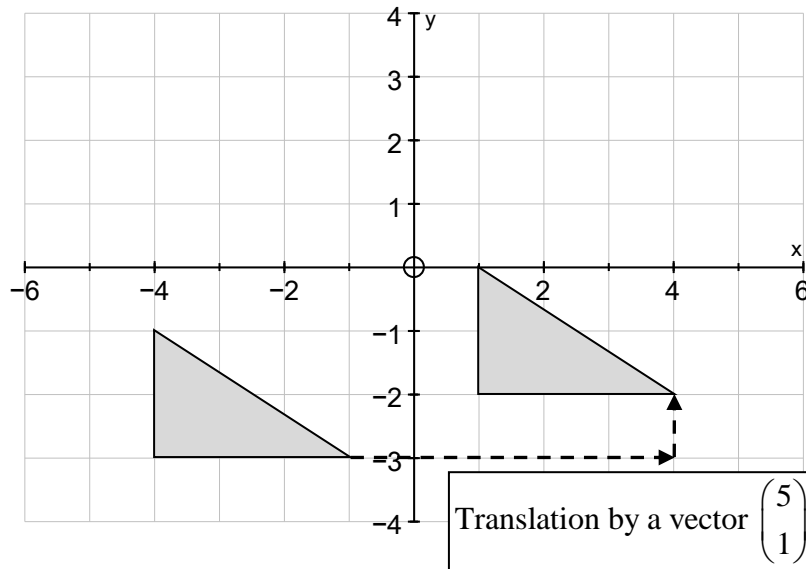# Transformations of shapes and Construction

(for transformations of curve equations, see Equations of curves)

Transformations
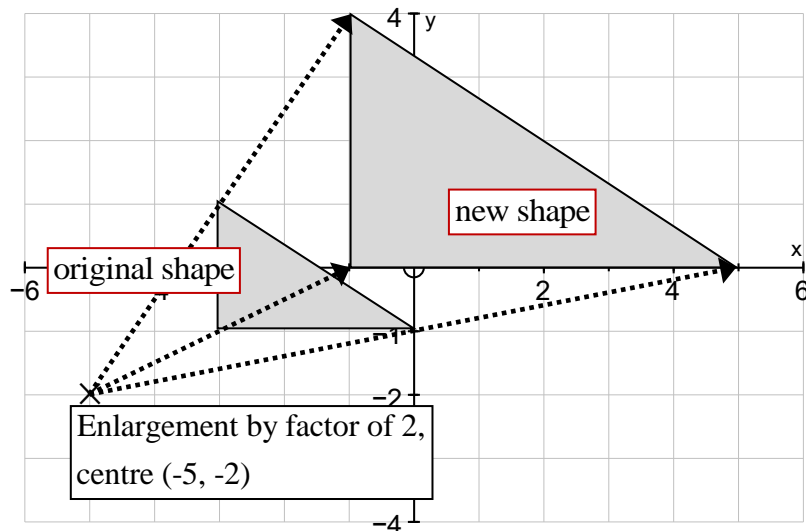
Translation

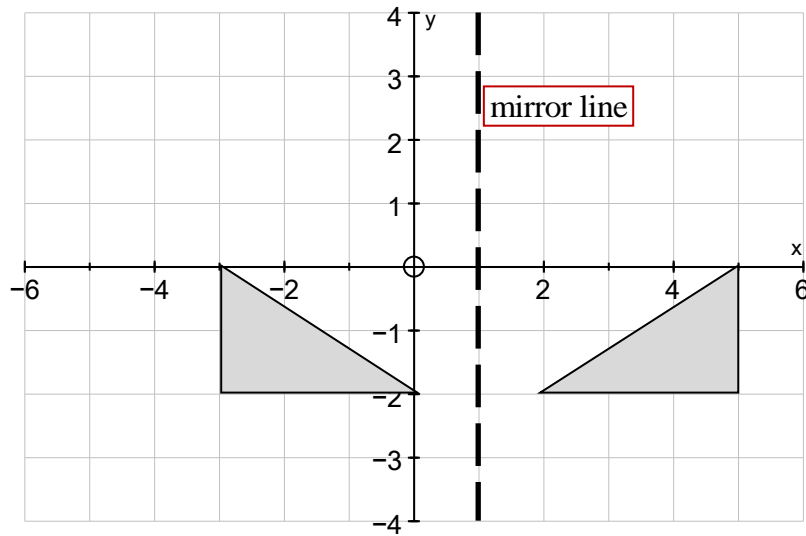A translation shifts a shape

Translation by a vector $\begin{pmatrix} 5 \\ 1 \end{pmatrix}$

Enlargement

Enlargement has a centre and a scale factor.

new shape

original shape
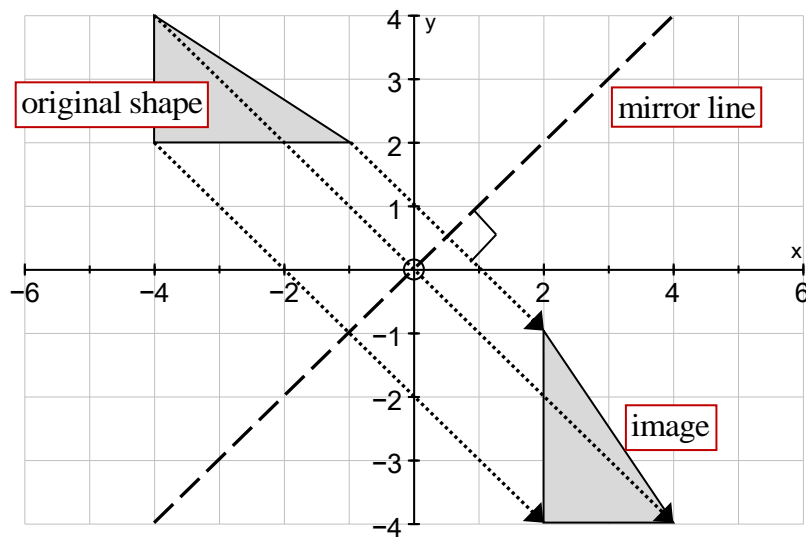
Enlargement by factor of 2, centre (-5, -2)

Reflection

Reflection makes a "mirror image" of a shape on the other side of a mirror line.
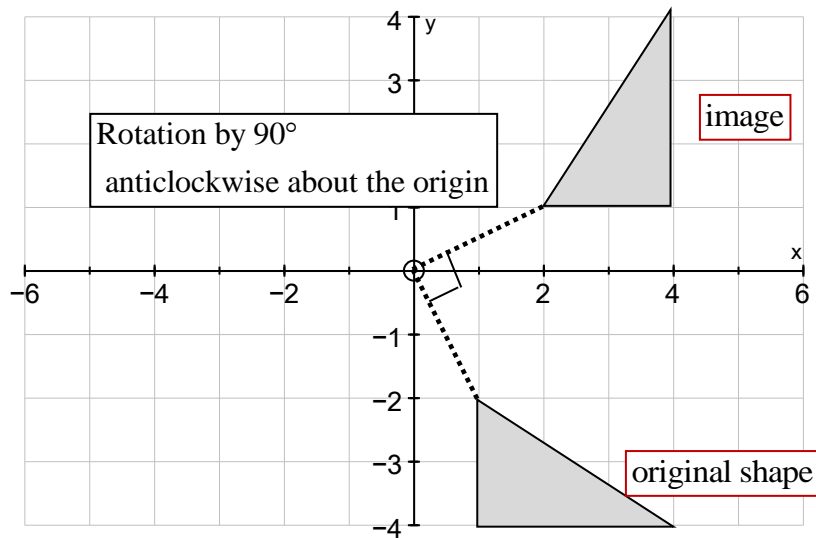

If the line is sloping, you will need to draw the image carefully with lines crossing the mirror line at right angles:
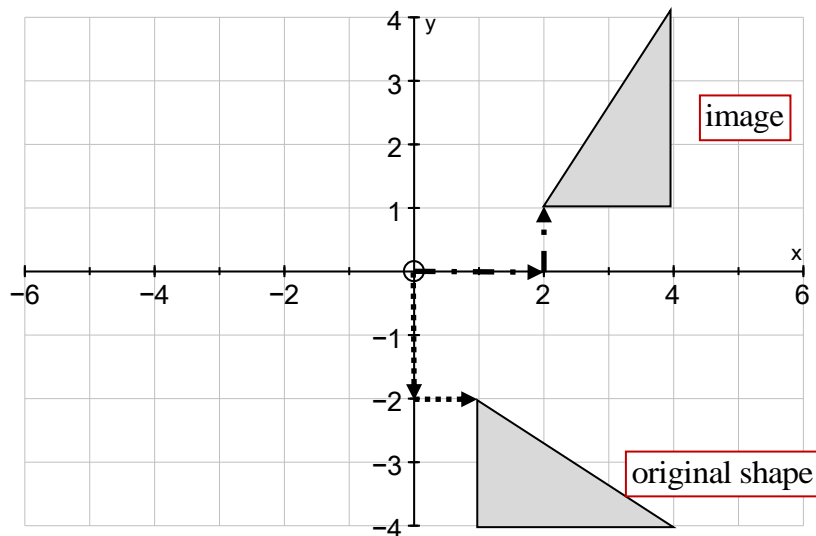
Rotation

Rotation uses a centre and an angle:

Rotation by 90°

anticlockwise about the origin

image

original shape

It is often convenient to think of the shape as being "held" by a dog-leg from the rotation centre. Rotate these legs to get the new coordinates of each point in your shape, then draw lines between the points:

image

original shape

Bearings and construction

Measuring the angle between two lines.

- The lines must cross and be long enough to reach the scale on the protractor. If they are not, use a ruler and a sharp pencil (or thin pen) to extend them.

- The protractor can measure an angle clockwise from the left side or anti-clockwise from the right. To use the right scale, make sure you "count up" the angle on the protractor scale that goes 0, 10, 20 etc (so a very small angle would be close to 0°). Think whether you want an angle <90°, between 90 and 180°, or >180° and check you have a suitable answer.

- If you are asked for an angle >180°, measure the angle between the lines and subtract from 360°.

Bearings

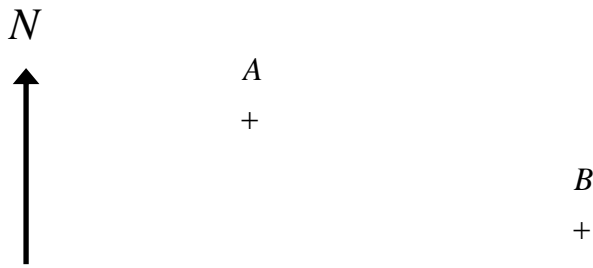All bearings are given as three digits e.g. 015°

Bearings are measured clockwise around from North so a bearing of 000° is due North and 090° is due East.
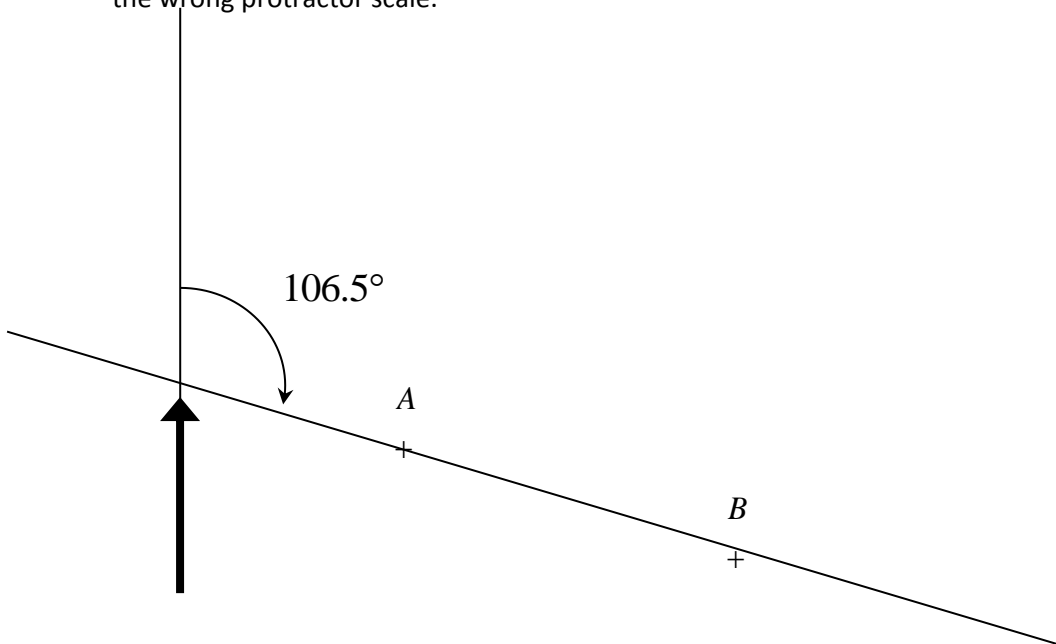

(image from http://www.ke4nyv.com/navigation.htm)
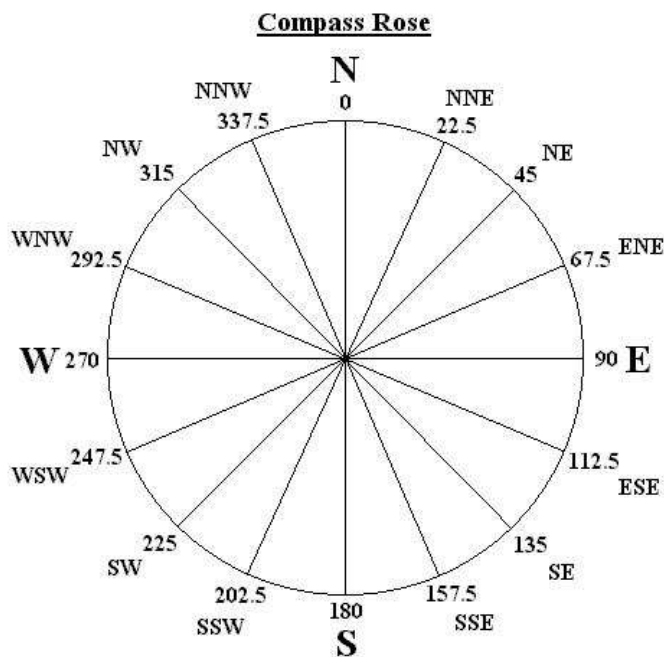
"Measure the bearing from A to B"

N

A
+

B
+

You need to extend the North arrow and draw a line through A and B so it crosses the North line. Then measure the angle. The angle is obviously more than 90°. If your angle is less, you have used the wrong protractor scale.

106.5°

A
+

B
+

Example 2. If the question asked for the angle from B to A, imagine you are <u>standing at B and facing A</u>. You need the angle <u>clockwise from North</u>.   Measure angle x as above, then add 180° (or take 180, if need be, so your answer is not bigger than 360°)

x

A
+

B
+

5
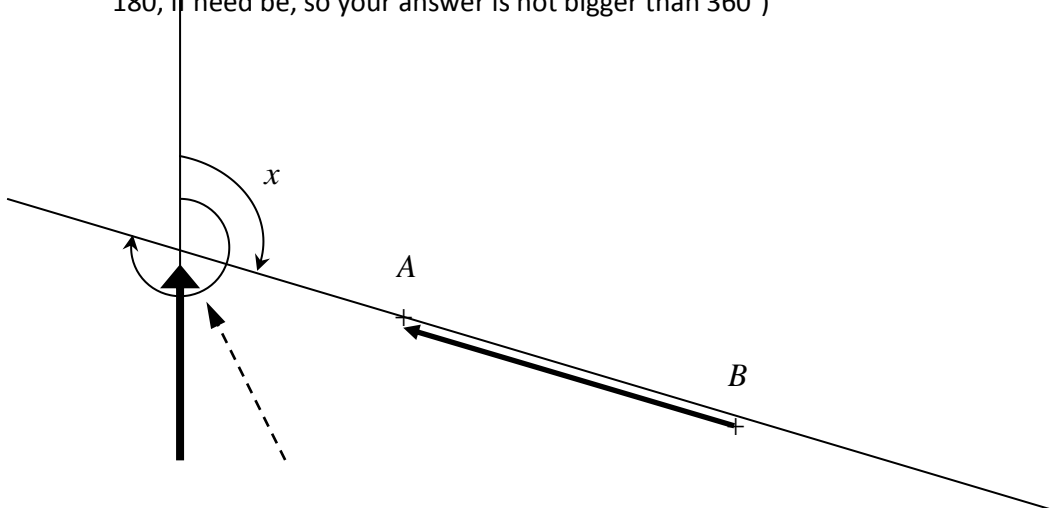
$$106.5° + 180° = 286.5°$$

Drawing a triangle, given 2 sides and an angle.

Usually one side is already drawn on the answer sheet (if not, draw it). Your length must be accurate to the nearest millimetre.
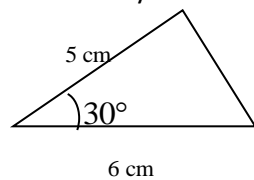
Use the protractor to measure the angle. Make a little mark, then (using the ruler) draw a long faint line through it and the starting point.

Set your compasses to draw a circle with the length of the third side. Draw an arc that cuts your line.
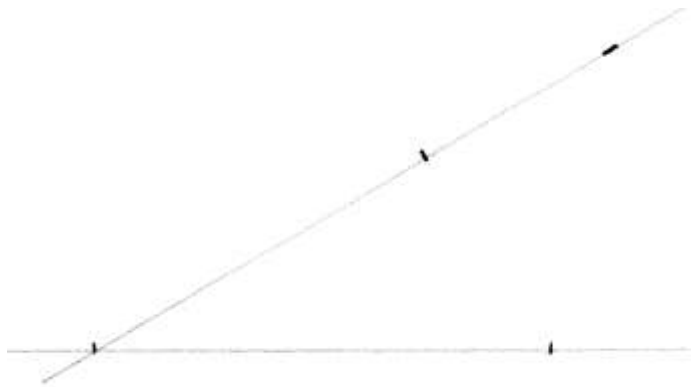
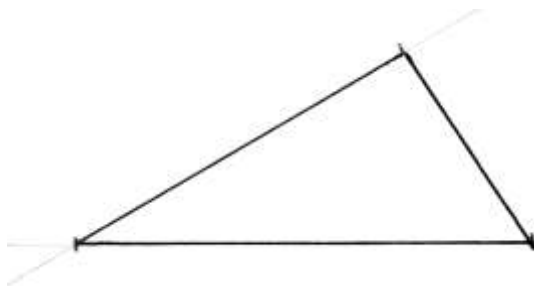Put a line between the corner points.

Example 3

Draw the following triangle accurately

5 cm   30°

6 cm

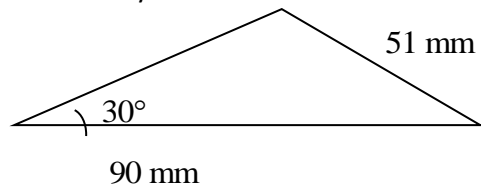Draw 2 lines at 30° to each other. Measure and mark a point 6 cm along one, 5 cm along the other.

Then draw lines between the points.

Example 4

Draw the following triangle accurately

51 mm

30°

90 mm

- As before, start by drawing two lines at 30°.
- Measure a 6 cm bottom edge and mark its ends.
- Set the compasses to draw a circle of 4 cm radius and draw a circular arc centered on point B
- This will cross line AC at two points. Draw a line through whichever looks most like the example in the sketch in the question.
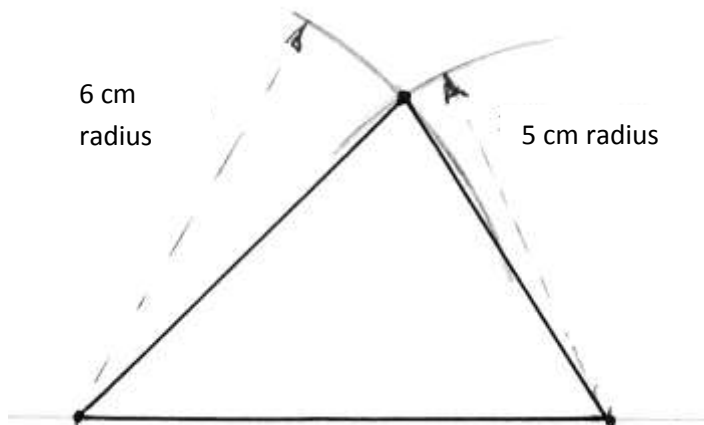

51 mm

30°
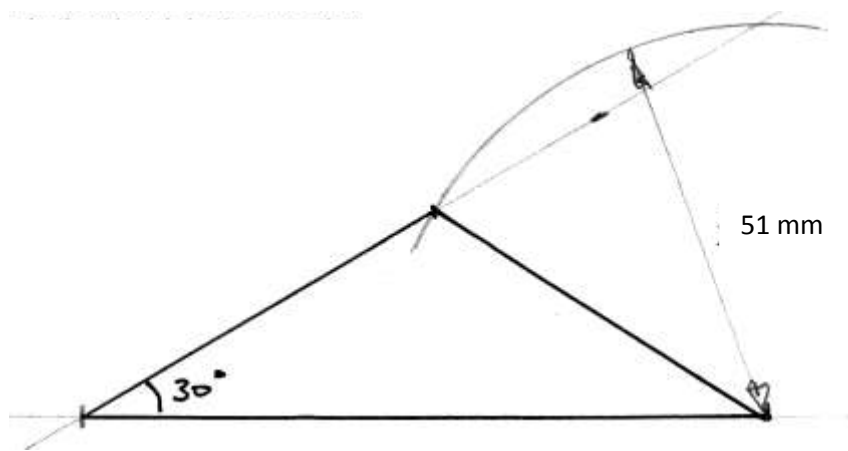
Drawing a triangle given the lengths of 3 sides.
- Draw one side
- Use compasses to draw an arc with exactly the right radius for each other side.
- Where the arcs cross is the third corner.

Example 5

Draw a triangle with sides of length 7, 6 and 5 cm.

6 cm
radius

5 cm radius

Bisecting an angle

- Using the compasses, draw an arc centered on the point where the lines cross.
- Your arc crosses each line once. Put the compass spike on one crossing point and draw an arc (can be same radius as first, but not essential).
- Now very carefully without changing the compass width, put the spike on the other crossing point and draw another arc (must be same radius as the one before).
- Draw a straight line through the intersections.
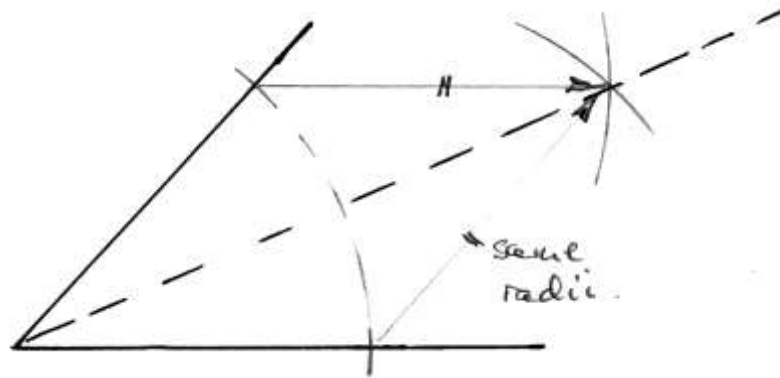
Drawing the perpendicular bisector of a line segment

- A line segment is a line between two points.
- A perpendicular bisector goes through the mid-point of this line and cuts it at right angles.
- You are expected to construct it using compasses. The examiners will look for your construction lines.
- Both arcs must be exactly the same radius.

This gives you the "locus of points equidistant from A and B". (A locus is a line defined by a series of points).