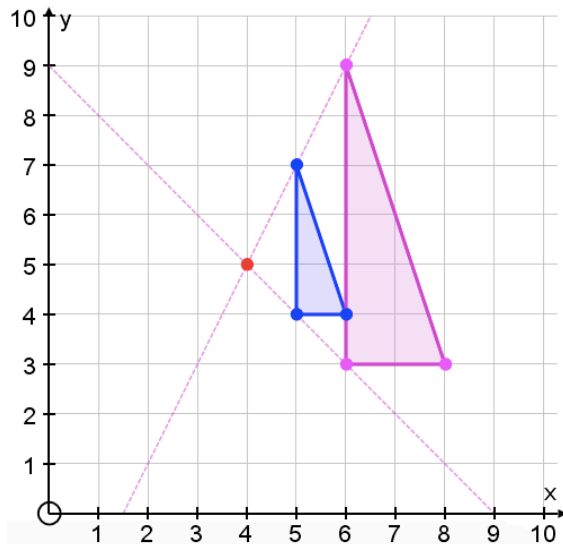# Enlargements with Negative Scale Factors

Notes
Last lesson we looked at enlargements where the scale factor was positive. Below we can compare a positive scale factor enlargement with a negative scale factor enlargement.

In both cases, the **blue** triangle (the "object") is being enlarged and the **pink** triangle is the image.

Positive scale factor	**Negative scale factor**
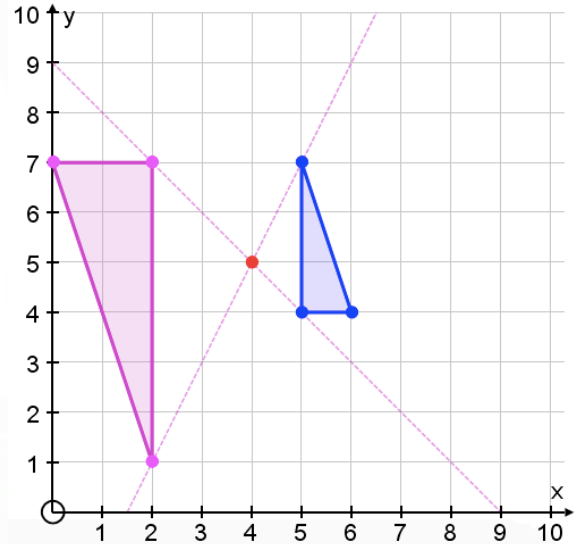
Similarities
1.   The image is the same size
2.   Construction lines are used
3.   Distances are still measured ***from the centre of enlargement***

Differences
1.   The image is on the other side of the centre of enlargement
2.   The image is upside down (i.e. it has rotated 180°)

Therefore, the method is very similar to the method for positive scale factors.

Success criteria Enlargements with negative scale factors
1.   Draw construction lines from each vertex and passing through the centre of enlargement
2.   Measure the distance (or count the squares) from centre to one of the shape's vertices point. Multiply this by the scale factor and measure in the opposite direction
        E.g.   Let the scale factor be -3.
                Let the distance from a vertex on the object to the centre of enlargement be 2 squares to the ***right*** and 3 ***down***.
                The image point will be 6 squares to the ***left*** and 9 squares ***up*** from the centre of enlargement
3.   Repeat step 2 for the other vertices
4.   Connect the points of the image to form the shape

N.B.   With negative scale factors, the centre of enlargement is in between the object and its image.
        With enlargements, measurements are always made ***from the centre of enlargement***.

E.g. 1 Enlarge the triangle with vertices $A(5, 2)$, $B(7, 1)$ and $C(4, 1)$ with scale factor -2 about $(5, 3)$.

Working:

Step 1:   Draw the construction lines (**Diagram 1**).

Step 2:   Point A is one square down *from the centre of enlargement*. Multiply this by -2 so we count 2 squares up *from the centre of enlargement* (**Diagram 2**).

Step 3:   Repeat step 2 for points B and C (**Diagram 3**).
Point B: **From the CoE** to B is 2 squares *right* and 2 *down*.
                    Multiply this by -2
                    So measure 4 squares *left* and 4 *up* **from the CoE**
Point C: **From the CoE** to C is 1 square *left* and 2 *down*.
                    Multiply this by -2
                    So measure 2 squares *right* and 4 *up* **from the CoE**
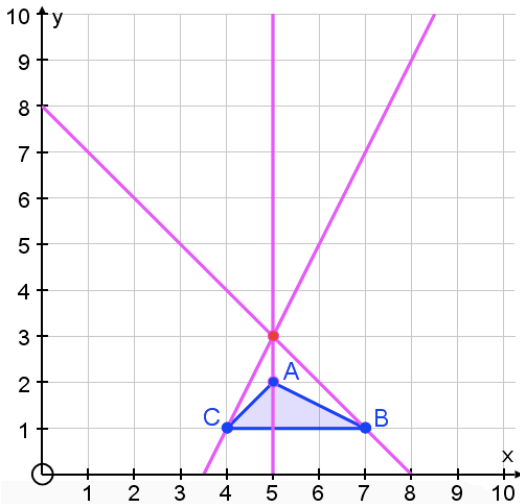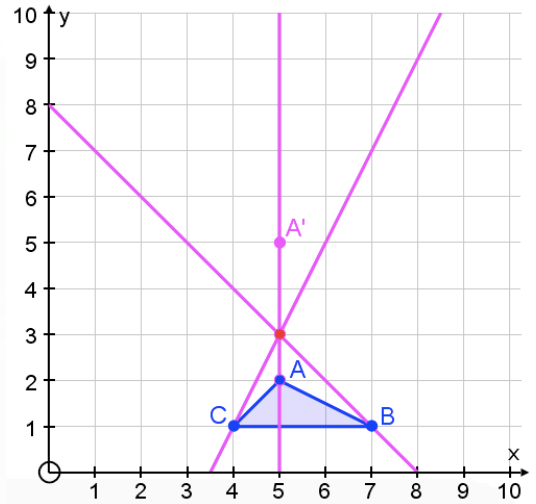
Step 4:   Join the dots up (**Diagram 4**).

Diagram 1
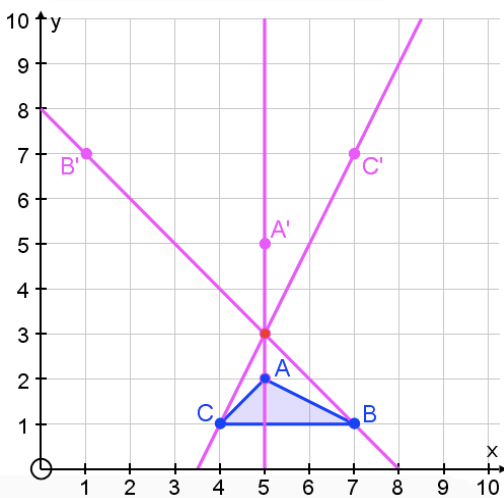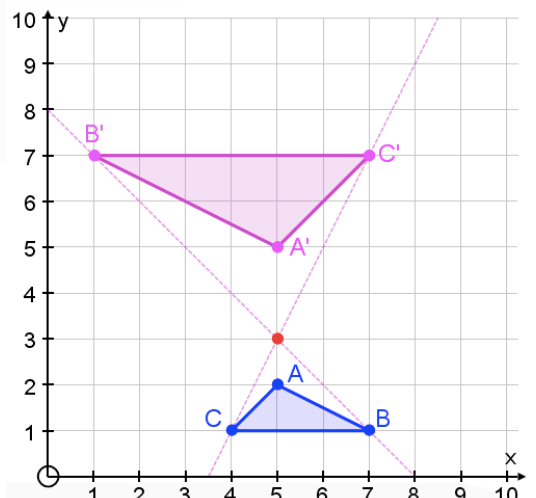

Diagram 2

Diagram 3


Diagram 4 (final answer)

Finding the centre of enlargement

When finding the centre of enlargement, use the same method as for positive scale factors

1.   Draw a line from a vertex on the image to its corresponding point on the object.
2.   Repeat step 1 for a different point on the image.
3.   The centre of enlargement is where the lines intersect.

E.g. 2 Given that the enlargement in the diagram has a negative scale factor, find the coordinates of the centre of enlargement.
In addition, state the scale factor of enlargement.
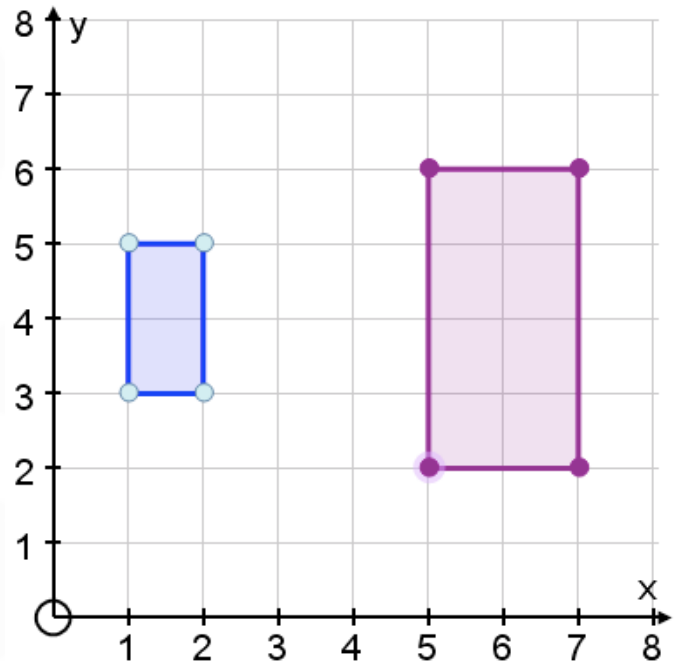
Working:
With negative enlargements the problem can be with rectangles when we forgot that the shape has rotated 180°. In **Diagram 5** below, the lines do not intersect so the points on the object are not mapped to corresponding points on the image. In **Diagram 6**, we recognise that the image has rotated 180° and now the lines intersect. The centre of enlargement is $(3, 4)$. Since the lengths on the image are twice as long, the scale factor is -2.
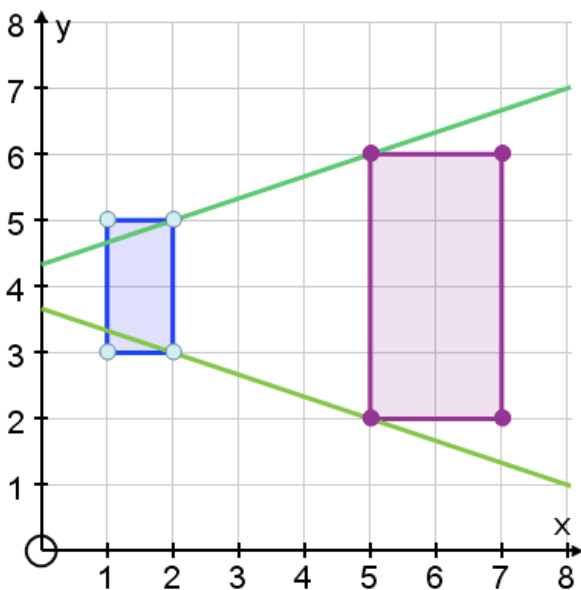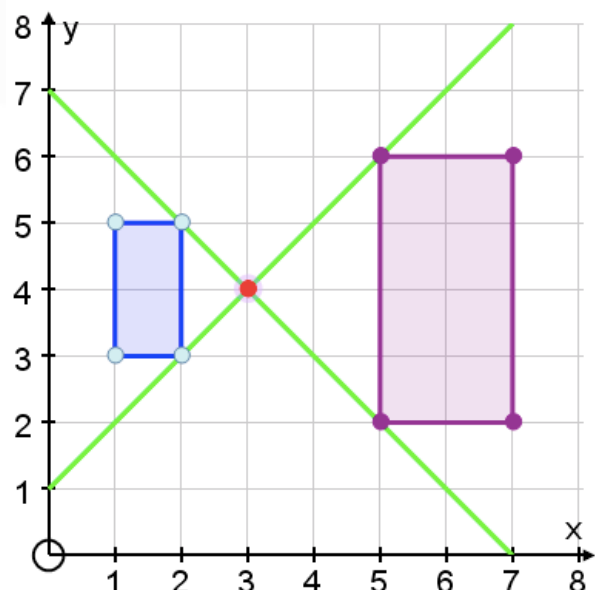
Diagram 5 (incorrect)

Diagram 6 (correct)

Video: **Finding the centre of enlargement**
Video: **Enlargements (negative scale factors)**

Solutions to Starter and E.g.s

Exercise
9-1 class textbook: p288 E9.1 Qu 1-7
A*-G class textbook: p250 E9.1 Qu 1-7
9-1 homework book: p99 E9.1 Qu 1-4
A*-G homework book: p71 E9.1 Qu 1-4

Summary
With enlargements, measurements are always made *from the centre of enlargement*.
Enlargements with negative scale factors
1.   Draw construction lines from each vertex and passing through the centre of enlargement
2.   Measure the distance (or count the squares) from centre to one of the shape's vertices point. Multiply this by the scale factor and measure in the opposite direction
3.   Repeat step 2 for the other vertices
4.   Connect the points of the image to form the shape
With negative scale factors, the centre of enlargement is in between the object and its image.

Finding the centre of enlargement
When finding the centre of enlargement, use the same method as for positive scale factors
1.   Draw a line from a vertex on the image to its corresponding point on the object.
2.   Repeat step 1 for a different point on the image.
3.   The centre of enlargement is where the lines intersect.

Homework book answers (only available during a lockdown)