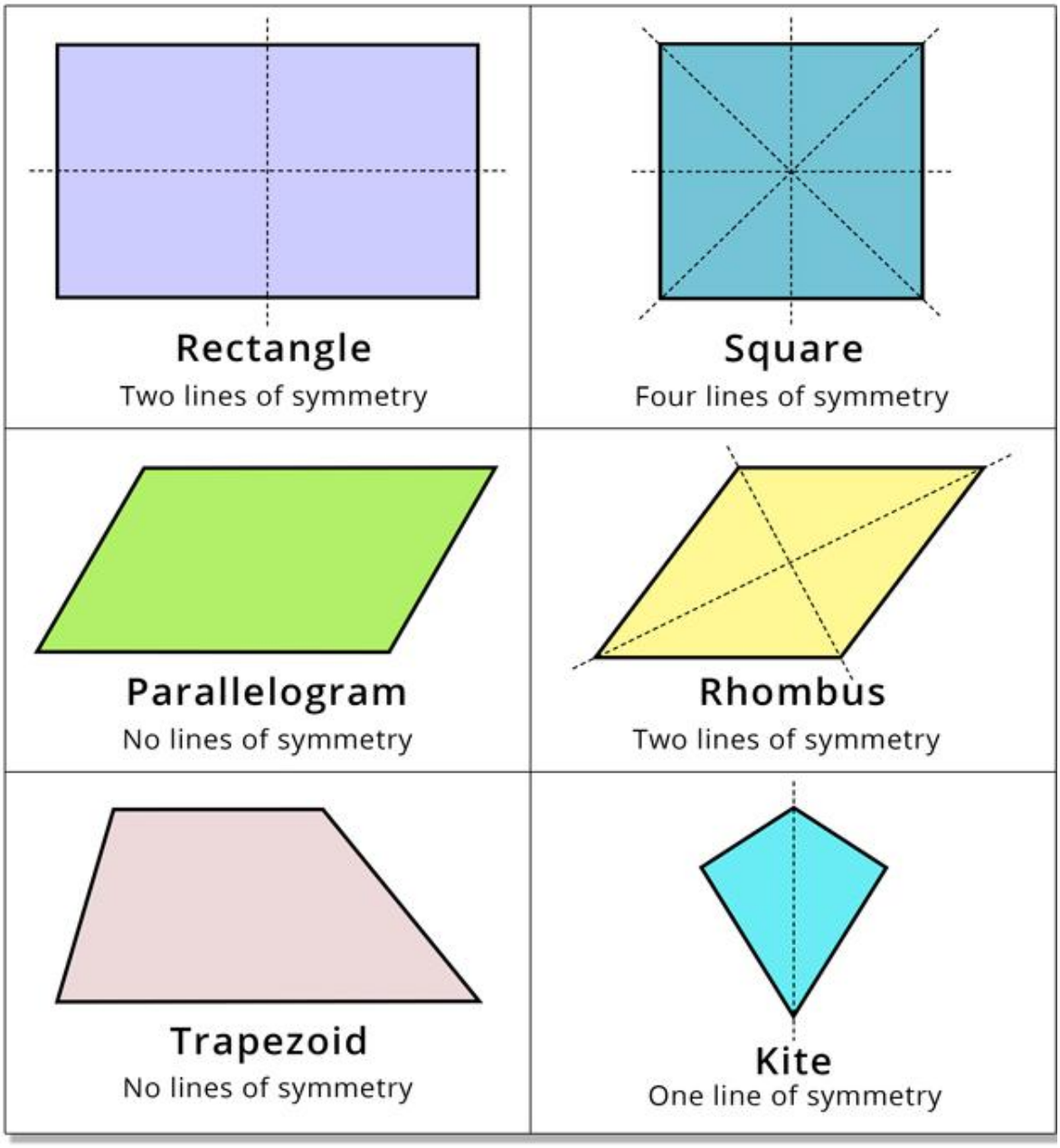
Lines of Symmetry in a Rhombus = 2







LINE OF SYMMETRY IN QUADRILATERALS


Rectangle
Two lines of symmetry
Square
Four lines of symmetry
Parallelogram
No lines of symmetry
Rhombus
Two lines of symmetry
Trapezoid
No lines of symmetry
Kite
One line of symmetry