Angles in Triangles and Quadrilaterals

Objectives:

- To investigate the sum of the angles of triangles and quadrilaterals.

Learning Outcomes:

I can identify acute, right, obtuse, straight and reflex angles.

I can distinguish and describe equilateral, isosceles, right-angled and scalene triangles.

I can distinguish and describe square, rectangle, rhombus, parallelogram, trapezium, kite and irregular quadrilateral.

I can measure angles accurately using a protractor.

I know the total interior angles of triangles and quadrilaterals.

Method: A series of lessons using a combination of whole-class teaching, pair, group and individual work.

What you need: Rulers, protractors, pupil worksheets. [Optional - sets of plastic 2D shapes, construction materials such as geostrips.]

Introductory Task 1: True/false statements and Questions to puzzle over (Think, pair, share)

This challenge is designed to get pupils thinking and to give you an insight into their prior learning. Establish in the follow-up discussion the answers that most pupils agree on and challenge those with an answer to explain their thinking to those who are not sure. Leave any unsolved problems open for the pupils (and you!) to puzzle over.

Introductory Task 2: Types of Angles

Knowing the size of answer you expect when measuring angles can help you avoid mistakes in the use of the protractor. Depending on their prior experience, you may wish to give your pupils this starter activity to consolidate their knowledge of the different types of angle.

The follow-up discussion should allow you to clarify any misconceptions about the names for different angles and establish how accurate or otherwise the pupils are in their use of a protractor. The correct definitions are as follows:

0 < acute angle < 90   Right angle = 90

90 < obtuse angle < 180   Straight angle = 180

180 < reflex angle < 360   Complete revolution = 360.

Main Lesson

Explain to the pupils the concept of 'total interior angle' for a shape. (The total you get when you add the interior angles from each corner). Some pupils may already have demonstrated in their responses to the first starter activity that the total of the interior angles for a particular triangle is 180 degrees, and the total for a particular quadrilateral is 360 degrees. Discuss whether the pupils think this would hold good for all triangles and quadrilaterals or only apply to certain ones. Perhaps it would only work for regular ones? How could they check?

Agree that drawing various shapes and carefully measuring their angles would be a good approach.

Get consensus that for this investigation there will be certain skills that the pupils will need. They will need to be accurate both with measuring angles using a protractor and in carrying out simple calculations. Today's lesson will help them to hone these skills.

Explain that they are going to be given a series of triangles and quadrilaterals on paper. They have to measure the angles and then add them together to find the total of the interior angles.

Demonstrate to the pupils how to use a protractor correctly. (There are a number of good online tools which can be used for this – project one on to the interactive whiteboard.) It is suggested that you use 180 degree protractors for this lesson. 360 degree protractors are generally easier to use, so learning the 180 correctly will ensure that pupils are able to use either.

Discuss potential *sources of error* and highlight the following points:
- The 'cross hairs' at the centre of the protractor should be **exactly on the point** where the two lines that form the angle meet.
- One of the zero lines should be **lined up exactly** along one of the lines that forms the angle.
- The two sets of numbers around the edge go in opposite directions. Ensure that you **measure from the correct zero**.
- Ensure that you **count the correct way between two labelled markings**. (Pupils will often misread, for example, 128 degrees for 132 degrees, correctly noting that the angle is two marks from the 130 but counting in the wrong direction.)

Set the pupils the measuring task. (See pupil sheets). Circulate and support where necessary, to eliminate as many errors as possible and to clarify misunderstandings.

Follow-up discussion: Establish a consensus as to the measurement of each angle and get pupils to mark their own work and make notes on their sheets as to the causes of their errors. (You could ask pupils to mark their work in coloured pen, writing in the correct answers where necessary, and then go back and re-measure the angles that they got wrong to identify their sources of error.)

Discuss the results for the totals of the interior angles.

Note that the totals for the triangles all add to approximately 180 degrees and for the quadrilaterals to 360 degrees. (Minor variations could be put down to inaccuracy in measuring.) Encourage further debate as to whether the total will be the same for all triangles and for all quadrilaterals.

To encourage further investigation, suggest that pupils each draw their own shape and measure its angles.

Extension Activity

Pupils requiring additional challenge may like to investigate the total of the interior angles for shapes with more sides (pentagon, hexagon, etc).

Pentagons turn out to be 540 degrees, hexagons 720 degrees etc. Ask the pupils what the pattern is in the numbers.

[Please see the separate investigation on this topic if you wish to explore it in more depth.]

True/False Statements for Discussion

The angles of any triangle add up to 180 degrees.

No quadrilateral has exactly three right angles.

The angles in a kite always add up to 360 degrees.

The angles of an equilateral triangle are all 45 degrees.

Questions to Puzzle Over

How **small** can the **largest** angle in a triangle be?

Do the angles in all quadrilaterals add to the same total?

What kinds of angles can an isosceles triangle have?

Can you have a triangle with two obtuse angles?

Types of Angle

How many angles can you find in this diagram? Which of them are acute, right, obtuse, straight and reflex?
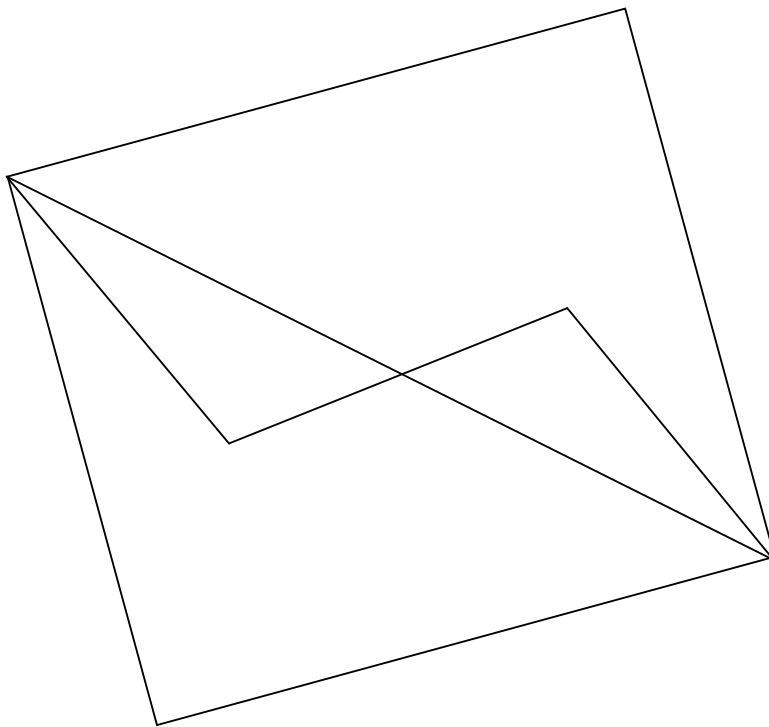
Measure them with a protractor. Label them all.

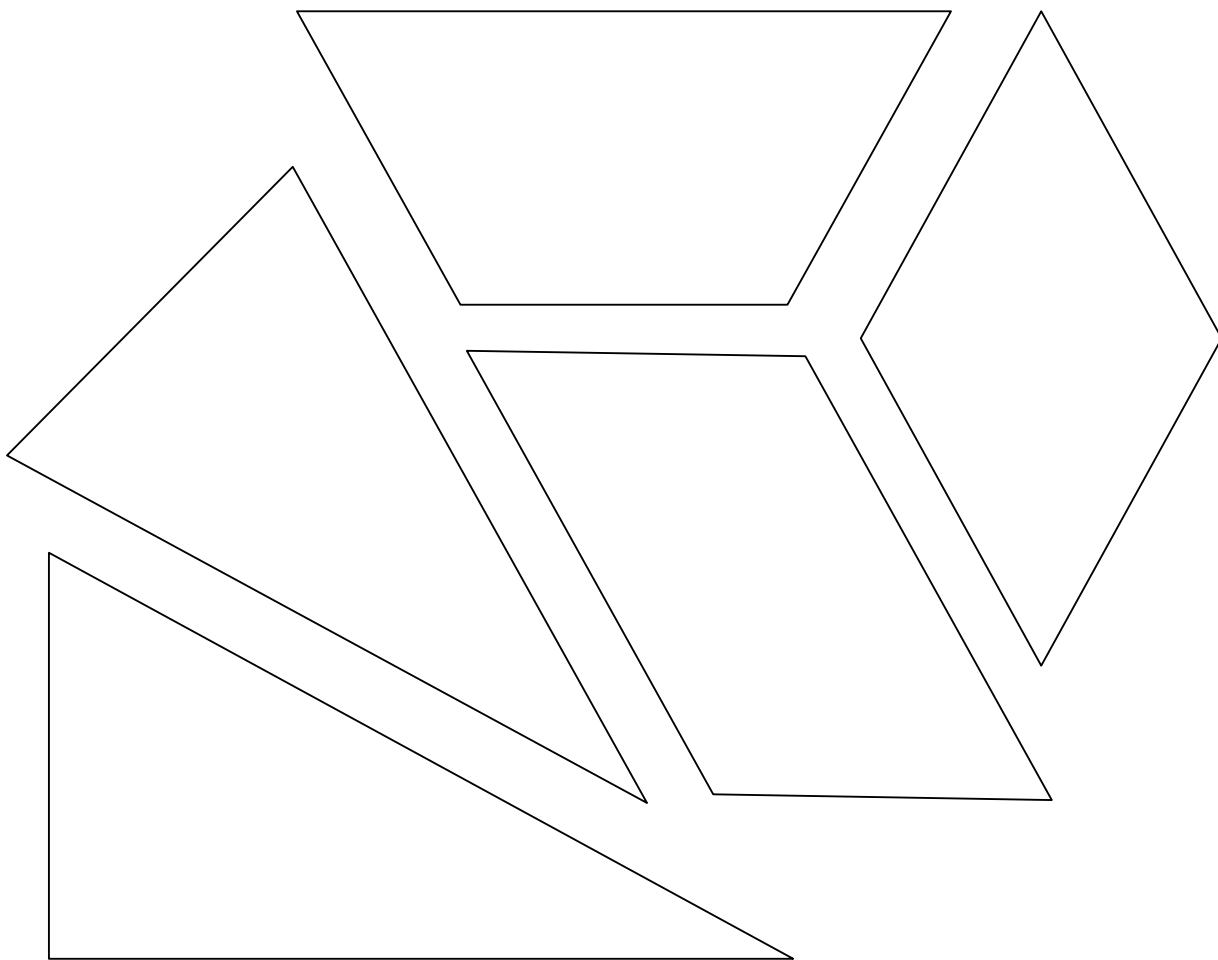Agree a definition of what acute, right, obtuse, straight and reflex angles are.

Name: _____   Class: _____   Date: _____

Totals of Interior Angles

Measure the angles and record them on the shapes.

For each shape, calculate the **total of the interior angles**.

Name the shapes.

Look at the totals of the interior angles. What do you notice?

What do you think the totals would be for other triangles and

quadrilaterals? Investigate!