

# 1 Sorting Quadrilaterals

## Attributes and Properties of Quadrilaterals

All geometric shapes have attributes. Attributes are features of a shape, for example, the numbers of sides and corners.

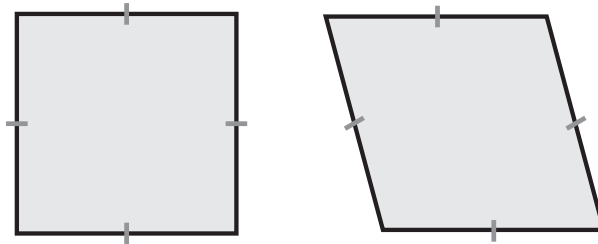
Some attributes are true of every shape of a certain type. These attributes are called properties. For example, quadrilaterals are four-sided shapes. Having four sides is a property of all quadrilaterals.

Here are some attributes and properties of quadrilaterals.

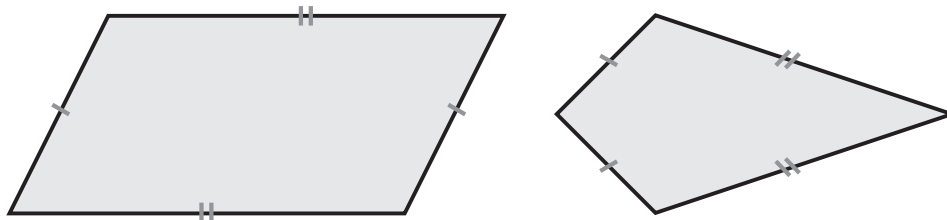
### Equal Sides

Some quadrilaterals have sides that are all equal in length. For example, squares and rhombuses have sides that are equal in length. All equal sides is a property of squares and rhombuses.

We use hatch marks on the sides of a shape to show that the sides are equal.



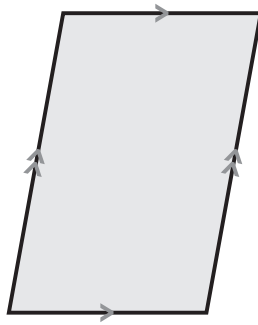
Some quadrilaterals, such as parallelograms and kites, have some sides that are equal in length. Having some equal sides is a property of kites and parallelograms.



### Parallel Sides

Some quadrilaterals have parallel sides. Parallelograms, such as squares, rectangles, and rhombuses, have two pairs of parallel sides. Having two pairs of parallel sides is a property of these squares, rectangles, and rhombuses. Trapezoids have one pair of parallel sides. Having one pair of parallel sides is a property of trapezoids.

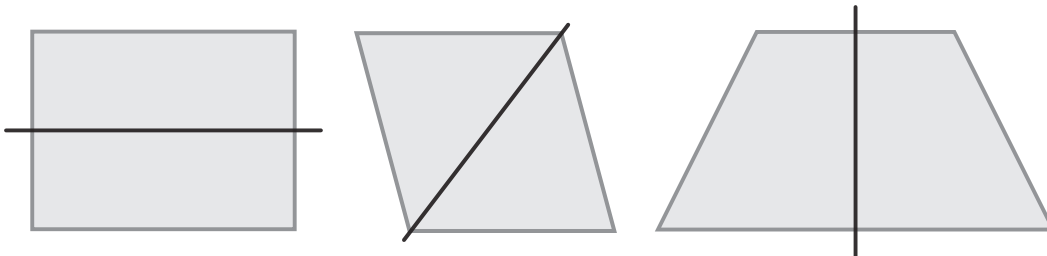
We use arrows on the sides of a shape to show that the sides are parallel.



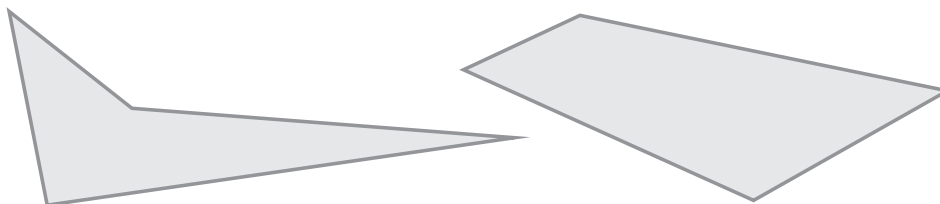
### Symmetry

Many quadrilaterals have the attribute of symmetry.

The following quadrilaterals all have one line of symmetry. One side of the shape is a mirror image of the other side.



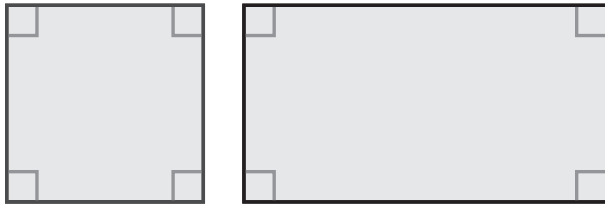
The following quadrilaterals do not have a line of symmetry.



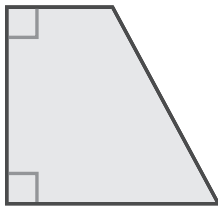
## Types of Angles

Rectangles and squares have all right angles ( $90^\circ$  angles). Right angles are a property of squares and rectangles.

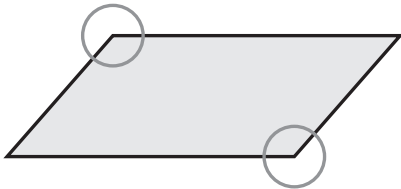
We use small squares in the corner to show right angles in shapes.



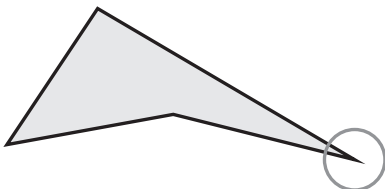
Some quadrilaterals, like this trapezoid, have some right angles. The right angles are attributes of **this** trapezoid because not all trapezoids have right angles.



Some quadrilaterals have angles greater than a right angle.

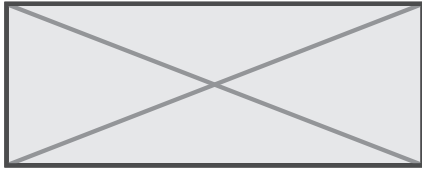


Some quadrilaterals have very small angles.

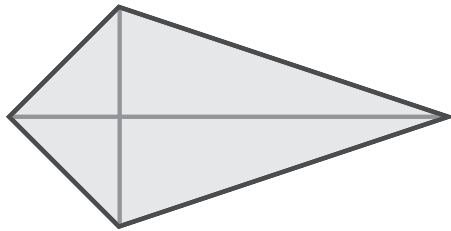


## Diagonals

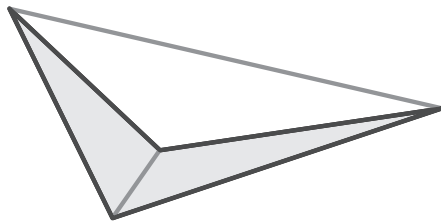
Diagonals of a shape connect vertices not already connected by edges of the shape. Rectangles have diagonals that are equal in length. Having diagonals that are equal in length is a property of rectangles.



Some quadrilaterals such as kites have diagonals that are not equal in length.



The diagonals of some quadrilaterals are outside of the shape.



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## Naming Quadrilaterals

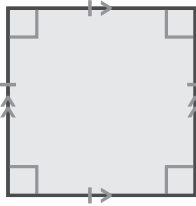
Squares, rectangles, parallelograms, rhombuses, kites, and trapezoids are all examples of quadrilaterals. These shapes have specific properties.

Some shapes can be named in many ways. For example, a square is also a rectangle, a rhombus, a parallelogram, and a quadrilateral since it meets all the definitions of all the shapes.

**Naming Quadrilaterals (continued)**

- Square

Properties: four equal sides; opposite sides are parallel; four square corners



- Rectangle

Properties: opposite sides are equal; opposite sides are parallel; four square corners



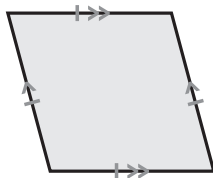
- Parallelogram

Properties: opposite sides are equal and opposite sides are parallel



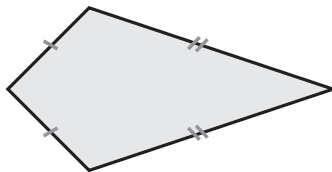
- Rhombus

Properties: four equal sides; opposite sides are parallel



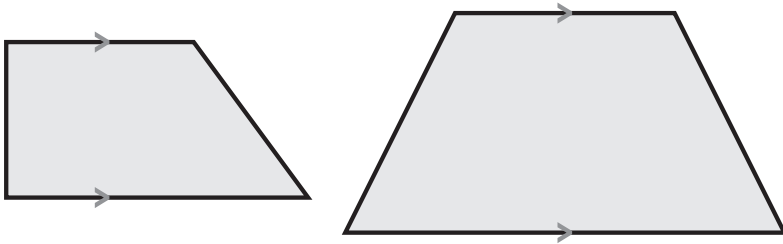
- Kite

Properties: no parallel sides; two pairs of adjacent sides equal



### Naming Quadrilaterals (continued)

- Trapezoid  
Property: one pair of parallel sides



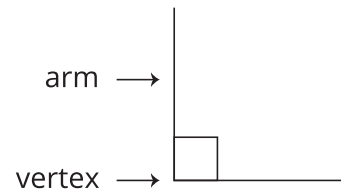
### Combining Properties

Some properties of quadrilaterals can be combined, but some cannot. For example, a quadrilateral can have four right angles and four equal sides (as a square does), but a quadrilateral cannot have four right angles and all sides of different lengths.

If a quadrilateral has symmetry, it has to have some sides that are equal in length.

### Definitions

**angle:** the amount of rotation between two lines (called arms) that meet at a point (called the vertex)



**attribute:** a characteristic of a shape, for example, the number of sides, number of vertices, or size

**diagonal (of a polygon):** a line that is not a side but connects any two vertices of a polygon

**kite:** a quadrilateral with two pairs of adjacent equal sides and no parallel sides

## Definitions (continued)

**line of symmetry:** a line that divides a 2-D shape in half so that if you were to fold along the line, the halves would match; shapes can have more than one line of symmetry

**parallel:** a term describing lines that are always the same distance apart

**parallelogram:** a quadrilateral that has two pairs of parallel and equal sides

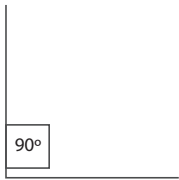
**property:** an attribute that is shared by all shapes of a certain type; for example, a property of squares is having four equal sides

**quadrilateral:** a four-sided polygon, for example, a square, a trapezoid, or a kite

**rectangle:** a parallelogram with four right angles

**rhombus:** a parallelogram with four equal sides

**right angle:** a  $90^\circ$  angle



**square:** a rectangle with four equal sides; also a rhombus with four right angles

**symmetry (of a 2-D shape):** the ability of a shape to be folded in half so that the halves match exactly

**trapezoid:** a quadrilateral that has two parallel sides