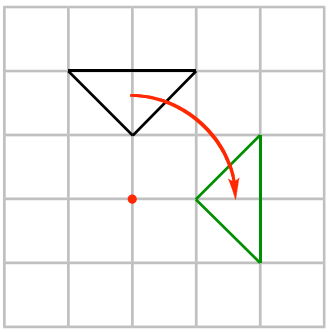
Rotation

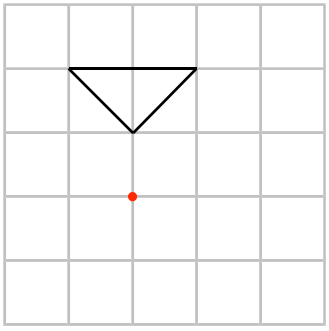
What's rotation?



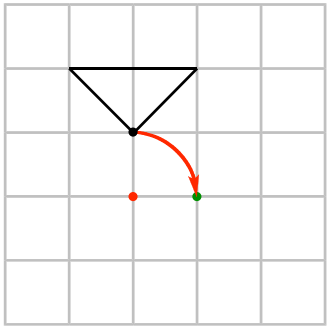
Rotation is a kind of transformation that turns an object around a point. The point is called the **centre of rotation**. The amount of turn is specified by the **angle of rotation** and this must be given a **direction**, either clockwise ↻ or anticlockwise ↺.

You can think of shapes as collections of points. For shapes with straight edges, you can consider them as a few points (the corners) connected by straight lines (the edges).

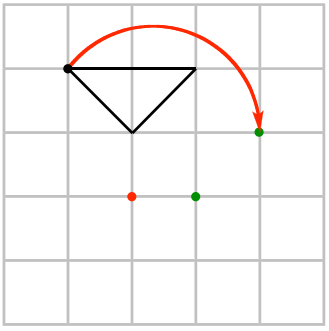
Rotation is like a roundabout in a children's playground – the centre of rotation is the middle of the roundabout. The corners of the shape are children on the roundabout. They stay the same distance from the middle of the roundabout as it goes round and round.



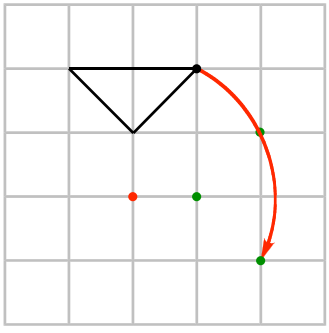
Step One
I want to rotate this triangle 90° clockwise using the red dot as my centre of rotation.



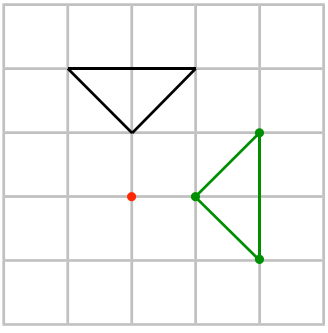
Step Two
I choose a corner on the triangle and rotate it 90° clockwise. It was 1 square above the red dot. It is now one square to the right.



Step Three
Another corner was two squares up and one square to the left of the red dot. After rotation, it's two squares right and one square up.

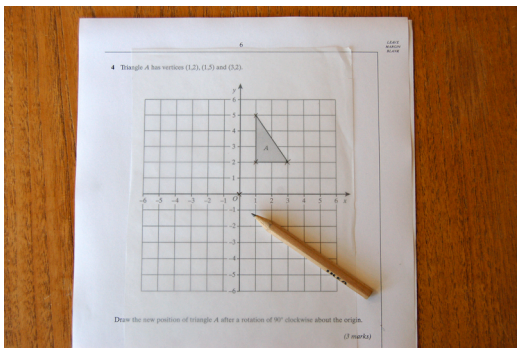


Step Four
Final corner. Was up 2, right 1. Now right 2, down 1.



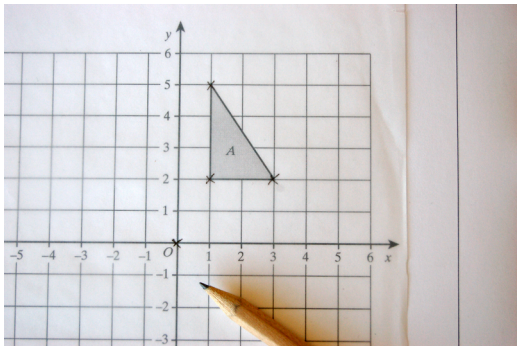
Step Five
Sit back and admire.

Rotating shapes using tracing paper



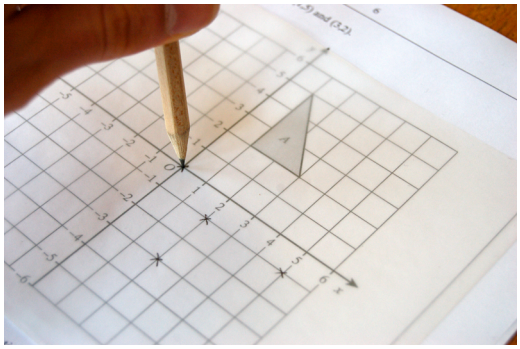
Step One
Lay a sheet of tracing paper over the entire grid in the question.

The question shown here asks me to rotate the grey triangle 90° clockwise about the origin.



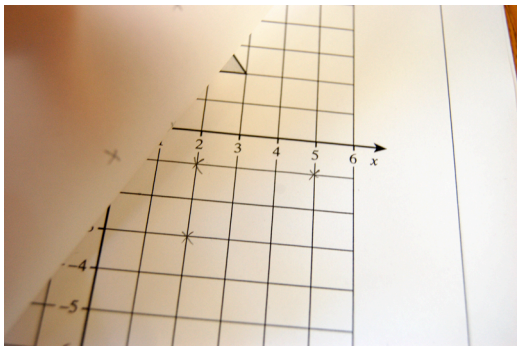
Step Two
With a pencil or pen, mark the centre of rotation and the corners of the shape on the tracing paper.

In this question, the centre of rotation is the origin, point (0,0), but it could be at any set of coordinates.

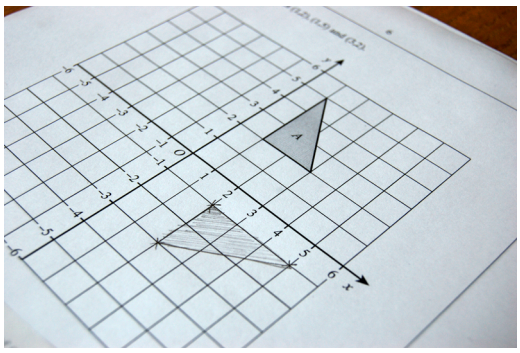


Step Three
Use your pencil or pen to hold the centre of rotation in position (it should not move) while your rotate the tracing paper.

I've rotated my tracing paper 90° clockwise because that's what the question asks for.



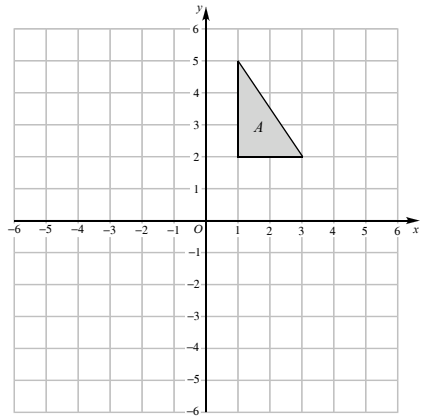
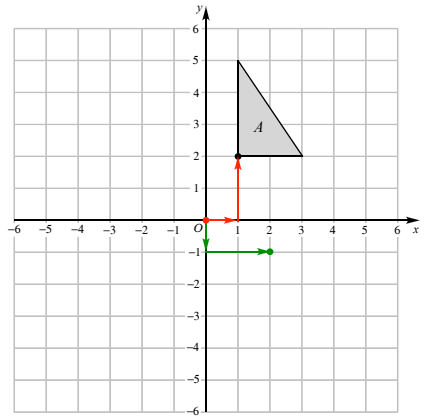
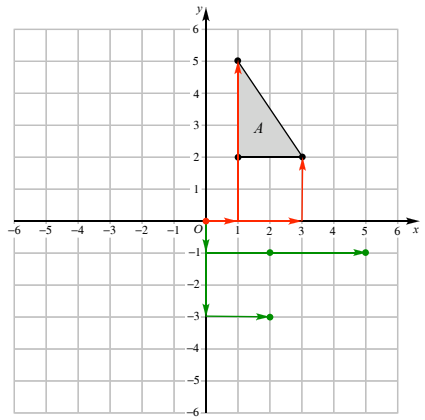
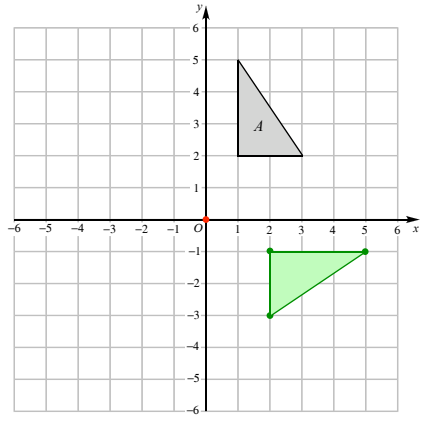
Step Four
Hold the tracing paper in position with your hand. Use the other hand to partly lift up the tracing paper and to mark the position of the corners of the rotated shape on the question paper.



Step Five
Using a ruler, connect the corners of the rotated shape with straight lines. You may want to shade the rotated shape in to make it stand out.

Job done – shape rotated.

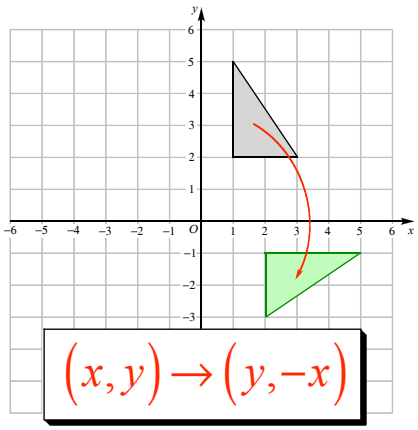
Rotating shapes using coordinates… part 1

	This is a question taken from a past paper (November 2003, Paper 1): Triangle A has vertices (1,2), (1,5) and (3,2). Draw the new position of triangle A after a rotation of 90° clockwise about the origin.
	As indicated by its coordinates, (1,2), the corner nearest the origin is one square right and two squares up from the origin. When this point is rotated about the origin, its distance from the origin remains the same, but its direction changes. The new, rotated point is one square to the down from the origin and two squares to the right. The new coordinates are (2,−1).
	The other two corners of the triangle are rotated, one at a time. Their new coordinates are (5,−1) and (2,−3).
	The rotated points are joined with straight lines to form the new, rotated triangle.

Rotating shapes using coordinates… part 2

Rotating a shape 90° clockwise about the origin

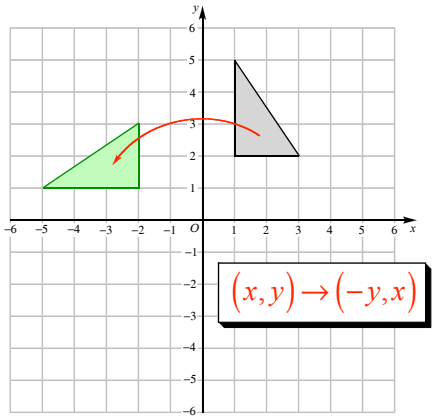
- Squares up become squares right
- Squares right become squares down
- Squares left become squares up
- Squares down become left



If your unrotated shape has a point on it with coordinates (x,y), then the coordinates of that point after rotation will be (y,−x). For example, (2,5) becomes (5,−2).

Rotating a shape 90° anticlockwise about the origin

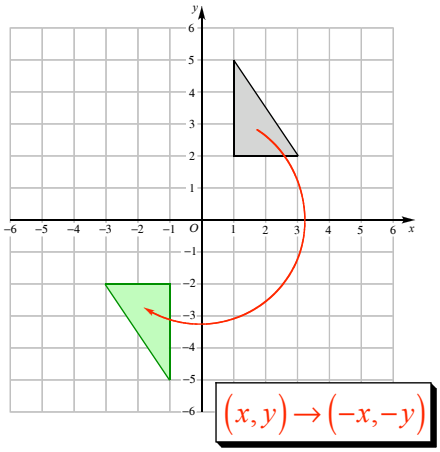
- Squares up become squares left
- Squares right become squares up
- Squares left become squares down
- Squares down become right



If your unrotated shape has a point on it with coordinates (x,y), then the coordinates of that point after rotation will be (−y, x). For example, (2,5) becomes (−5,2).

Rotating a shape 180° about the origin

- Squares up become squares down
- Squares right become squares left
- Squares left become squares right
- Squares down become up



If your unrotated shape has a point on it with coordinates (x,y), then the coordinates of that point after rotation will be (−x, −y). For example, (2,5) becomes (−2,−5).

Rotating a shape, but not about the origin

If your centre of rotation is not the origin, all you have to do is give each point "fake" coordinates – the ones they would have **if your centre of rotation were the origin**.

Follow the rules above to convert the fake coordinates of your unrotated shape into the fake coordinates of the rotated shape.

Plot your rotated shape using the fake coordinates the find the location of each point from the centre of rotation. To find the real coordinates of the points on the rotated shape, simply them off the axes.