All About Quadrilaterals

All quadrilaterals have four sides (edges) and four vertices (corners).

The interior angles of a quadrilateral always add up to 360˚.

The Rectangle

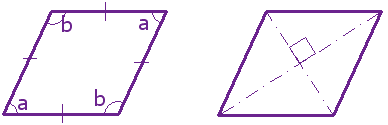
|  |  |  |
| --- | --- | --- |
| Rectangle |  |  |
| http://www.mathsisfun.com/images/quadrilateral-right-key.gif | *means "right angle"* |
| http://www.mathsisfun.com/images/quadrilateral-equal-key.gifandhttp://www.mathsisfun.com/images/quadrilateral-equal-key2.gif | *show equal sides* |
|  |  |

A **rectangle** is a four-sided shape where every angle is a [right angle](http://www.mathsisfun.com/rightangle.html) (90°).

Also **opposite sides** are [parallel](http://www.mathsisfun.com/geometry/parallel-lines.html) and of equal length.

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| --- | --- |
| http://www.mathsisfun.com/images/area/rectangle.gif | [Rectangle](http://www.mathsisfun.com/quadrilaterals.html) Area = w × h w = width h = height |

The Rhombus



A [**rhombus**](http://www.mathsisfun.com/geometry/rhombus.html) is a four-sided shape where all sides have equal length.

Also opposite sides are parallel *and* opposite angles are equal.

Another interesting thing is that the diagonals (dashed lines in second figure) of a rhombus bisect each other at right angles.

The Square

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| Square |  |  |
| http://www.mathsisfun.com/images/quadrilateral-right-key.gif | *means "right angle"* |
| http://www.mathsisfun.com/images/quadrilateral-equal-key.gif | *show equal sides* |
|  |  |

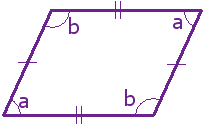
A square has equal sides and every angle is a right angle (90°)

Also opposite sides are parallel.

A square also fits the definition of a **rectangle** (all angles are 90°), and a **rhombus** (all sides are equal length).

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| http://www.mathsisfun.com/images/area/squar2.gif | [Square](http://www.mathsisfun.com/quadrilaterals.html) Area = a2 a = length of side |

The Parallelogram



Opposite sides are parallel and equal in length, and opposite angles are equal (angles "a" are the same, and angles "b" are the same)

NOTE: Squares, Rectangles and Rhombuses are all Parallelograms!

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| http://www.mathsisfun.com/images/area/parallel.gif | [Parallelogram](http://www.mathsisfun.com/quadrilaterals.html) Area = b × h b = base h = vertical height |

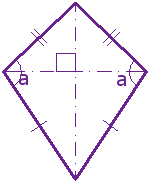
The Trapezoid

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| Trapezoid (or Trapezium) | |
| Trapezoid | Isosceles Trapezoid |

A trapezoid has one pair of opposite sides parallel. It is called an **Isosceles** trapezoid if the sides that aren't parallel are equal in length and both angles coming from a parallel side are equal, as shown.

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| http://www.mathsisfun.com/images/area/trap.gif | Trapezoid Area = ½(a+b) × h h = vertical height |

The Kite



Hey, it looks like a kite. It has two pairs of sides. Each pair is made up of adjacent sides that are equal in length. The angles are equal where the pairs meet. Diagonals (dashed lines) meet at a right angle, and one of the diagonal bisects (cuts equally in half) the other.

Irregular Quadrilaterals

The only [regular](http://www.mathsisfun.com/geometry/regular-polygons.html) quadrilateral is a square. So all other quadrilaterals are **irregular**.

All About Polygons

Polygons are 2-dimensional shapes. They are made of straight lines, and the shape is "closed" (all the lines connect up).

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| **http://www.mathsisfun.com/geometry/images/pentagon-irregular.gif** | **http://www.mathsisfun.com/geometry/images/pentagon-not.gif** | **http://www.mathsisfun.com/geometry/images/pentagon-not2.gif** |
| **Polygon**  (straight sides) | **Not** a Polygon  (has a curve) | **Not** a Polygon  (open, not closed) |

## The word “polygon” comes from Greek. “Poly-“ means “many” and “-gon” means “angle”.

## Types of Polygons

### Simple or Complex

A **simple** polygon has only one boundary, and it doesn't cross over itself. A **complex** polygon intersects itself!

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| --- | --- |
| **http://www.mathsisfun.com/geometry/images/pentagon-irregular.gif** | **http://www.mathsisfun.com/geometry/images/pentagon-complex.gif** |
| Simple Polygon (this one's a Pentagon) | Complex Polygon (also a Pentagon) |

### Concave or Convex

A **convex** polygon has no angles pointing inwards. More precisely, no internal angles can be more than 180°.

If there are any internal angles greater than 180° then it is **concave**. (*Think: concave has a "cave" in it*)

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| **http://www.mathsisfun.com/geometry/images/pentagon-irregular.gif** | **http://www.mathsisfun.com/geometry/images/pentagon-concave.gif** |
| Convex | Concave |

### Regular or Irregular

If all angles are equal and all sides are equal, then it is **regular**, otherwise it is**irregular**

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| --- | --- |
| **http://www.mathsisfun.com/geometry/images/pentagon-regular.gif** | **http://www.mathsisfun.com/geometry/images/pentagon-irregular.gif** |
| Regular | Irregular |

## More Examples

|  |  |  |
| --- | --- | --- |
| **http://www.mathsisfun.com/geometry/images/star-polygon.gif** | **http://www.mathsisfun.com/geometry/images/concave-octagon.gif** | **http://www.mathsisfun.com/geometry/images/hexagon-irregular.gif** |
| **Complex Polygon**  (a "star polygon", in  this case, a [pentagram](http://www.mathsisfun.com/geometry/pentagram.html)) | **Concave Octagon** | **Irregular Hexagon** |

## Interior Angles

When you begin with a simple polygon with four or more sides and draw all the diagonals possible from one vertex, the polygon then is divided into several non-overlapping triangles. The figure below illustrates this division using a seven-sided polygon. The **interior angle sum** of this polygon can now be found by multiplying the number of triangles by 180°.

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|  |
| |  | | --- | |  | | http://media.wiley.com/Lux/41/18141.nfg006.jpg | |  | |

5 triangles x 180˚ = 900˚. The interior angles of a heptagon add up to 900˚.

Exterior Angles

Finding the sum of the exterior angles of a simple polygon is easy. No matter what type of polygon you have, the sum of the exterior angles is ALWAYS equal to 360°.

If you are working with a regular polygon, you can determine the size of EACH exterior angle by simply dividing the sum, 360, by the number of angles. Remember, this will ONLY work in a regular polygon.

Example: What is the size of one of the exterior angles of a regular pentagon?

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| https://www.cdli.ca/courses/math1204/unit06_org02_ilo01/les01_005.gif | 360˚ ÷ 5 (the number of angles in a pentagon) = 72˚, so the measurement of each exterior angle of a regular pentagon is 72˚. Note that the exterior angle is a complement to the interior angle of the pentagon, so it is also easy to see that each interior angle of a regular pentagon measures 108˚. |

## Name that Polygon!

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|  |  | If it is a **Regular Polygon**... |  | For polygons with 13 or more sides, it is OK (and easier) to write “13-gon”, “14-gon”…”100-gon”, etc.  What shape would a Googolgon most resemble? |
| **Name** | **Sides** | **Interior Angle** |  |
| [Triangle](http://www.mathsisfun.com/triangle.html) *(or Trigon)* | **3** | 60° |  |
| [Quadrilateral](http://www.mathsisfun.com/quadrilaterals.html) *(or Tetragon)* | **4** | 90° |  |
| [Pentagon](http://www.mathsisfun.com/geometry/pentagon.html) | **5** | 108° |  |
| [Hexagon](http://www.mathsisfun.com/geometry/hexagon.html) | **6** | 120° |  |
| Heptagon *(or Septagon)* | **7** | 128.571° |  |
| Octagon | **8** | 135° |  |
| Nonagon *(or Enneagon)* | **9** | 140° |  |
| Decagon | **10** | 144° |  |
| Hendecagon *(or Undecagon)* | **11** | 147.273° |  |
| Dodecagon | **12** | 150° |  |
| Triskaidecagon | **13** | 152.308° |  |
| Tetrakaidecagon | **14** | 154.286° |  |
| Pentadecagon | **15** | 156° |  |
| Hexakaidecagon | **16** | 157.5° |  |
| Heptadecagon | **17** | 158.824° |  |
| Octakaidecagon | **18** | 160° |  |
| Enneadecagon | **19** | 161.053° |  |
| Icosagon | **20** | 162° |  |
| Triacontagon | **30** | 168° |  |
| Tetracontagon | **40** | 171° |  |
| Pentacontagon | **50** | 172.8° |  |
| Hexacontagon | **60** | 174° |  |
| Heptacontagon | **70** | 174.857° |  |
| Octacontagon | **80** | 175.5° |  |
| Enneacontagon | **90** | 176° |  |
| Hectagon | **100** | 176.4° |  |
| Chiliagon | **1,000** | 179.64° |  |
| Myriagon | **10,000** | 179.964° |  |
| Megagon | **1,000,000** | ~180° |  |
| Googolgon | **10100** | ~180° |  |
| n-gon | **n** | (**n**-2) × 180**°** / **n** |  |

All About Circles

**The definition** of a circle is:

The [set of all points](http://www.mathsisfun.com/sets/set-of-points.html) on a plane that are a fixed distance from a center.

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| Radius and Diameter  The **Radius** is the distance from the center to the edge.  The **Diameter** starts at one side of the circle, goes through the center and ends on the other side.  So the Diameter is twice the Radius:  Diameter = 2 × Radius | circle |
| Circumference  The **Circumference** is the distance around the edge of the circle.  It is exactly [Pi](http://www.mathsisfun.com/numbers/pi.html) *(the symbol is* **π***)* times the Diameter, so:  Circumference = **π** × Diameter  And so these are also true:  Circumference = 2 × **π** × Radius  Circumference / Diameter = **π** | |

|  |  |
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| Area  The area of a circle is **π** times the Radius squared, which is written:  A = **π** × r2  Or, in terms of the Diameter:  A = (**π**/4) × D2  It is easy to remember if you think of the area of the square that the circle would fit inside. | area of circle |
|  |  |

Parts of a Circle

Because people have studied circles for thousands of years special names have come about.

Nobody wants to say *"that line that starts at one side of the circle, goes through the center and ends on the other side"* when a word like *"Diameter"* would do.

So here are the most common special names:

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| circle lines | Lines  A line that goes from one point to another on the circle's circumference is called a **Chord**.  If that line passes through the center it is called a **Diameter**.  If a line "just touches" the circle as it passes it is called a **Tangent**.  And a part of the circumference is called an **Arc**. |

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| Slices  There are two main "slices" of a circle  The "pizza" slice is called a [**Sector**](http://www.mathsisfun.com/geometry/circle-sector-segment.html).  And the slice made by a chord is called a [**Segment**](http://www.mathsisfun.com/geometry/circle-sector-segment.html). | circle slices |

Common Sectors

The Quadrant and Semicircle are two special types of Sector:

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| quadrant | One quarter of a circle is called a **Quadrant**.  Half a circle is called a **Semicircle.** |
| Semicircle |

Inside and Outside

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| circle | *Riddle: How many sides does a circle have? Two! An inside and an outside.*  A circle has an inside and an outside (of course!). But it also has an "on", because you could be right on the circle.  Example: "A" is outside the circle, "B" is inside the circle and "C" is on the circle. |