**6.1 - KEY CONCEPTS FOR YOUR NOTEBOOKS:**

In geometry, a figure that lies in a plane is called a plane figure. A polygon is a closed plane figure

with the following properties:

A

E

D

B

C

1. It is formed by three or more line segments called **sides**.
2. Each side intersects exactly two sides, one at each endpoint, so that no two sides with

a common endpoint are collinear.

Each endpoint of a side is a vertex of the polygon. The plural of **vertex** is *vertices*. A polygon can

be named by listing the vertices in consecutive order. For example, ABCDE AND CDEAB are both

correct names for the polygon shown.

A **regular polygon** is one that is both *equilateral* and *equiangular*. If a polygon is not regular, it is called **irregular.**

A polygon is **convex** if no line that contains a side of the polygon contains a point in the interior

of the polygon. A polygon that is not convex is called *nonconvex* or **concave**. A regular polygon is always convex.

**CLASSIFYING POLYGONS:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Polygon** | **# of Sides** | **# of Triangles** | **Sum of Interior**  **Angle Measures** |  |
| **Triangle** | **3** | **1** | **(1)180° = 180°** |  |
| **Quadrilateral** | **4** | **2** | **(2)180° = 360°** |  |
| **Pentagon** | **5** | **3** | **(3)180° = 540°** |  |
| **Hexagon** | **6** | **4** | **(4)180° = 720°** |  |
| **Heptagon** | **7** | **5** | **(5)180° = 950°** |  |
| **Octagon** | **8** | **6** | **(6)180° = 1080°** |  |
| **Nonagon** | **9** | **7** | **(7)180° = 1260°** |  |
| **Decagon** | **10** | **8** | **(8)180° = 1440°** |  |
| **Dodecagon** | **12** | **10** | **(10)180° = 1800°** |  |
| **N-gon** | **http://www.mathopenref.com/images/polygons/convexline.gifn** | **n - 2** | **(n - 2)180°** |  |

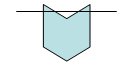
**Properties of a Convex Polygon**

**A line drawn through a convex polygon** will intersect the polygon exactly twice, as can be seen from the figure on the left. You can also see that the line will divide the polygon into exactly two pieces.

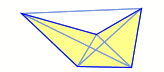
http://www.mathopenref.com/images/polygons/polydiagonals.gif**All the** [diagonals](http://www.mathopenref.com/polygondiagonal.html) of a convex polygon lie entirely inside the polygon. See figure on the left. (In a [concave polygon](http://www.mathopenref.com/polygonconcave.html), some diagonals will lie outside the polygon).

**The area** of an irregular convex polygon can be found by dividing it into triangles and summing the triangle's areas.

**Regular Polygons** are always convex by definition. You will see then that, no matter what you do, it will remain convex.

**Properties of a Concave Polygon**

**A line drawn through a concave polygon**, depending on exactly where you draw it, can intersect the polygon in more than two places. In the figure on the right, the line cuts the polygon in 4 places. You can also see that the line can divide the polygon into more than two pieces, here three.

**Some of the** [diagonals](http://www.mathopenref.com/polygondiagonal.html) of a concave polygon will lie outside the polygon. In the figure on the right, the diagonal at the top of the polygon is outside the polygon's interior space. (In a [convex polygon](http://www.mathopenref.com/polygonconvex.html), all diagonals will lie inside the polygon).

**The area** of a concave polygon can be found by treating it as any other irregular polygon.

**Regular Polygons** are never concave by definition. You will see then that, no matter what you do, it will remain convex, not concave.

**Regular Polygon case**

In the case of [**regular polygons**](http://www.mathopenref.com/polygonregular.html)**,** the formula for the number of triangles in a polygon is:

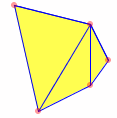
|  |  |
| --- | --- |
| http://www.mathopenref.com/images/polygons/numtriangles.gif |  |

Where…***n***  is the number of sides (or vertices)

Why? The triangles are created by drawing the [**diagonals**](http://www.mathopenref.com/polygondiagonal.html) from one [**vertex**](http://www.mathopenref.com/vertex.html) to all the others. Since there would be no diagonal drawn back to itself, and the diagonals to each adjacent vertex would lie on top of the adjacent sides, the number of diagonals from a single vertex is three less the number of sides, or n-3. The number of triangles is one more than that, so n-2.

This can be used as another way to calculate the sum of the [**interior angles**](http://www.mathopenref.com/polygoninteriorangles.html) of a polygon. The[**interior angles of a triangle**](http://www.mathopenref.com/triangleinternalangles.html) always sum to 180°. The number of triangles is n-2 (above). Therefore the interior angles of the polygon must be the sum of all the triangles' interior angles, or 180(n-2).

**Irregular Polygon case**

**For** [**convex**](http://www.mathopenref.com/polygonconvex.html) **,** [**irregular polygons**](http://www.mathopenref.com/polygonirregular.html), dividing it into triangles can help if you trying to find its area. For example, in the figure on the right, it may be possible to find the area of each triangle and then sum them.   
For most [**concave**](http://www.mathopenref.com/polygonconcave.html) **,** [**irregular polygons**](http://www.mathopenref.com/polygonirregular.html) **,** the triangles are of little practical use.

**POLYGON ANGLE SUM THEOREM:**

The sum of the interior angle measures of a convex polygon with *n* sides is (n - 2)180°.

|  |  |  |
| --- | --- | --- |
|  | **Interior**  **Angles** | **Exterior**  **Angles** |
| **Sum of Angle Measures** | **(n - 2)180°** | **360°** |
| **One Angle Measure** | **(n - 2)180°**  **n** | **360°**  **n** |

**EXAMPLES:**

**Irregular Irregular Regular Irregular not a polygon irregular**

**Concave Concave Convex Convex Convex**

**Octagon Decagon Hexagon Quadrilateral Heptagon**

**POLYGON EXTERIOR ANGLE SUM THEOREM:**

The sum of the exterior angle measures, one angle at each vertex, of a convex polygon is 360°.

**EXAMPLES:**

1. Find the sum of the interior angle measures of a convex heptagon?

A

E

D

B

C

32c°

32c°

35c°

18c°

18c°

2. Find the measure of each interior angle of a regular 16-gon?

3. Find the measure of each interior angle of pentagon ABCDE:

4. Find the measure of each exterior angle of a regular 20-gon?

**J**

5. Find the value of b in polygon FGHJKL?

**L**

**K**

**H**

**G\G**

**F**

1

6. If Ann made paper stars for party decorations as shown, what is the measure of angle 1?

**EXTERIOR ANGLES OF POLYGONS**

**Regular polygons**

In the figure above check "regular". As you can see, for regular polygons all the exterior angles are the same, and like all polygons they add to 360° (see note below). So each exterior angle is 360 divided by the n, the number of sides. As a demonstration of this, drag any vertex towards the center of the polygon. You will see that the angles combine to a full 360° circle.

**Convex case**

In the case of [convex polygons](http://www.mathopenref.com/polygonconvex.html), where all the vertices point "outwards" away form the interior, the exterior angles are always on the outside of the polygon.

Although there are two possible exterior angles at each vertex (see note below) we usually only consider one per [vertex](http://www.mathopenref.com/vertex.html), selecting the ones that all go around in the same direction, clockwise in the figure above.

Taken one per vertex in this manner, the exterior angles always add to 360°

This is true no matter how many sides the polygon has, and regardless of whether it is [regular](http://www.mathopenref.com/polygonregular.html) or [irregular](http://www.mathopenref.com/polygonirregular.html), [convex](http://www.mathopenref.com/polygonconvex.html) or [concave](http://www.mathopenref.com/polygonconcave.html).

**Concave case**

If the polygon is [concave](http://www.mathopenref.com/polygonconcave.html), things are a little trickier. A concave polygon has one or more vertices "pushed in" so they point towards the interior. (You just have to remember to add the negative angles correctly.)

**Exterior and Interior angles are supplementary**

At any given vertex, the interior angle is supplementary to an exterior angle.

**The sum of exterior angles - watch out!**

In most geometry textbooks they say flatly that the exterior angles of a polygon add to 360° This is only true if:

1. You take only one per vertex, and
2. Take all the angles that point in the same direction around the polygon.

But in many cases they fail to state these conditions. So if you are asked *"What is the sum of the exterior angles of a polygon?"* without any conditions, you will have to guess which one they mean. Usually they mean taking one per vertex, and the answer is 360.

**INTERIOR ANGLES OF POLYGONS**

**Sum of Interior Angles**

The interior angles of any polygon always add up to a constant value, which depends only on the number of sides. For example the interior angles of a [pentagon](http://www.mathopenref.com/pentagon.html) always add up to 540° no matter if it regular or irregular, [convex](http://www.mathopenref.com/polygonconvex.html) or [concave](http://www.mathopenref.com/polygonconcave.html), or what size and shape it is. The sum of the interior angles of a polygon is given by the formula

|  |  |  |
| --- | --- | --- |
| http://www.mathopenref.com/images/polygons/anglesum.gif | where *n*  is the number of sides |  |

**So for example:**

|  |  |  |
| --- | --- | --- |
| A [square](http://www.mathopenref.com/square.html) | has 4 sides, | so interior angles add up to 360° |
| A [pentagon](http://www.mathopenref.com/pentagon.html) | has 5 sides, | so interior angles add up to 540° |
| A [hexagon](http://www.mathopenref.com/hexagon.html) | has 6 sides, | so interior angles add up to 720° |
| ... etc |  |  |

**In Regular Polygons**

For a regular polygon, the total described above is spread evenly among all the interior angles, since they all have the same values. So for example the interior angles of a pentagon always add up to 540°, so in a regular pentagon (5 sides), each one is one fifth of that, or 108°. Or, as a formula, each interior angle of a regular polygon is given by:

|  |  |  |
| --- | --- | --- |
| http://www.mathopenref.com/images/polygons/interiorangle.gif | where *n*  is the number of sides |  |

**CENTRAL ANGLES**

**Regular Polygon case**

The central angle is the angle made at the center of the polygon by any two adjacent vertices of the polygon. If you were to draw a line from any two adjacent vertices to the center, they would make the central angle. Because the polygon is regular, all central angles are equal. It does not matter which side you choose.   
  
All central angles would add up to 360° (a full circle), so the measure of the central angle is 360 divided by the number of sides. Or, as a formula:

|  |  |  |
| --- | --- | --- |
| http://www.mathopenref.com/images/polygons/polygoncentralangle.gif | where *n*  is the number of sides |  |

The measure of the central angle thus depends only on the number of sides. In the figure above, resize the polygon and note that the central angle does not change. The angle depends only on the number of sides, not the size of the polygon. If you change the number of sides, you will see that as the number of sides gets larger, the central angle gets smaller.

**Irregular Polygon case**

Irregular polygons are not considered as having a center, and so have no central angle.

**6.2 – PROPERTIES OF PARALLELOGRAMS**

Z

**P**

**Q**

**R**

**S**

**THEOREM: Properties of Parallelograms:**

**1)** If a quadrilateral is a parallelogram, then its opposite sides are congruent. ( Opposite Sides ≌)

i.e…If PQRS is a parallelogram, the P̅Q̅ ≌ R̅S̅ and Q̅R̅ ≌ P̅S̅.

**2)** If a quadrilateral is a parallelogram, then its opposite angles are congruent. . ( Opposite <’s ≌)

i.e…If PQRS is a parallelogram, then <A ≌ <C and <B ≌ <D

**3)** If a quadrilateral is a parallelogram, then its consecutive angles are supplementary. ( Cons. <’s supp.)

i.e…If PQRS is a parallelogram, then <P +<Q=180°; <Q+<R=180°;<R +<S=180°;<S +<P =180°;

**4)** If a quadrilateral is a parallelogram, then its diagonals bisect each other. . ( Diags bisect ea. other)

i.e…If PQRS is a parallelogram, then P̅Z̅≌R̅Z̅ and Q̅Z̅≌S̅Z̅.

**Formula for the number of diagonals**

As described above, the number of diagonals from a single vertex is three less than the the number of vertices or sides, or (n-3).

There are N vertices, which gives us n(n-3) diagonals

But each diagonal has two ends, so this would count each one twice. So as a final step we divide by 2, for the final formula:

|  |  |
| --- | --- |
| http://www.mathopenref.com/images/polygons/diagonals.gif |  |

Where, *N*  is the number of sides (or vertices)

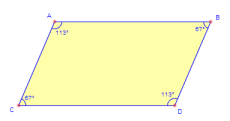
**6.3 – CONDITIONS FOR PARALLELOGRAMS**

A parallelogram is a [quadrilateral](http://www.mathopenref.com/quadrilateral.html) with opposite sides [parallel](http://www.mathopenref.com/parallel.html). It is the "parent" of some other quadrilaterals, which are obtained by adding restrictions of various kinds:

* A [rectangle](http://www.mathopenref.com/rectangle.html) is a parallelogram but with all four interior angles fixed at 90°
* A [rhombus](http://www.mathopenref.com/rhombus.html) is a parallelogram but with all sides equal in length
* A [square](http://www.mathopenref.com/square.html) is a parallelogram but with all sides equal in length and all angles fixed at 90°

**PROPERTIES OF A PARALLELOGRAM**

|  |  |
| --- | --- |
| **Base** | Any side can be considered a base. Choose any one you like. If used to calculate the area (see below) the corresponding altitude must be used. In the figure above, one of the four possible bases and its corresponding altitude has been chosen. |
| **Altitude (height)** | The altitude (or height) of a parallelogram is the [perpendicular](http://www.mathopenref.com/perpendicular.html) distance from the base to the opposite side (which may have to be extended). In the figure above, the altitude corresponding to the base CD is shown. |
| **Area** | The area of a parallelogram can be found by multiplying a base by the corresponding altitude. See also [Area of a Parallelogram](http://www.mathopenref.com/parallelogramarea.html) |
| **Perimeter** | The distance around the parallelogram. The sum of its sides. See also [Perimeter of a Parallelogram](http://www.mathopenref.com/parallelogramperimeter.html) |
| **Opposite sides** | Opposite sides are [congruent](http://www.mathopenref.com/congruent.html) (equal in length). As you reshape the parallelogram at the top of the page, note how the opposite sides are always the same length. |
| **Diagonals** | Each diagonal cuts the other diagonal into two equal parts, as in the diagram below. See [Diagonals of a parallelogram](http://www.mathopenref.com/parallelogramdiags.html) for an interactive demonstration of this.  Diagonals of a parallelogram |
| **Interior angles** | 1. Opposite angles are equal as can be seen below. 2. Consecutive angles are always supplementary (add to 180°) |



**CONDITIONS FOR PARALLELOGRAMS**

1. Both pairs of opposite sides are parallel (definition)

2. One pair of opposite sides are parallel and congruent (TH1)

3. Both pairs of opposite sides are congruent (TH2)

4. Both pairs of opposite angles are congruent (TH 3)

5. One angle is supplementary to both of its consecutive angles (TH 4)

6. The diagonals bisect each other (TH 5)

**Area formula**

The area of a parallelogram is given by the formula

|  |  |
| --- | --- |
| http://www.mathopenref.com/images/parallelogram/area.gif |  |

**where** *b* is the length of any base  
 *a* is the corresponding altitude

Recall that any of the four sides can be chosen as the base. You must use the altitude that goes with the base you choose. The altitude (or height) of a parallelogram is the[**perpendicular**](http://www.mathopenref.com/perpendicular.html) distance from the base to the opposite side (which may have to be extended). In the figure above, the altitude corresponding to the base CD is shown.

**6.4/6.5 – PROPERTIES AND CONDITIONS OF SPECIAL PARALLELOGRAMS**

**RECTANGLES**

**Properties of a rectangle**

* Opposite sides are[**parallel**](http://www.mathopenref.com/parallel.html) and[**congruent**](http://www.mathopenref.com/congruent.html) Adjust the rectangle above and satisfy yourself that this is so.
* The diagonals [bisect](http://www.mathopenref.com/bisectorline.html) each other
* The diagonals are [congruent](http://www.mathopenref.com/congruent.html)

**Other ways to think about rectangles**

A rectangle can be thought about in other ways:

* A [**square**](http://www.mathopenref.com/square.html) is a special case of a rectangle where all four sides are the same length. Adjust the rectangle above to create a square.
* It is also a special case of **a** [**parallelogram**](http://www.mathopenref.com/parallelogram.html) but with extra limitation that the angles are fixed at 90°.

The **Golden rectangle** has been known since antiquity as one having a pleasing shape, and is frequently found in art and architecture as a rectangular shape that seems 'right' to the eye. It is mentioned in Euclid's Elements and was known to artists and philosophers such as Leonardo da Vinci.

One of the most interesting properties of the golden rectangle is that if you cut off a square section whose side is equal to the shortest side, the piece that remains is also a golden rectangle. In the figure below, the yellow rectangle is in the same proportion as the original larger rectangle after the gray square is cut off. Both the rectangles ABCD and PBCQ are golden rectangles.

A rectangle has two diagonals. Each one is a [line segment](http://www.mathopenref.com/linesegment.html) drawn between the opposite [vertices](http://www.mathopenref.com/vertex.html) (corners) of the rectangle. (corners) of the rectangle. The diagonals have the following properties:

* The two diagonals are [congruent](http://www.mathopenref.com/congruent.html) (same length). In the figure above, click 'show both diagonals', then drag the orange dot at any vertex of the rectangle and convince yourself this is so.
* Each diagonal [bisects](http://www.mathopenref.com/bisectorline.html) the other. In other words, the point where the diagonals [intersect](http://www.mathopenref.com/intersection.html) (cross), divides each diagonal into two equal parts
* Each diagonal divides the rectangle into two [congruent right triangles](http://www.mathopenref.com/congruenttriangles.html). Because the triangles are congruent, they have the same area, and each triangle has half the area of the rectangle

**Length of the diagonal**

In the figure above, click 'reset'. As you can see, a diagonal of a rectangle divides it into two [right triangles](http://www.mathopenref.com/righttriangle.html), BCD and DAB. The diagonal of the rectangle is the [hypotenuse](http://www.mathopenref.com/hypotenuse.html) of these triangles. We can use [Pythagoras' Theorem](http://www.mathopenref.com/pythagorastheorem.html) to find the length of the diagonal if we know the width and height of the rectangle.

**As a formula:**

|  |  |  |
| --- | --- | --- |
| http://www.mathopenref.com/images/quadrilateral/rectdiag.gif | where: *w*  is the width of the rectangle *h*  is the height of the rectangle |  |

**RHOMBUS**

A rhombus is actually just a special type of [parallelogram](http://www.mathopenref.com/parallelogram.html). Recall that in a parallelogram each pair of opposite sides are equal in length.   With a rhombus, *all four* sides are the same length. It therefore has all the properties of a parallelogram.

Its a bit like a square that can 'lean over' and the interior angles need *not* be 90°. Sometimes called a 'diamond' or 'lozenge' shape.

**Properties of a rhombus**

|  |  |
| --- | --- |
| **Base** | Any side can be considered a base. Choose any one you like. If used to calculate the area (see below) the corresponding altitude must be used. In the figure above one of the four possible bases has been chosen. |
| **Altitude** | The altitude of a rhombus is the [perpendicular](http://www.mathopenref.com/perpendicular.html) distance from the base to the opposite side (which may have to be extended). In the figure above, the altitude corresponding to the base CD is shown. |
| **Area** | There are several ways to find the area of a rhombus. The most common is (base × altitude). Each is described in [Area of a rhombus](http://www.mathopenref.com/rhombusarea.html) |
| **Perimeter** | Distance around the rhombus. The sum of its side lengths. See [Perimeter of a rhombus](http://www.mathopenref.com/rhombusperimeter.html) |
| **Diagonals** | Each of the two diagonals is the [perpendicular bisector](http://www.mathopenref.com/bisectorperpendicular.html) of the other. |

Many of the area calculations can be applied to them also. Choose a formula based on the values you know to begin with.

**1. The "base times height" method**

First pick one side to be the base. Any one will do, they are all the same length. Then determine the altitude - the perpendicular distance from the chosen base to the opposite side. The area is the product of these two, or, as a formula:

|  |  |  |
| --- | --- | --- |
| http://www.mathopenref.com/images/rhombusarea/ba.gif | where ***b*** is the length of the base ***a*** is the altitude (height). |  |

**2. The "diagonals" method**

Another simple formula for the area of a rhombus when you know the lengths of the diagonals. The area is half the product of the diagonals. As a formula:

|  |  |
| --- | --- |
| http://www.mathopenref.com/images/rhombusarea/d1d2.gif | where ***d1*** is the length of a diagonal |

**6.6 – PROPERTIES OF KITES AND TRAPEZOIDS**

**KITE:**

A kite is a member of the [quadrilateral](http://www.mathopenref.com/quadrilateral.html) family, and while easy to understand visually, is a little tricky to define in precise mathematical terms. It has two pairs of equal sides. Each pair must be [adjacent sides](http://www.mathopenref.com/adjacentsides.html) (sharing a common vertex) and each pair must be distinct. That is, the pairs cannot have a side in common.

**Properties of a kite**

* **Diagonals** [**intersect**](http://www.mathopenref.com/intersection.html) **at** [**right angles**](http://www.mathopenref.com/angleright.html).   
  In the figure above, click 'show diagonals' and reshape the kite. As you reshape the kite, notice the diagonals always intersect each other at 90°
* **Angles between unequal sides are equal**   
  In the figure above notice that ∠ABC = ∠ADC no matter how how you reshape the kite.
* **Area**   
  The area of a kite can be calculated in various ways. See [Area of a Kite](http://www.mathopenref.com/kitearea.html)
* **Perimeter**   
  The distance around the kite. The sum of its sides. See [Perimeter of a Kite](http://www.mathopenref.com/kiteperimeter.html)
* **A kite can become a** [**rhombus**](http://www.mathopenref.com/rhombus.html)   
  In the special case where all 4 sides are the same length, the kite satisfies the definition of a [rhombus](http://www.mathopenref.com/rhombus.html). A rhombus in turn can become a [square](http://www.mathopenref.com/square.html) if its interior angles are 90°. Adjust the kite above and try to create a square.

There are two methods for calculating the area of a kite shown below is the formula you will use.

**The "diagonals" method**

If you know the lengths of the two diagonals, the area is half the product of the diagonals. This is the method used in the figure above. As a formula:

|  |  |  |
| --- | --- | --- |
| http://www.mathopenref.com/images/rhombusarea/d1d2.gif | where ***d1*** is the length of a diagonal ***d2*** is the length of the other diagonal |  |

This also works for finding the [area of a rhombus](http://www.mathopenref.com/rhombusarea.html), and the [area of a square](http://www.mathopenref.com/squarearea.html) since a [rhombus](http://www.mathopenref.com/rhombus.html) is a particular kind of kite (one where all four sides are congruent) and a [square](http://www.mathopenref.com/square.html) is a particular kind of rhombus (where all angles are 90°).

**How to find the perimeter of a kite**

Like any polygon, the perimeter is the total distance around the outside, which can be found by adding together the length of each side. For example, a kite whose sides are 4,4,10 and 10, the perimeter is the sum of these, or:

*Perimeter = 4+4+10+10 = 28*

By definition, a kite has two pairs of equal sides. In the figure above AB=AD and BC=DC. So, as a formula we can say:

|  |  |  |
| --- | --- | --- |
| *perimeter = 2a+2b* | where: *a* is the length of each side in one pair *b* is the length of each side in the other pair |  |

**TRAPEZOIDS:**

**Definition notes**

There is considerable confusion over the definition of 'trapezoid' and 'trapezium' due to differences, as you can see from the table below, the meanings of the two words .

|  |  |  |
| --- | --- | --- |
| **Trapezoid** |  | A quadrilateral with one pair of parallel sides |
| **Trapezium** |  | A quadrilateral with no sides parallel |

**Attributes**

|  |  |
| --- | --- |
| **Base** | One of the parallel sides. Every trapezoid has two bases. See [Base definitions](http://www.mathopenref.com/base.html). |
| **Leg** | The sides AC and BD above are called the legs of the trapezoid, and are usually not parallel, although they could be (see parallelogram note below). Every trapezoid has two legs. |
| **Altitude** | The [altitude](http://www.mathopenref.com/altitude.html) of a trapezoid is the [perpendicular](http://www.mathopenref.com/perpendicular.html) distance from one base to the other. (One base may need to be extended). |
| **Median** | The median of a trapezoid is a line joining the midpoints of the two legs. See [Trapezoid median](http://www.mathopenref.com/trapezoidmedian.html) |
| **Area** | The usual way to calculate the area is the average base length times altitude. See [Area of a Trapezoid](http://www.mathopenref.com/trapezoidarea.html) |
| **Perimeter** | The distance a round the trapezoid. The sum of its side lengths. See [Perimeter of a Trapezoid](http://www.mathopenref.com/trapezoidperimeter.html) |
|  |  |

If both legs are the same length, this is called an **isosceles trapezoid**, and both base angles are the same.

If the legs are parallel, it now has *two* pairs of parallel sides, and is a [parallelogram](http://www.mathopenref.com/parallelogram.html).

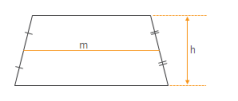
**Area formula**

The area of a trapezoid is given by the formula

|  |  |  |  |
| --- | --- | --- | --- |
| http://www.mathopenref.com/images/trapezium/trapezoidarea.gif | *where b1, b2 are the lengths of the two bases a is the altitude of the trapezoid* |  |  |

Recall that the bases are the two parallel sides of the trapezoid. The altitude (or height) of a trapezoid is the [perpendicular](http://www.mathopenref.com/perpendicular.html) distance between the two bases. This is equivalent to the altitude times the average length of the bases.

**If you know the median**

Recall that the [median](http://www.mathopenref.com/trapezoidmedian.html) (m) of a trapezoid is the line segment linking the midpoints of the non-parallel sides. Recall also that the median's length is the average of the two parallel sides. See [Median of a Trapezoid](http://www.mathopenref.com/trapezoidmedian.html)

If the median length is m, and the altitude h, the area of the trapezoid is http://www.mathopenref.com/images/trapezoidarea/Equation-1.jpg

**Area as a compound shape**

Trapezoid as a compound shapeAnother way to find the area of a trapezoid is treat it as some simpler shapes, and then add or subtract their areas to find the result. For example, a trapezoid could be considered to be a smaller rectangle plus to right triangles.