

As outcomes, Year 8 pupils should, for example:

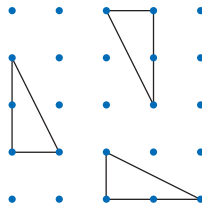
Combinations of transformations (continued)

Understand and demonstrate some general results about repeated transformations. For example:

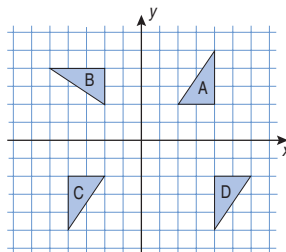
- Reflection in two parallel lines is equivalent to a translation.
- Reflection in two perpendicular lines is equivalent to a half-turn rotation.
- Two rotations about the same centre are equivalent to a single rotation.
- Two translations are equivalent to a single translation.

Explore the effect of combining transformations.

- Draw a 1 by 2 right-angled triangle in different positions and orientations on 5 by 5 spotty paper. Choose one of the triangles to be your original. Describe the transformations from your original to the other triangles drawn. Can any be done in more than one way?



- Triangles A, B, C and D are drawn on a grid.



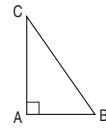
- Find a single transformation that will map:
  - A on to C;
  - C on to D.
- Find a combination of two transformations that will map:
  - B on to C;
  - C on to D.
- Find other examples of combined transformations, such as:
  - A to C: with centre (0, 0), rotation of 90°, followed by a further rotation of 90°;
  - A to C: reflection in the y-axis followed by reflection in the x-axis;
  - B to C: rotation of 90° centre (-2, 2), followed by translation (0, -4);
  - C to D: reflection in the y-axis followed by reflection in the line  $x = 4$ ;
  - C to D: rotation of 270° centre (0, 0), followed by a rotation of 90° centre (4, 4).

Use ICT, or plastic or card shapes, to generate tessellations using a combination of reflections, rotations and translations of a simple shape.

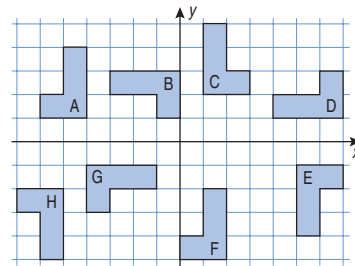
As outcomes, Year 9 pupils should, for example:

Combinations of transformations (continued)

- ABC is a right-angled triangle. ABC is reflected in the line AB and the image is then reflected in the line CA extended. State, with reasons, what shape is formed by the combined object and images.



- Two transformations are defined as follows:
  - Transformation A is a reflection in the x-axis.
  - Transformation C is a rotation of 90° centre (0, 0).
 Does the order in which these transformations are applied to a given shape matter?
- Some congruent L-shapes are placed on a grid in this formation.



Describe transformations from shape C to each of the other shapes.

- Some transformations are defined as follows:
  - P is a reflection in the x-axis.
  - Q is a reflection in the y-axis.
  - R is a rotation of 90° centre (0, 0).
  - S is a rotation of 180° centre (0, 0).
  - T is a rotation of 270° centre (0, 0).
  - I is the identity transformation.
 Investigate the effect of pairs of transformations and find which ones are commutative.
- Investigate the effect of a combination of reflections in non-perpendicular intersecting mirror lines, linking to rotation symmetry, the kaleidoscope effect and the natural world.

Use **dynamic geometry software** to explore equivalences of combinations of transformations, for example:

- to demonstrate that only an even number of reflections can be equivalent to a rotation;
- to demonstrate that two half turns about centres  $C_1$  and  $C_2$  are equivalent to a translation in a direction parallel to  $C_1C_2$  and of twice the distance  $C_1C_2$ .