Line symmetry and reflection

Year 8

#MathsEveryoneCan

White Rose Maths

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Autumn	Proportional Reasoning						Representations					
	Ratio and scale		Multiplicative change		Multiplying and dividing fractions		Working in the Cartesian plane			Representing data		Tables & Probability
Spring	Algebraic Techniques						Developing Number					
	Brackets, equations and inequalities				Sequences	Indices	Fractions and percentages		Standard index form		Number sense	
Summer	Developing Geometry						Reasoning with Data					
	Angles in parallel lines and polygons		Area of trapezia and circles		Line symmetry and reflection		The data handling cycle				Measures of location	

Summer 1: Developing Geometry

Weeks 1 and 2: Angles in parallel lines and polygons

This block builds on KS2 and Year 7 understanding of angle notation and relationships, extending all students to explore angles in parallel lines and thus solve increasingly complex missing angle problems. Links are then made to the closely connected properties of polygons and quadrilaterals. The use of dynamic geometry software to illustrate results is highly recommended, and students following the Higher strand will also develop their understanding of the idea of proof. They will also look start to explore constructions with rulers and pairs of compasses. This key block may take slightly longer than two weeks and the following blocks may need to be adjusted accordingly.
National Curriculum content covered includes:

- apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
- understand and use the relationship between parallel lines and alternate and corresponding angles
- derive and use the sum of angles in a triangle and use it to deduce the angle sum in any polygon, and to derive properties of regular polygons
- use the standard conventions for labelling the sides and angles of triangle ABC
- derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures [for example, equal lengths and angles] using appropriate language and technologies
- derive and use the standard ruler and compass constructions (H only)

Weeks 3 and 4: Area of trapezia and circles

Students following the Higher strand will have met the formulae for the area of a trapezium in Year 7; this knowledge is now extended to all students, along with the formula for the area of a circle.

A key aspect of the unit is choosing and using the correct formula for the correct shape, reinforcing recognising the shapes, their properties and names and looking explicitly at compound shapes.
National Curriculum content covered includes:

- derive and apply formulae to calculate and solve problems involving: perimeter and area of triangles, parallelograms, trapezia
- calculate and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes

Weeks 5 and 6: Line symmetry and reflection

The teaching of reflection is split from that of rotation and translation to try and ensure students attain a deeper understanding and avoid mixing up the different concepts. Although there is comparatively little content in this block, it is worth investing time to build confidence with shapes and lines in different orientations. Students can revisit and enhance their knowledge of special triangles and quadrilaterals and focus on key vocabulary such as object, image, congruent etc.
Rotation and translations will be explored in Year 9
National Curriculum content covered includes:

- describe, sketch and draw using conventional terms and notations: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons that are reflectively and rotationally symmetric
- identify properties of, and describe the results of reflections applied to given figures

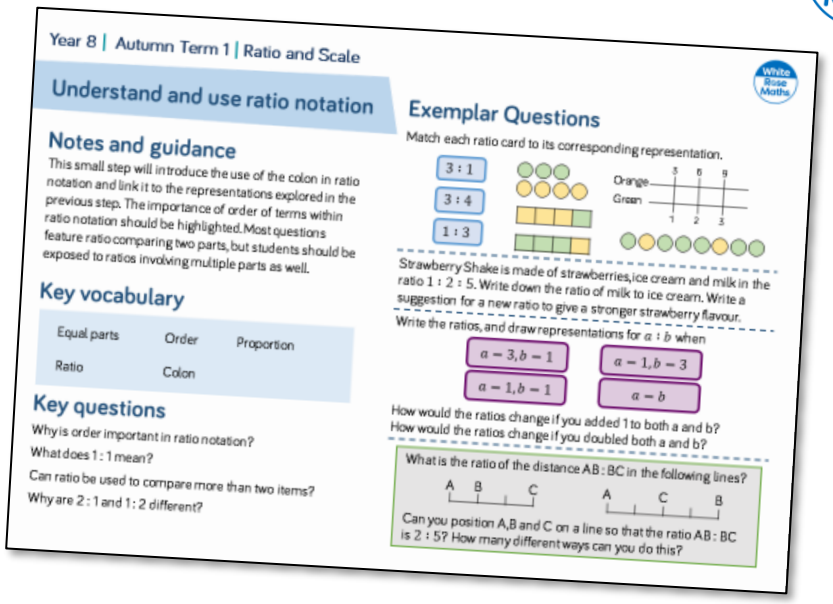
Why Small Steps?

We know that breaking the curriculum down into small manageable steps should help students to understand concepts better. Too often, we have noticed that teachers will try and cover too many concepts at once and this can lead to cognitive overload. We believe it is better to follow a "small steps" approach.

As a result, for each block of content in the scheme of learning we will provide a "small step" breakdown. ***It is not the intention that each small step should last a lesson – some will be a short step within a lesson, some will take longer than a lesson.*** We would encourage teachers to spend the appropriate amount of time on each step for their group, and to teach some of the steps alongside each other if necessary.

What We Provide

- Some ***brief guidance*** notes to help identify key teaching and learning points
- A list of ***key vocabulary*** that we would expect teachers to draw to students' attention when teaching the small step,
- A series of ***key questions*** to incorporate in lessons to aid mathematical thinking.
- A set of questions to help ***exemplify*** the small step concept that needs to be focussed on.



Year 8 | Autumn Term 1 | Ratio and Scale

Understand and use ratio notation

Notes and guidance

This small step will introduce the use of the colon in ratio notation and link it to the representations explored in the previous step. The importance of order of terms within ratio notation should be highlighted. Most questions feature ratio comparing two parts, but students should be exposed to ratios involving multiple parts as well.

Key vocabulary

Equal parts, Order, Proportion, Ratio, Colon

Key questions

Why is order important in ratio notation?

What does 1 : 1 mean?

Can ratio be used to compare more than two items?

Why are 2 : 1 and 1 : 2 different?

Exemplar Questions

Match each ratio card to its corresponding representation.

3 : 1, 3 : 4, 1 : 3

Orange, Green

Strawberry Shake is made of strawberries, ice cream and milk in the ratio 1 : 2 : 5. Write down the ratio of milk to ice cream. Write a suggestion for a new ratio to give a stronger strawberry flavour.

Write the ratios, and draw representations for $a : b$ when

$a = 3, b = 1$, $a = 1, b = 3$, $a = 1, b = 1$, $a = b$

How would the ratios change if you added 1 to both a and b?

How would the ratios change if you doubled both a and b?

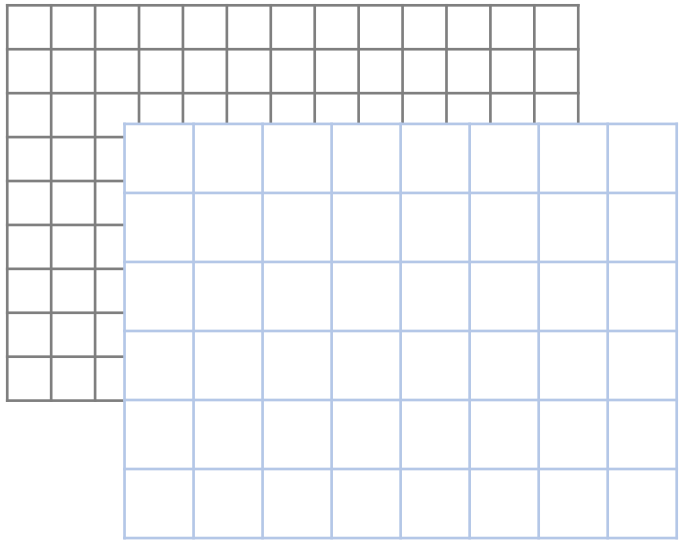
What is the ratio of the distance AB : BC in the following lines?

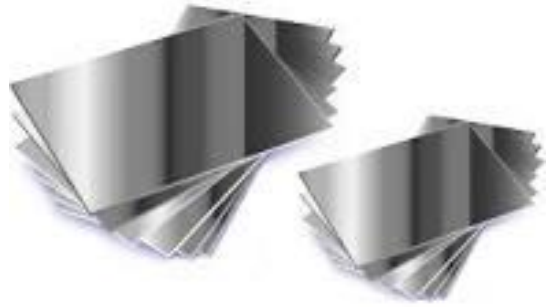
Can you position A, B and C on a line so that the ratio AB : BC is 2 : 5? How many different ways can you do this?

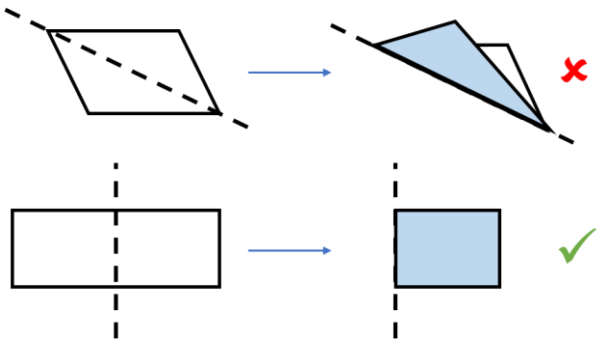
- These include reasoning and problem-solving questions that are fully integrated into the scheme of learning. Depending on the attainment of your students, you many wish to use some or all of these exemplars, which are in approximate order of difficulty. Particularly challenging questions are indicated with the symbol  .
- For each block, we also provide ideas for key representations that will be useful for all students.

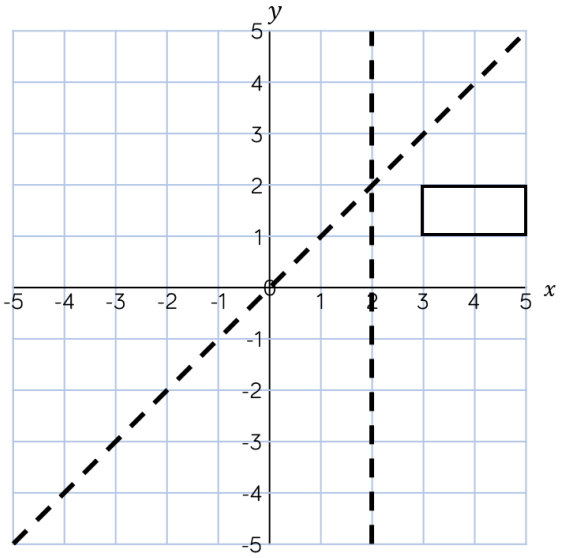
In many of the blocks of material, some of the small steps are in **bold**. These are content aimed at higher attaining students, but we would encourage teachers to use these with as many students as possible – if you feel your class can access any particular small step, then please include it in your planning.

Key Representations









Students should be encouraged to use mirrors both to investigate lines of symmetry and to perform reflections in lines, particularly diagonal lines.
Although they must be removed as a support eventually, teachers should be mindful of doing this too early before students have gained their own understanding. This may not even be in Year 8 for some students. Tracing paper can be used up to and including in GCSE examinations; how to use it effectively will need careful modelling by the teacher, as will other strategies like turning the book so that diagonal lines appear horizontal or vertical and using paper copies of shapes and folding.
Throughout the block, practising on cm- or even 2 cm-square paper makes the activities more accessible than using very small squares.

Line symmetry and reflection

Small Steps

- Recognise line symmetry
- Reflect a shape in a horizontal or vertical line 1 (shapes touching the line)
- Reflect a shape in a horizontal or vertical line 2 (shapes not touching the line)
- Reflect a shape in a diagonal line 1 (shapes touching the line)
- Reflect a shape in a diagonal line 2 (shapes not touching the line)

H denotes Higher Tier GCSE content

R denotes 'review step' – content should have been covered earlier in KS3

Recognise line symmetry

Notes and guidance

Students will be familiar with the concept of line symmetry from Key Stage 2. As well as looking at conventional shapes and counting lines, students can explore the structure of shapes and how this affects the number of lines e.g. considering why a quadrilateral cannot have 3 lines of symmetry and/or how designs for shapes with 3 lines are based around an equilateral triangle.

Key vocabulary

Line symmetry	Regular	Polygon
Isosceles	Equilateral	Rhombus etc.

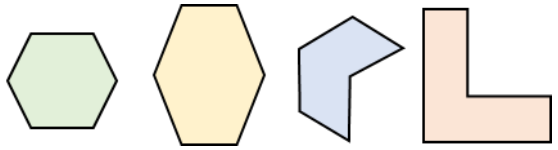
Key questions

Do all regular polygons have lines of symmetry?

Why does a rhombus have two lines of symmetry but a parallelogram none? What do you notice about the other special quadrilaterals?

Exemplar Questions

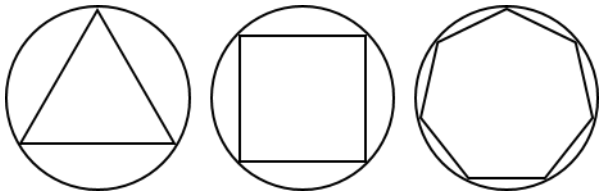
How many lines of symmetry do these hexagons have?



- What assumptions have you made?
- What types of triangle or quadrilateral can you make with 0, 1, 2, 3 or 4 lines of symmetry?

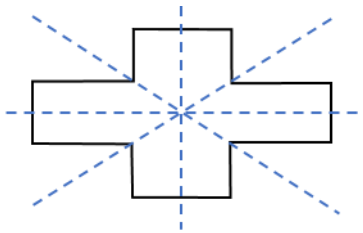
Dora says a circle has an infinite number of lines of symmetry.
Do you agree? Explain why or why not.

A company is looking at designs for a new logo.
These logos are circles that contain regular polygons.



How many lines of symmetry do the logos have?

Dexter has drawn four lines of symmetry on the shape. Do you agree with Dexter's choices? Why or why not?



Reflect vertically/horizontally (1)

Notes and guidance

In this step, students can make links with the previous step, noticing that reflecting when a shape is "on the line" automatically produces a line of symmetry. As before, they could use paper folding and mirrors to check their results. Students could also be challenged to find the areas of the shape either by counting squares or recalling and revisiting formulae as appropriate.

Key vocabulary

Reflect	Line symmetry	Congruent
Object	Image	Vertical/Horizontal

Key questions

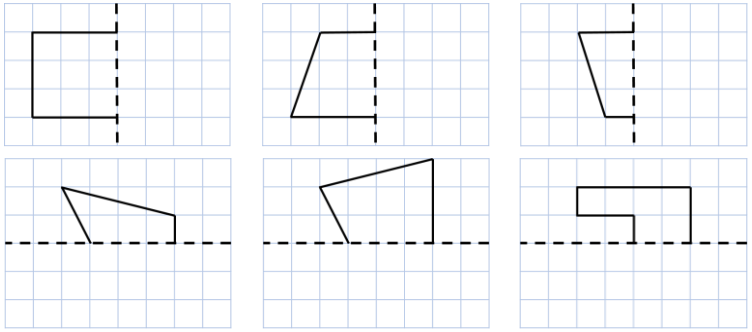
After a reflection, does the resulting shape always have a line of symmetry? Why or why not?

What's the same and what's different about the two parts of a shape following a reflection?

What's the area of the original shape? What's the area of the resulting shape?

Exemplar Questions

Reflect the shapes in the given lines.



- Give the mathematical name of each resulting shape.
- Draw on any additional lines of symmetry the resulting shapes may have. Check by folding.

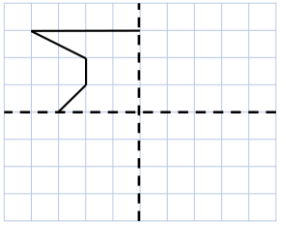
On a coordinate grid with axes from -5 to 5 in both directions, plot and join the points given to form a trapezium.

(1, 0) (3, 0) (3, 2) (2, 2)

Reflect the trapezium:

- in the x-axis
- in the line $x = 3$
- in the line $x = 2$
- in the line $x = 1$
- in the line $y = 2$

Complete the shape so both dotted lines are lines of symmetry. Create your own design with two lines of symmetry on a squared grid.



Reflect vertically/horizontally (2)

Notes and guidance

This step now moves students on to shapes that are not touching the line. Students can again use folding and mirrors to check their results and will need to be encouraged to take care that their images are the same distance away from the mirror line as the object. This step provides a good opportunity to revisit equations of lines parallel to the axes which were met in the Autumn term.

Key vocabulary

Reflect	Line symmetry	Congruent
Vertical/Horizontal	Object	Image

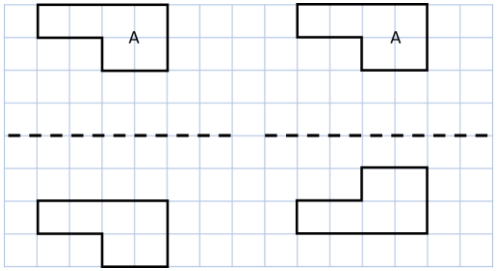
Key questions

How far is each vertex of the object from the mirror line?
What does this tell us about the position of the image?

How do we know whether the equation of a line parallel to an axis is of the form $x = \ldots$ or $y = \ldots$?

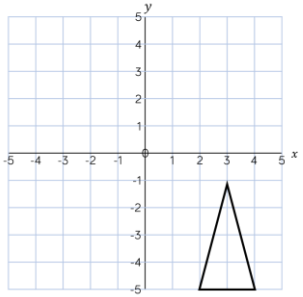
Exemplar Questions

Explain why both attempts to reflect shape A in the given line are incorrect.
Copy shape A and the line on squared paper and draw the correct reflection.



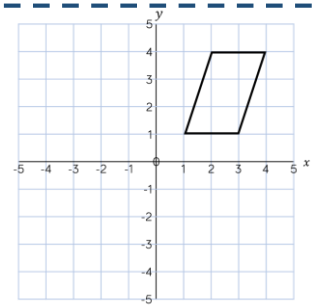
Reflect the triangle:

- in the x-axis
- in the y-axis
- in the line $x = 1$
- in the $y = -1$
- in the $y = -3$



Write down the coordinates of the vertices of the parallelogram. Compare these with the coordinates of the vertices of the parallelogram formed by

- reflecting in the x-axis
- reflecting in the y-axis



Draw a pair of axes and draw a square whose opposite corners are at the points $(-3, 3)$ and $(5, -1)$.
What are the equations of the vertical and horizontal lines of symmetry of the square? Can you generalise?

Reflect in a diagonal line (1)

Notes and guidance

Using mirrors or tracing paper and folding to support and check answers is even more important for the more challenging diagonal lines. It is also helpful to model drawing a perpendicular line from the vertices of the object to the mirror line and then extend this to find the position of the corresponding vertices of the image.

Key vocabulary

Reflect Object Image Vertex

Perpendicular distance

Key questions

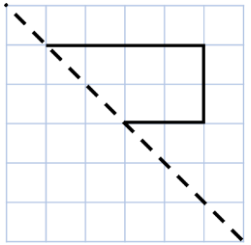
Why does it help to rotate your exercise book when reflecting in diagonal lines?

Why don't we have to worry about points/vertices that are on the line?

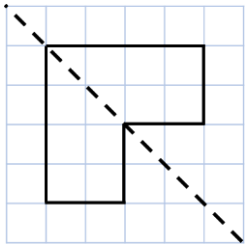
How do we know how far the vertices of the image are from the mirror line?

Exemplar Questions

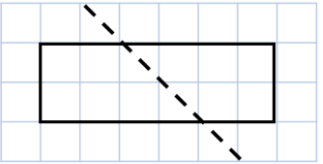
Amir and Mo are both trying to reflect this shape in the line shown.
Compare their answers.
Who do you agree with? Why?
Use a mirror to check.



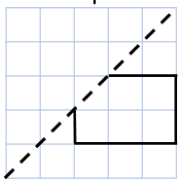
Amir

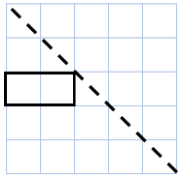


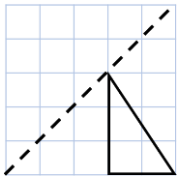
Mo

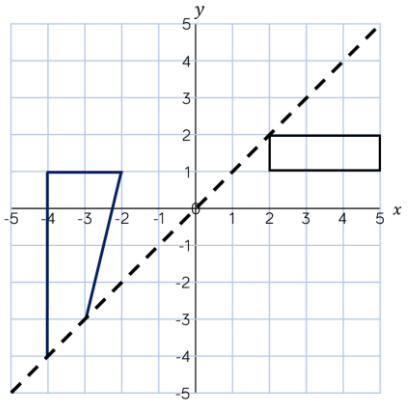


Reflect the shapes in the lines shown.









What is the equation of the diagonal line going through (0, 0), (1, 1) etc.?

Reflect both shapes in this line.

Hint – draw perpendicular lines from each vertex to the line to help.

Reflect in a diagonal line (2)

Notes and guidance

We now consider shapes that are not touching a diagonal line. Students can again use folding and mirrors to check their results, and will again need to be encouraged to take care that their images are the same perpendicular distance away from the mirror line as the object. Practising on cm- or even 2 cm-square paper can makes this (and earlier steps) more accessible than using very small squares.

Key vocabulary

Reflect	Object	Image
Vertex	Perpendicular distance	

Key questions

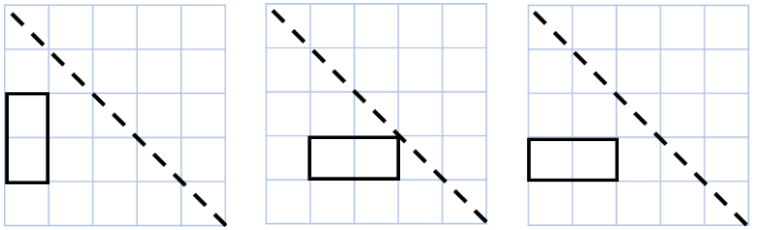
What is the equation of the line that goes through (0,0), (1,1) etc.?

How can we tell the lines $y = x$ and $y = -x$ apart?

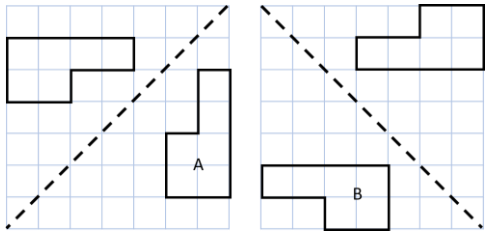
Why do we count the distance to the mirror line diagonally rather than horizontally?

Exemplar Questions

Reflect the rectangles in the lines.



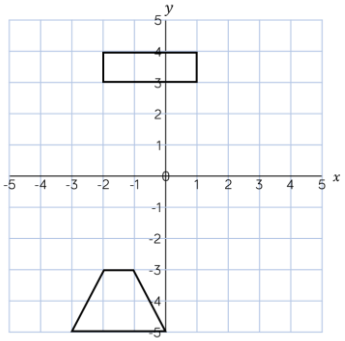
What's the same and what's different?



Dora has reflected both shape A and shape B incorrectly.
Draw the shapes and the correct reflections.

Reflect the rectangle and the isosceles trapezium in:

- the line $y = x$
- the line $y = -x$



Plot the points $(1, 5)$, $(-2, 3)$ and $(1, -2)$ and join them to form a triangle.
Reflect the triangle in the line $y = x$
Investigate reflecting other shapes that "cross" $y = x$ and $y = -x$