

# A Departmental Workshop

## Angle Properties

*This is a suggested plan for a professional development session. It has been written to support anyone wishing to lead such a session with a group of teachers and the green 'key points' sections are intended as a support specifically for such a facilitator in guiding discussions.*

*N.B. These workshops have been written to provide enough professional development activity and discussion for one session of approximately one hour with the option of further activity (as outlined in the 'Possible next steps' section at the end). This final section references the NCETM Secondary Mastery Professional Development Materials which can be found here [www.ncetm.org.uk/secondarymasterypd](http://www.ncetm.org.uk/secondarymasterypd)*

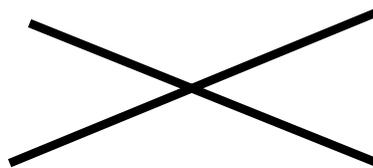
### Overview

Some facts in maths are to do with convention and so just need to be memorised (e.g. the first number in a coordinate is called the 'x' coordinate and signifies how many across). However, the vast majority of mathematical facts are the result of logical and reasoned deduction from fundamental mathematical structures. The student who understands these structures well can easily recall important facts and formulae without the need for rote learning or 'blind' memory. The fact that the sum of the interior angles in a triangle is  $180^\circ$  is not an arbitrary fact; it is true for a reason. Similarly, the range of other angle facts and properties that students need to know and use at Key Stage 3 have their basis in a few key structures.

This workshop explores the fundamental structures underpinning angle properties and gives you the opportunity to work with other teachers and discuss:

- how to support students in understanding these key structures and seeing all the various angle properties as part of a connected whole
- what implications there might be for your future practice and curriculum development.

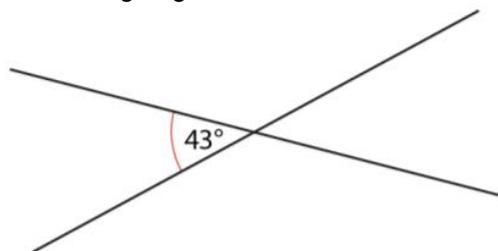
**Activity 1a:** Invite everyone in the group to take two pencils (or any other similar model for two straight lines) and make the following arrangement:



Offer the following instructions:

- think of the point of intersection as a hinge and 'open and close' the gap between the two lines, paying attention to how the various angles between the lines change
- keep one of the lines still and just rotate the other line about the hinge, again attending to how the angles change and how they are related.

**Activity 1b:** Draw the following diagram on the board or flipchart and invite everyone in the group to draw it and fill in the missing angles



### Discussion

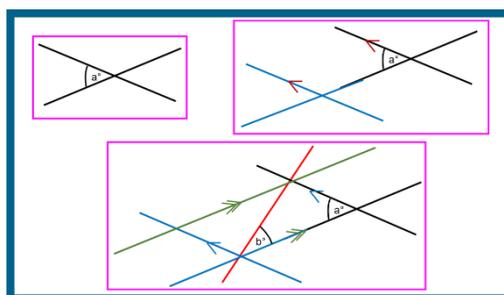
- What is the minimum amount of information that a student needs to know to be able to fill in the three missing angles?
- Is this something they need to memorise or can they reason it out?
- What are the fundamental ideas behind 'vertically opposite angles' and what, if anything, needs to be 'just memorised'?

**Key Point:** In the diagram there are two straight lines. By considering one of them, the  $43^\circ$  angle, and the fact that angles on a straight line add up to  $180^\circ$ , the  $137^\circ$  can be obtained. Then by considering the other straight line and this  $137^\circ$  angle, the second  $43^\circ$  can be found. Similarly, for the second  $137^\circ$  angle.

So, the fact that angles on a straight line add up to  $180^\circ$  needs to be known. But is this a fact you just have to memorise or is there a way to reason this out?

Maybe the only (arbitrary) fact to memorise is that a full turn is  $360^\circ$  and everything else can be reasoned about.

**Activity 2:** Using the handout (slide 1 in the PowerPoint file), invite everyone in the group to look at the following sequence of diagrams and to fill in the missing angles



Alternatively, watch the animated PowerPoint slide 2, showing the same diagrams.

**Key Point:** It is not uncommon for students to be introduced to the idea that the sum of the interior angles in a triangle is  $180^\circ$  before any other angle properties (e.g. vertically opposite angles are equal).

This can result in students seeing such things as merely facts to learn and not properties arising as a result of reasoning from some earlier results. Considering the ideal order that certain mathematical ideas are introduced and built on from earlier ones, is an important consideration when designing a coherent curriculum.

### Discussion

- What is the minimum amount of information that a student needs to know to be able to fill in the missing angles themselves?
- What is the chain of reasoning required to deduce that the sum of the interior angles in a triangle is  $180^\circ$ ?
- If you offered these diagrams to your students, how would you present them and what questions would you ask to support them in their reasoning?

### Possible next steps

This session may have surfaced some more long-term developments that you and your department (or group of teachers you are working with) wish to take. This section offers a way of doing this at some point in a future session or series of sessions.

Have a look at 'Core Concept 6.1: Geometrical Properties' from the [NCETM Secondary Mastery Professional Development Materials: Theme 6](#).

In particular, look at the key ideas in 6.1.1 '*Understand and use angle properties*' (page 8 and pages 12 to 22) and discuss:

- how these ideas might influence your own teaching of angle properties in KS3
- how the teaching of angle properties is introduced and sequenced in your current scheme of work
- how the ideas in this workshop might support developments in your scheme of work.