# Quadrilateral quest

Students review the properties of the 6 special quadrilaterals: square, rectangle, parallelogram, trapezium, kite and rhombus through a variety of activities. The lesson concludes with a visual overview of the hierarchy of different types of quadrilaterals.

## Visible learning

### Learning intention

* To be able to compare quadrilaterals using their properties.

### Success criteria

* I can identify different types of quadrilaterals.
* I can compare quadrilaterals using their properties.
* I can justify why a shape is a particular quadrilateral.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* Identifies and applies the properties of triangles and quadrilaterals to solve problems  
  **MA4-GEO-C-01**

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## Activity structure

Please use the associated PowerPoint *Quadrilateral quest* to display images in this lesson.

### Launch

1. Randomly assign students in groups of 3 ([bit.ly/visiblegroups](https://bit.ly/visiblegroups)).
2. Verbally state each of the following scenarios below, one at a time. Use slides 2 and 3 of the *Quadrilateral quest* PowerPoint to display a brief summary for students to discuss in their groups of 3.

Jenna has a shape that she claims must be a rectangle. It has 4 straight sides and the opposite sides are the same length. Is she right? Explain your reasoning.

On his quadrilateral George measured one right angle and found that all 4 sides were straight and had the same length. George decided his shape must be a square. Do you think George is correct? Explain your reasoning.

These questions should spark students’ prior knowledge of each of the quadrilateral’s properties. Some prompting questions may be required for students to consider the possibilities.

1. After allowing time for students to discuss their reasoning in their groups of 3, use a questioning technique such as Pose-Pause-Pounce-Bounce [PDF 200KB] ([bit.ly/pausepouncebouncestrategy](https://bit.ly/pausepouncebounce)) for students to share their answers and reasoning for each of the scenarios.

### Explore

For the following 3 activities students need to recall the properties of each of the quadrilaterals previously explored in this unit: square, rectangle, parallelogram, trapezium, rhombus, and kite. A brief review may be required before commencing these activities.

#### Constructing quadrilaterals

1. Issue students with mini whiteboards ([bit.ly/miniwhiteboards](https://bit.ly/miniwhiteboards)).

If mini whiteboards aren’t available students can use one sheet of laminated A4 paper, or a sheet of paper in a plastic sleeve.

1. Challenge students to draw the following one at a time:

* a square that is not a rectangle
* a parallelogram that is not a trapezium
* a rhombus that is not a parallelogram.

1. After each instruction, allow students time to draw. Ask students to display their image for you and the class to view.
2. Conduct a class discussion about what students noticed and wondered ([bit.ly/noticewonderstrategy](https://bit.ly/noticewonderstrategy)) when trying to draw the above shapes. Use a questioning strategy such as Pose-Pause-Pounce-Bounce question strategy [PDF 200KB] ([bit.ly/pausepouncebouncestrategy](https://bit.ly/pausepouncebouncestrategy)) for students to share their thoughts. Students should be prompted to discuss if a drawing was impossible to construct, or to explain the strategy they used to complete the instruction.

#### Classifying quadrilaterals

1. Keep students in their previous groups of 3.
2. Issue each group with Appendix A ‘Classifying quadrilaterals’ which contains a table comparing the number of parallel and equal sides. Students need to consider if any of the 6 quadrilaterals fit into each of the cells of the table. This activity is best completed at vertical non-permanent surfaces ([bit.ly/VNPSstrategy](https://bit.ly/VNPSstrategy)) where students can easily remove errors if needed.
3. Once students complete the task, encourage students to go on a gallery walk ([bit.ly/DLSgallerywalk](https://bit.ly/DLSgallerywalk)) to compare other group’s responses with their own.
4. A class discussion may be held after this for students to share if they would make changes to their own work, or to give reasons why a quadrilateral should or should not be placed in a particular cell of the table. The discussion should also explore what students noticed and wondered when they finished their table. For example, no quadrilateral had one pair of equal sides (unless an isosceles trapezium was listed, which is a trapezium where the sides that are not parallel are equal in length).

#### What quadrilateral am I?

1. Hand out Appendix B ‘What quadrilateral am I?’ to each group of 3. This contains a page of quadrilaterals that have not been drawn to scale but have geometrical notations that explain the properties of the quadrilateral. Students need to determine what the best name is for each quadrilateral.

For each group, Appendix B could be enlarged onto A3 paper and attached to a vertical surface for the group to work from.

1. Have each group combine with another group to compare answers, encouraging students to discuss their reasoning.

### Summarise

1. Issue students with Appendix C ‘Table of quadrilateral properties’.
2. Have students work independently to tick the relevant cells that correspond to the properties of each of the 6 special quadrilaterals.
3. Once completed, develop the solutions as a class, through a class discussion using the Pose-Pause-Pounce-Bounce question strategy [PDF 200KB] ([bit.ly/pausepouncebouncestrategy](https://bit.ly/pausepouncebouncestrategy)) questioning technique. The solutions can be found in the sample solutions at the conclusion of this document.
4. Using the completed Appendix C, as a class, create a hierarchy of the six quadrilaterals as a Venn diagram and/or a flow chart. Completed Venn diagrams and flow charts can be found on slides 5 and 6 of the *Quadrilateral quest* PowerPoint.

### Apply

Students are to complete these two activities in visibly random groups of 3.

#### Activity 1 – quadrilateral statements

1. At vertical non-permanent surfaces, each group of 3 completes statements about quadrilaterals using Appendix D ‘Quadrilateral statements’.
2. Students can complete a gallery walk to view other group’s responses, followed by a class discussion.

#### Activity 2 – properties of quadrilaterals Venn diagrams

1. At vertical non-permanent surfaces, students complete the ‘Properties of quadrilaterals Venn diagrams’ activity in Appendix E.
2. Students select a quadrilateral that could belong in each of the regions of the Venn diagram. If they believe a section is impossible to fill, they need to justify their reasoning.

* Two versions of this task have been created, a double and a triple Venn diagram.
* Students could be challenged to create their own Venn diagram task using criteria of their choice. They should also complete sample solutions for their activity.

1. Students may like to do a gallery walk to compare their Venn diagrams with other groups.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* The scenarios provided should spark students’ prior knowledge of each of the quadrilateral’s properties. Some prompting questions may be required for students to consider the possibilities and a review of some of the properties of quadrilaterals may be required.

**Explore**

* Students may struggle to construct the quadrilaterals with its restrictions and this activity may be best done as a class or in pairs.
* Students could be challenged to create another table in Appendix A that compares properties of the 6 quadrilaterals, such as one that includes the properties of diagonals.
* Students may need some assistance interpreting Appendix B, as each quadrilateral appears the same but has different notations marked on it which indicate which quadrilateral it is.

**Summarise**

* Students could be encouraged to create their own hierarchy of the six quadrilaterals as a Venn diagram and/or a flow chart independently or in pairs, rather than as a class.

**Apply**

* Two Venn diagrams have been provided, one a double and the other a triple. Choose the appropriate one for your students.
* Students could be challenged to create their own criteria for properties of quadrilaterals Venn, complete with sample solutions.

### Suggested opportunities for assessment

* Monitor student conversations and responses during class discussions to check for any misconceptions or to address further learning that may be required.
* Appendix A, B and C can be collected as evidence of student learning.

## Appendix A

### Classifying quadrilaterals

Determine where each of the 6 quadrilaterals fit within the table below by considering if the shape has equal and/or parallel sides.

* Square
* Rectangle
* Parallelogram
* Trapezium
* Rhombus
* Kite

|  |  |  |  |
| --- | --- | --- | --- |
|  | **No parallel sides** | **One pair of parallel sides** | **Two pairs of parallel sides** |
| **No equal sides** |  |  |  |
| **One pair equal sides** |  |  |  |
| **Two pairs of equal sides** |  |  |  |
| **All sides equal** |  |  |  |

## Appendix B

### What quadrilateral am I?

The following quadrilaterals have not been drawn to scale but contain geometry conventions to indicate their properties.

Write the best name for each of the quadrilaterals using the choices: *quadrilateral, square, rectangle, parallelogram, trapezium, rhombus, and kite*.

|  |  |  |
| --- | --- | --- |
| A quadrilateral showing all sides equal. | A quadrilateral showing 3 angles as 90 degrees. | A quadrilateral showing opposite sides parallel. |
| A quadrilateral showing one pair of equal parallel sides. | A quadrilateral showing all sides equal and one angle 90 degrees. | A quadrilateral showing diagonals that bisect each other. |
| A quadrilateral showing all interior angles to be equal. | A quadrilateral showing 2 pairs of equal adjacent sides. | A quadrilateral with one diagonal drawn in, showing 2 angles equal in the triangle formed. |
| A quadrilateral showing one pair of parallel sides. | A quadrilateral showing diagonals that are equal and bisect each other. | A quadrilateral showing opposite angles equal. |
| A quadrilateral showing two interior angles to be 90 degrees. | A quadrilateral showing 2 opposite equal angles to be 90 degrees and 2 equal pairs of adjacent sides. | A quadrilateral showing unequal diagonals that bisect each other at right angles. |
| A quadrilateral showing equal diagonals that bisect each other at right angles. | A quadrilateral showing diagonals that cross at right angles. One diagonal is bisected by the other diagonal. | A quadrilateral showing one pair of opposite angles that are 90 degrees. |

## Appendix C

### Table of quadrilateral properties

Tick each of the cells to make this table represent all the properties of each quadrilateral.

A table with 6 quadrilaterals listed along the top: square, rhombus, rectangle, parallelogram, trapezium and kite. 
Down the first column is a list of properties: opposite sides are parallel, opposite sides are equal, all sides are equal, adjacent sides are perpendicular, opposite angles are equal, diagonals are equal, diagonals bisect each other, diagonals bisect each other at right angles and diagonals bisect the angles of the quadrilateral. 

## Appendix D

### Quadrilateral statements

#### Part 1

Directions: Use the terms: always, never, sometimes, square, rectangle, parallelogram, trapezium, rhombus, and kite to complete the 2 sentences.

* Every rectangle is also a \_\_\_\_\_\_\_\_\_\_\_\_, and every \_\_\_\_\_\_\_\_\_\_\_\_ is also a kite.
* A rhombus is \_\_\_\_\_\_\_\_\_\_\_\_ a square and a rectangle is \_\_\_\_\_\_\_\_\_\_\_\_ a trapezium.

#### Part 2

Directions: Use the terms square, rhombus, kite, parallelogram, trapezium, rectangle, irregular quadrilateral at most one time each to complete the 2 sentences.

* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ but not a \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ but not a \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Appendix E

### Properties of quadrilaterals Venn diagrams

#### Double Venn diagram

A double venn diagram. 
The first circle is labelled 'A' with the title 'no equal angles', the second circle is labelled 'B' with the title 'one pair of parallel sides'. The overlap of the circles is labelled 'C' and outside both circle is labelled 'D'. 
There are 2 text boxes which read:
'Draw a quadrilateral that could belong in each of the regions' and 'If you think a region is impossible to fill, convince me why!'

#### Triple Venn diagram

A triple venn diagram. 
The first circle is labelled 'A' with the title 'at least one pair of parallel sides', the second circle is labelled 'B' with the title 'at least one right-angle' and the third circle is labelled 'C' with the title 'all 4 sides are the same length. The overlap between the first and second circle is labelled 'D', the overlap between the second and third circle is labelled 'E', the overlap between the first and third circle is labelled 'F' and the overlap of all 3 circles is labelled 'G'. Outside the 3 circles is labelled 'H'. 
There are 2 text boxes which read: 'Draw a quadrilateral that could belong in each of the regions' and 'If you think a region is impossible to fill, convince me why!'

## Sample solutions

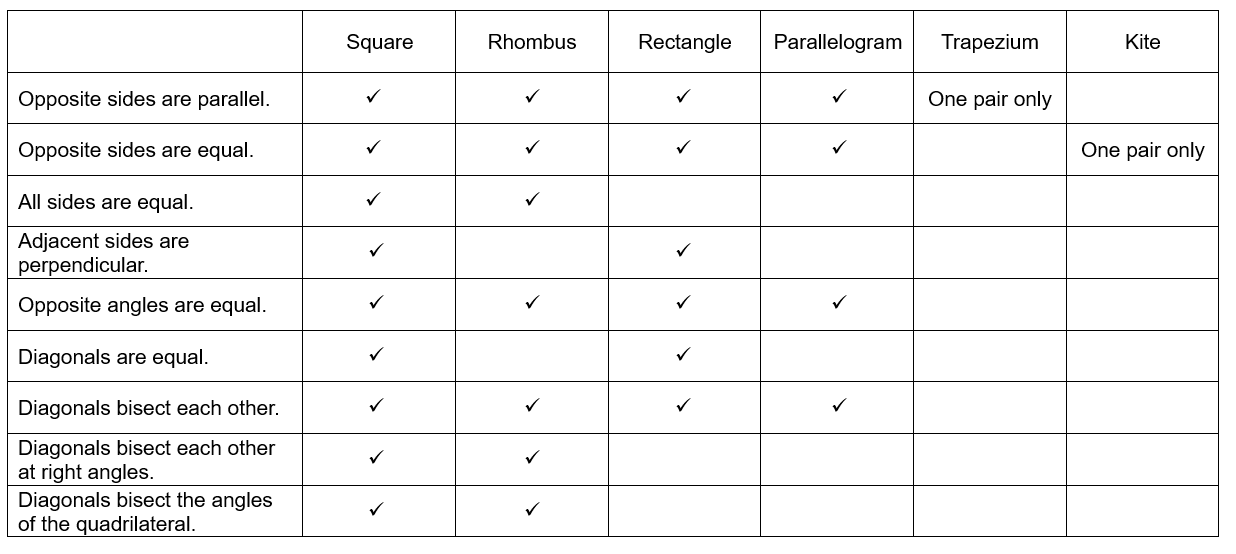
### Appendix A – classifying quadrilaterals

|  |  |  |  |
| --- | --- | --- | --- |
|  | **No parallel sides** | **One pair of parallel sides** | **Two pairs of parallel sides** |
| **No equal sides** |  | Trapezium |  |
| **One pair equal sides** |  |  |  |
| **Two pairs of equal sides** | Kite |  | Parallelogram  Rectangle |
| **All sides equal** |  |  | Square  Rhombus |

### Appendix B – What quadrilateral am I?

1. Rhombus
2. Rectangle
3. Parallelogram
4. Parallelogram
5. Square
6. Parallelogram
7. Rectangle
8. Kite
9. Trapezium
10. Trapezium
11. Rectangle
12. Parallelogram
13. Trapezium
14. Kite
15. Rhombus
16. Square
17. Kite
18. Rectangle

### Appendix C – table of quadrilateral properties



### Appendix D – quadrilateral statements

#### Part 1

Every **rectangle** is also a parallelogram, and every **rhombus** is also a kite.

A rhombus is **sometimes** a square and a rectangle is **always** a trapezium.

#### Part 2

A **square** is a **rectangle** but not a **kite**.

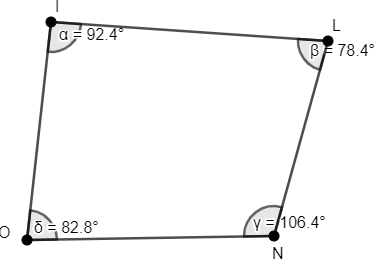
A **rhombus** is a **parallelogram** but not a **trapezium**.

Please note that the final 2 statements are sample answers, other options could be explored. These questions are from Open Middle ([openmiddle.com/what-is-it-not/](https://www.openmiddle.com/what-is-it-not/)).

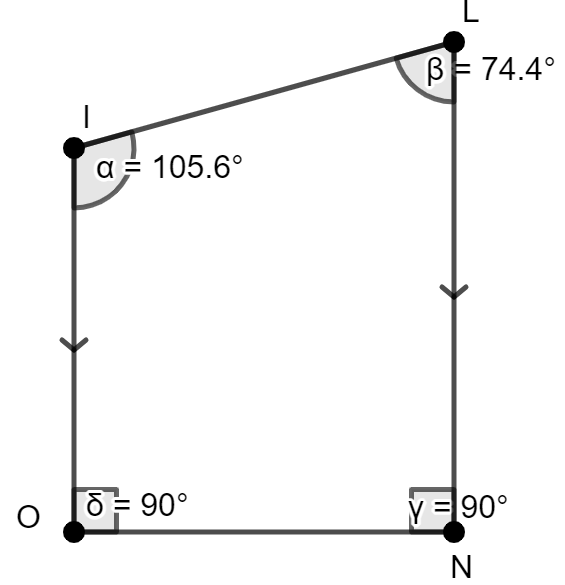
### Appendix E – properties of quadrilaterals Venn diagrams

#### Double Venn diagram

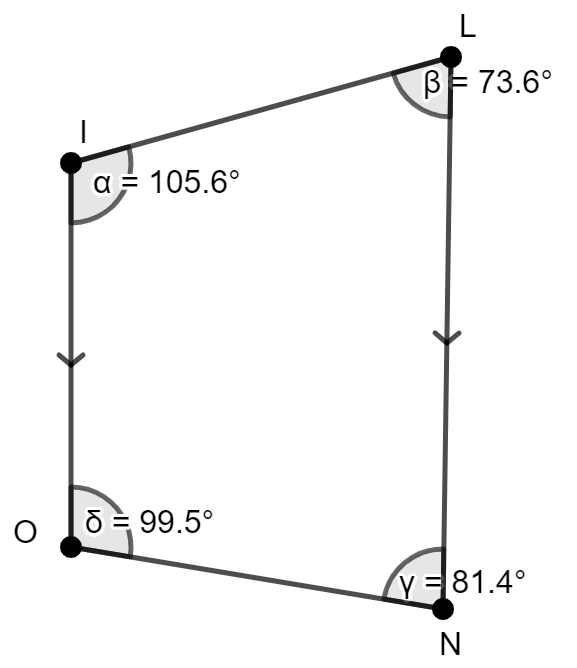
* Section A: Quadrilateral



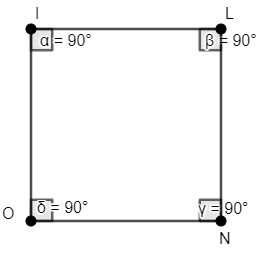
* Section B: Trapezium



* Section C: Trapezium

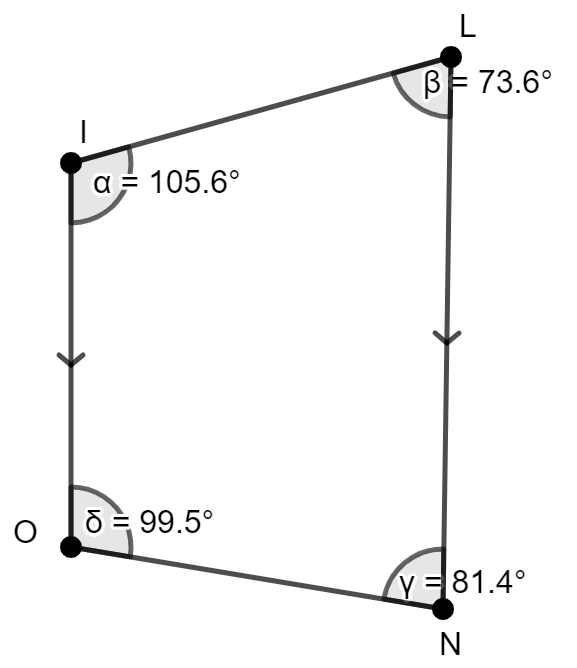


* Section D: Square

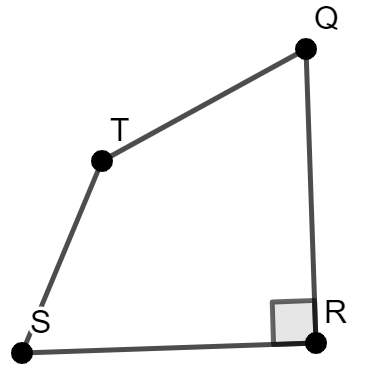


#### Triple Venn diagram

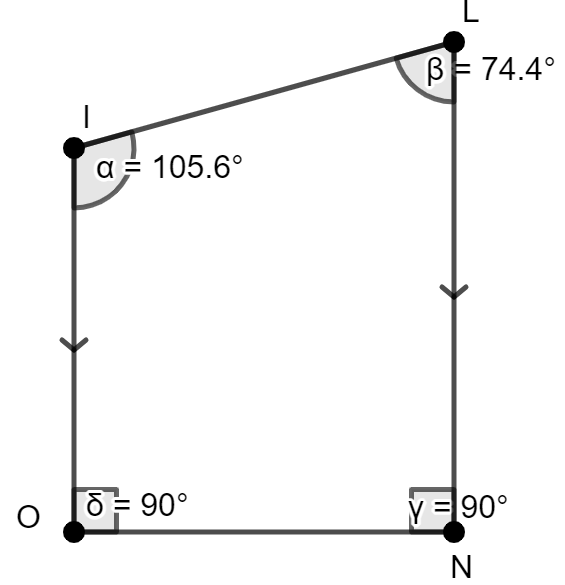
* Section A: Trapezium



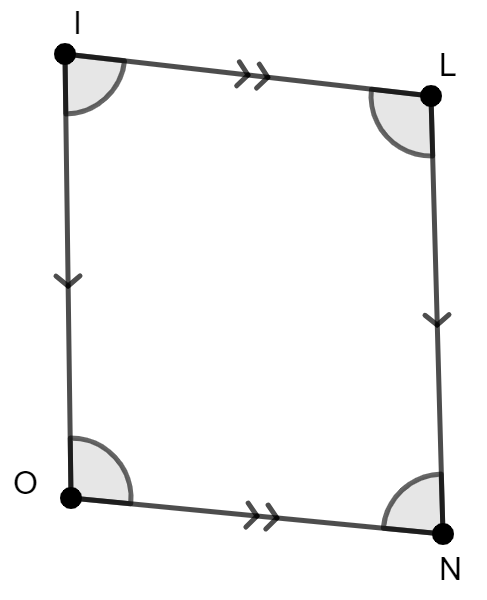
* Section B: Quadrilateral



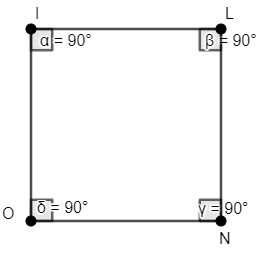
* Section C: empty as you can only make a rhombus or square which both have parallel sides.
* Section D: Trapezium



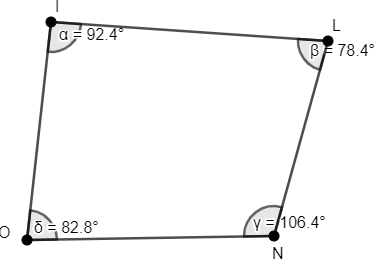
* Section E: empty as you can only make a rhombus or square which both have parallel sides.
* Section F: Rhombus



* Section G: Square



* Section H: Quadrilateral



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