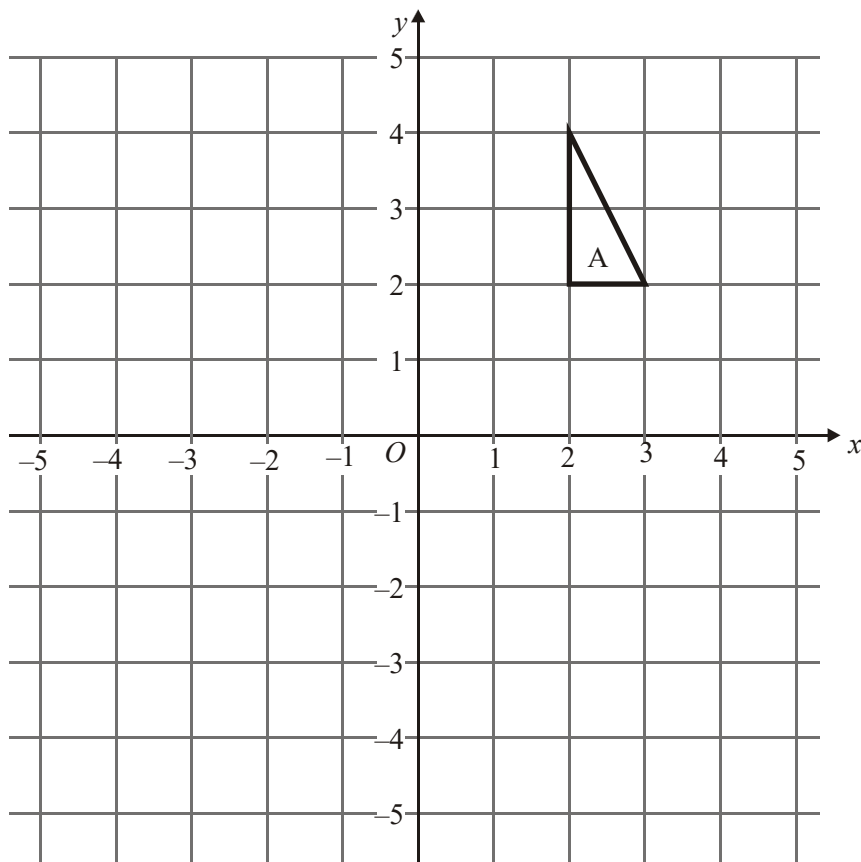


1.



- (a) On the grid, rotate triangle **A** 180° about O .
Label your new triangle **B**.

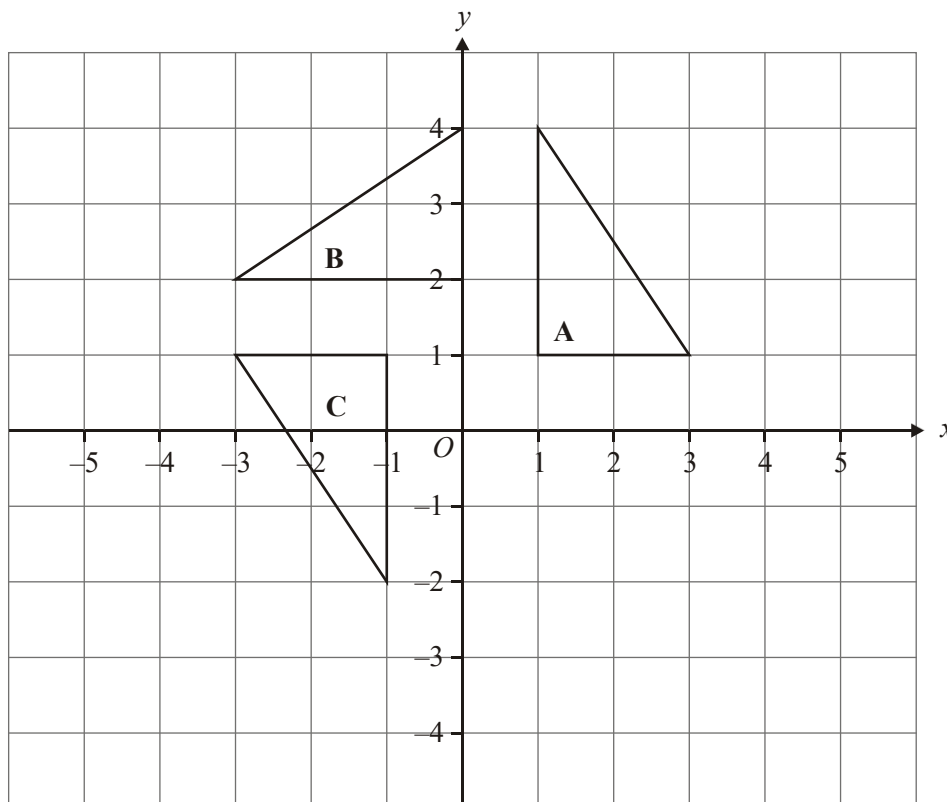
(2)

- (b) On the grid, enlarge triangle **A** by scale factor $\frac{1}{2}$, centre O .
Label your new triangle **C**.

(3)

(Total 5 marks)

2.



Shape **A** is rotated 90° anticlockwise, centre $(0, 1)$, to shape **B**

Shape **B** is rotated 90° anticlockwise, centre $(0, 1)$, to shape **C**

Shape **C** is rotated 90° anticlockwise, centre $(0, 1)$, to shape **D**

(a) Mark the position of Shape **D**

(2)

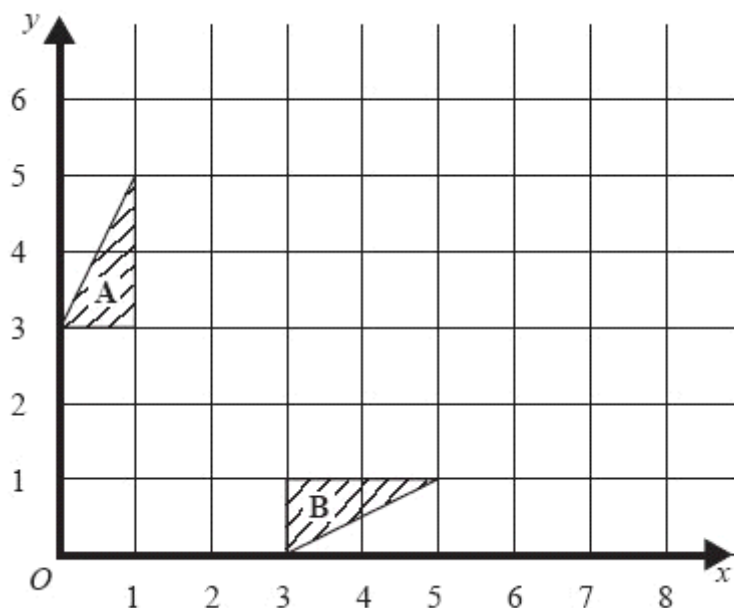
(b) Describe the single transformation that takes shape **C** to shape **A**.

.....

(2)

(Total 4 marks)

3.



Triangle **A** and triangle **B** have been drawn on the grid.

- (a) Reflect triangle **A** in the line $x = 3$.
Label this image **C**.

(2)

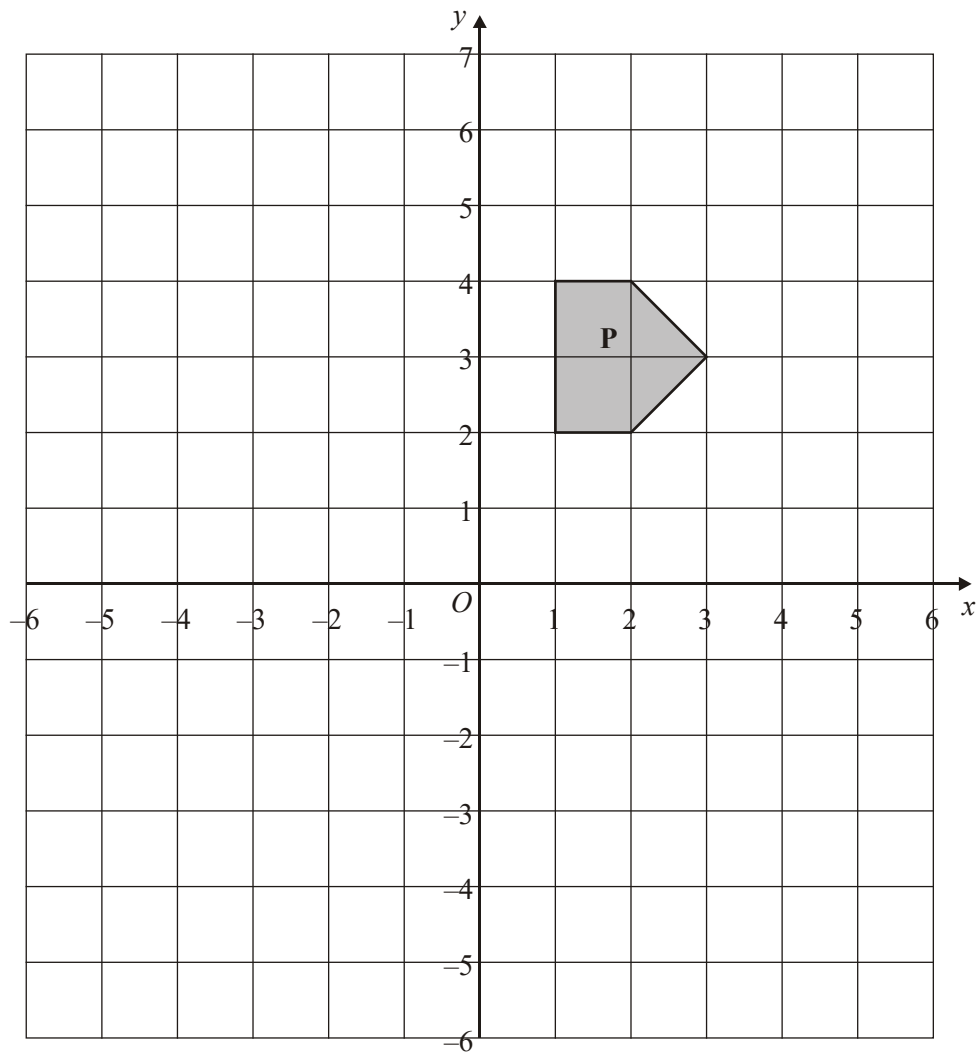
- (b) Describe fully the single transformation which will map triangle **A** onto triangle **B**.

.....

(2)

(Total 4 marks)

4.



- (a) On the grid, rotate the shaded shape **P** one quarter turn anticlockwise about O .

Label the new shape **Q**.

(3)

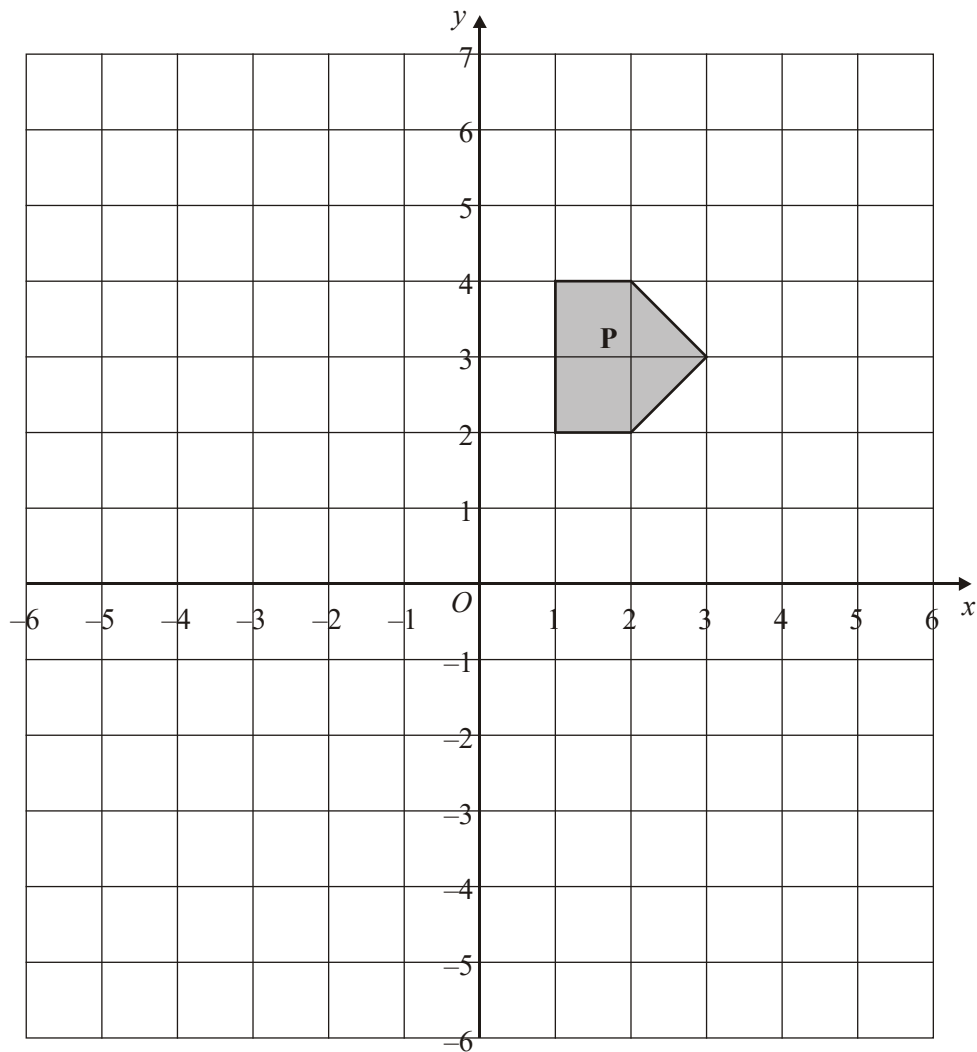
- (b) On the grid, translate the shaded shape **P** by 2 units to the right and 3 units up.

Label the new shape **R**.

(1)

(Total 4 marks)

5.

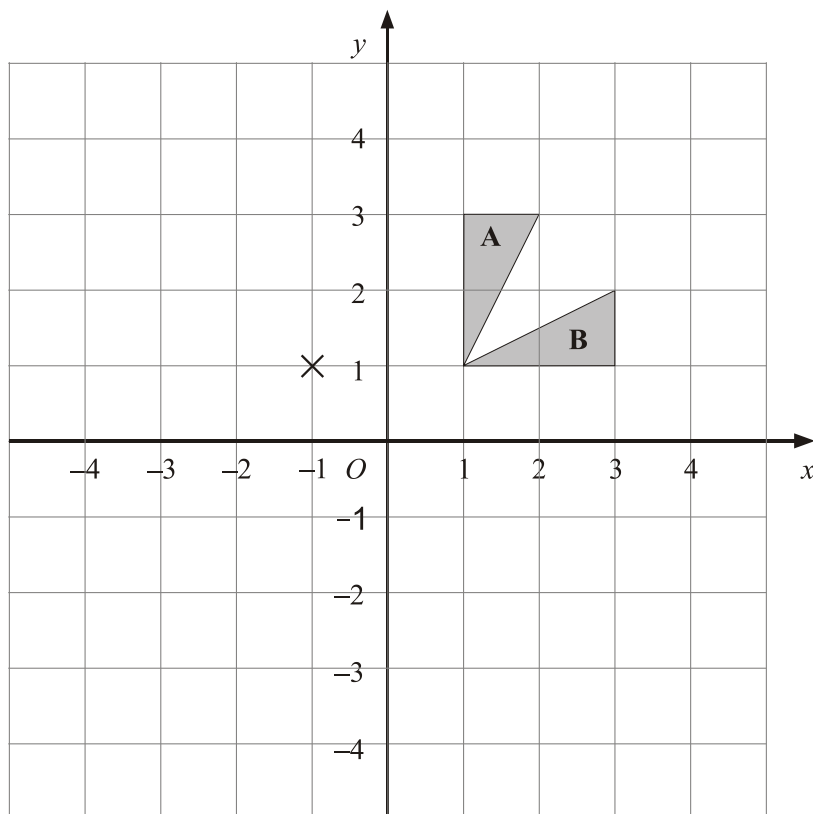


On the grid, rotate the shaded shape **P** one quarter turn anticlockwise about *O*.

Label the new shape **Q**.

(Total 3 marks)

6.



- (a) Describe fully the single transformation that maps triangle **A** onto triangle **B**.

.....

(2)

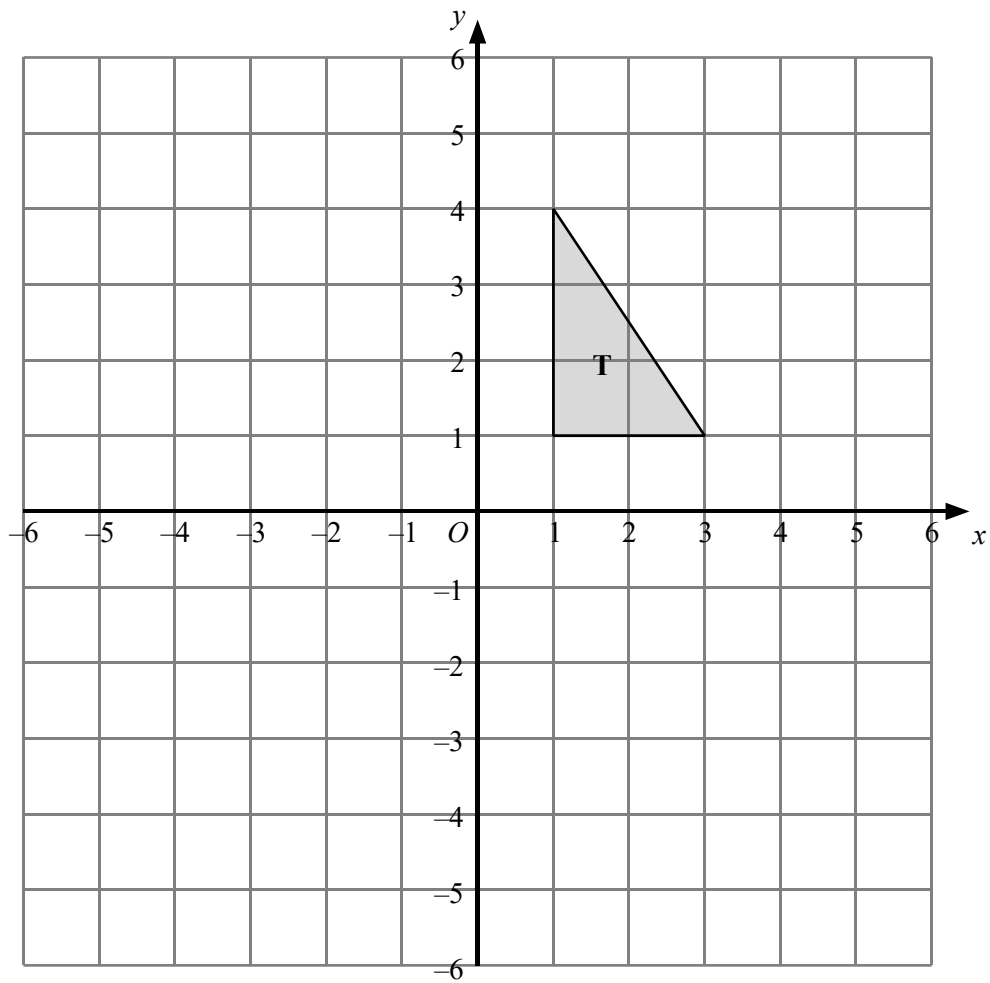
- (b) On the grid, rotate triangle **A** 90° anticlockwise about the point $(-1, 1)$

Label your new triangle **C**.

(2)

(Total 4 marks)

7.



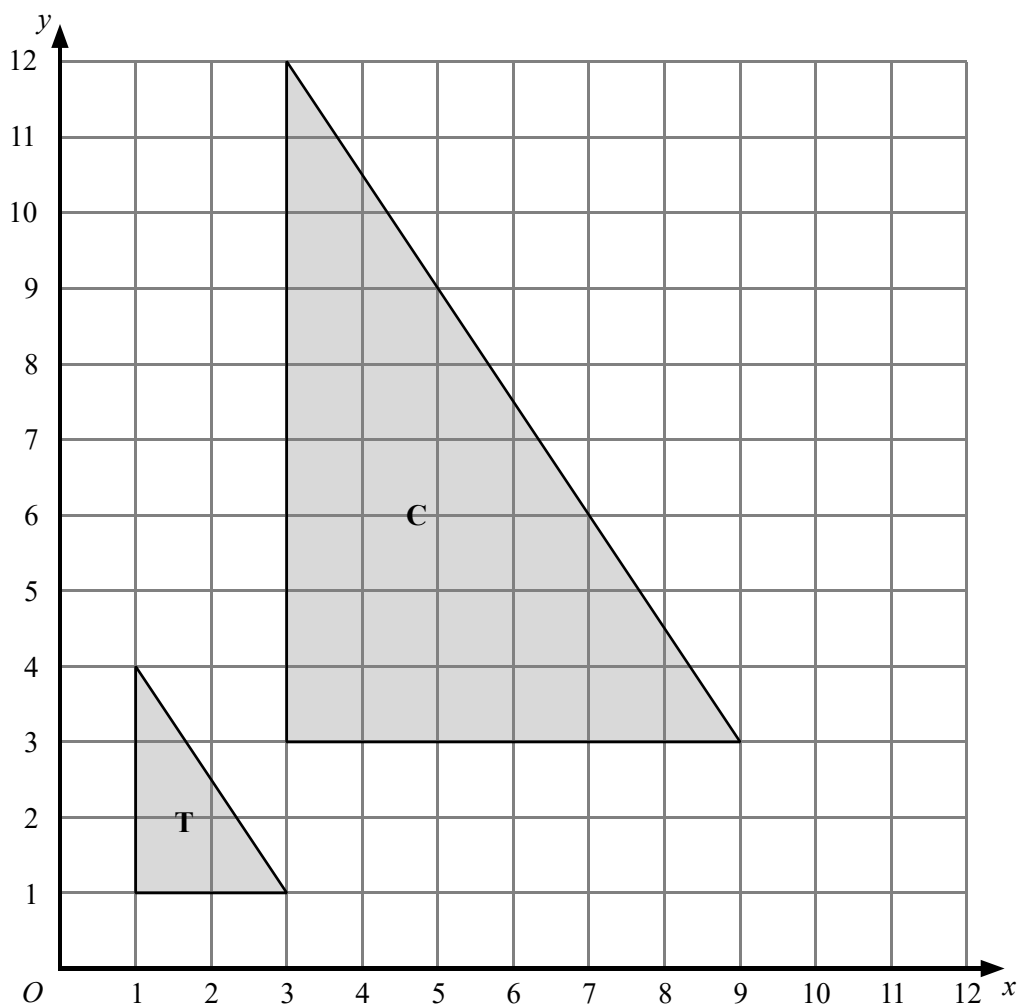
Triangle **T** has been drawn on the grid.

- (a) Reflect triangle **T** in the y -axis.
Label the new triangle **A**.

(1)

- (b) Rotate triangle **T** by a half turn, centre *O*.
Label the new triangle **B**.

(2)

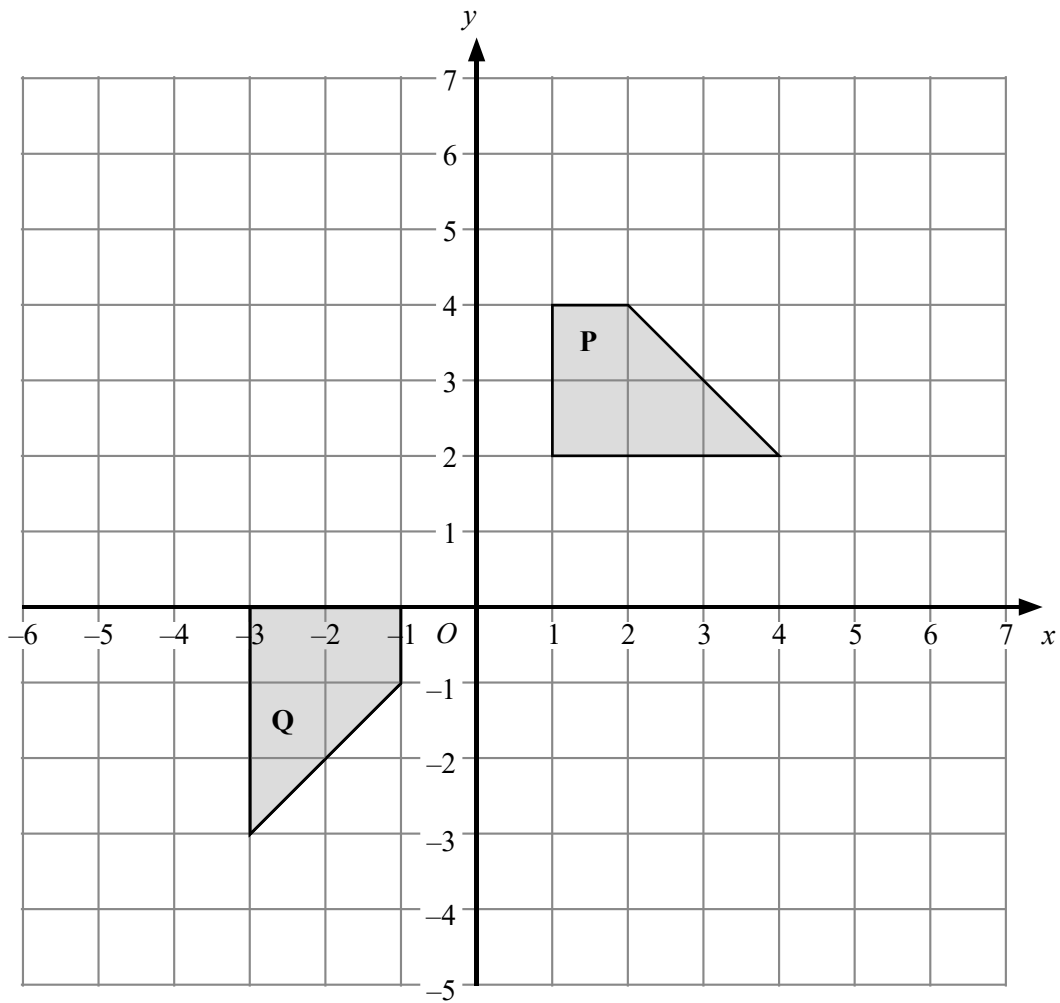


- (c) Describe fully the single transformation which maps triangle **T** onto triangle **C**.

.....

(3)
 (Total 6 marks)

8.

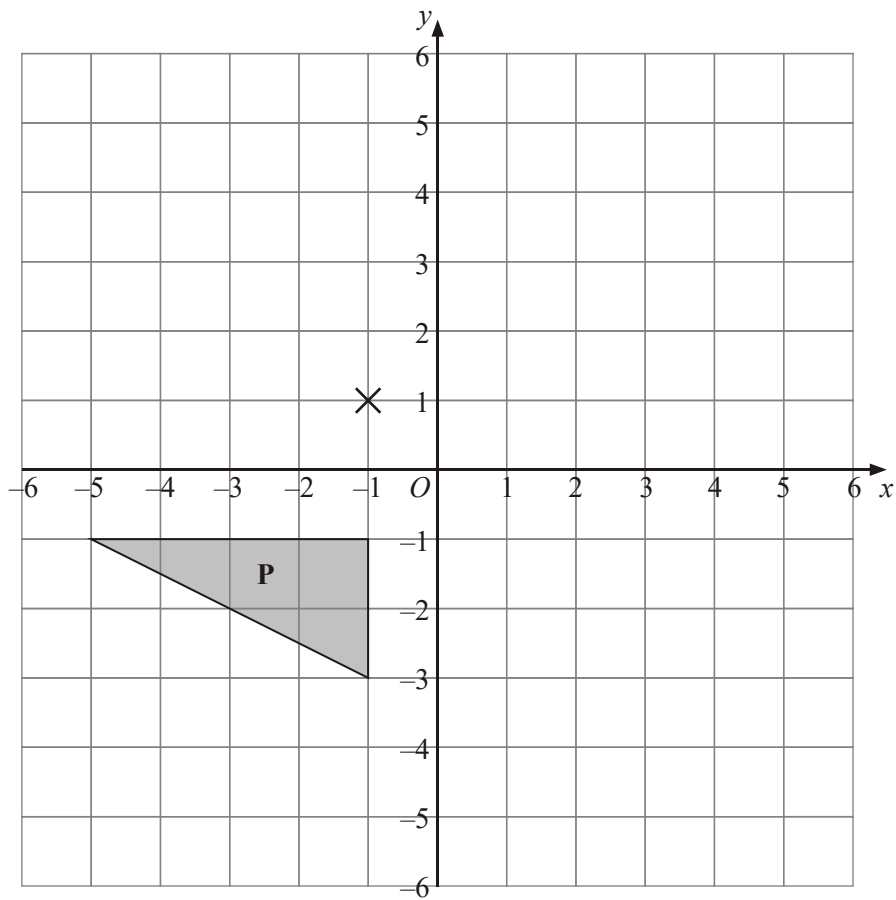


Describe fully the single transformation that will map shape **P** onto shape **Q**.

.....

(Total 3 marks)

9.



- (a) Rotate triangle **P** 180° about the point $(-1, 1)$.

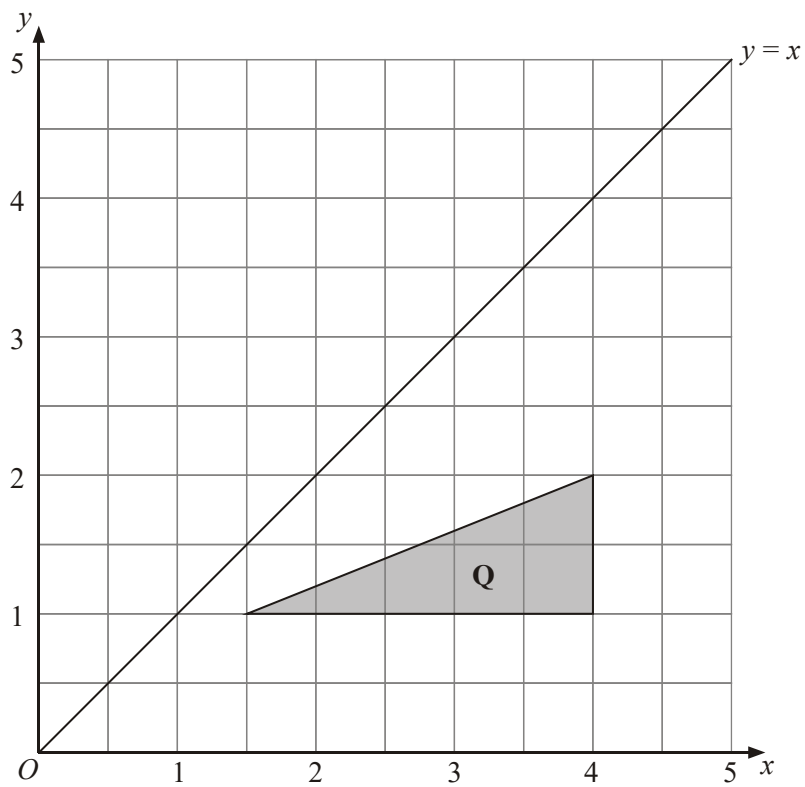
Label the new triangle **A**.

(2)

- (b) Translate triangle **P** by the vector $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$.

Label the new triangle **B**.

(1)

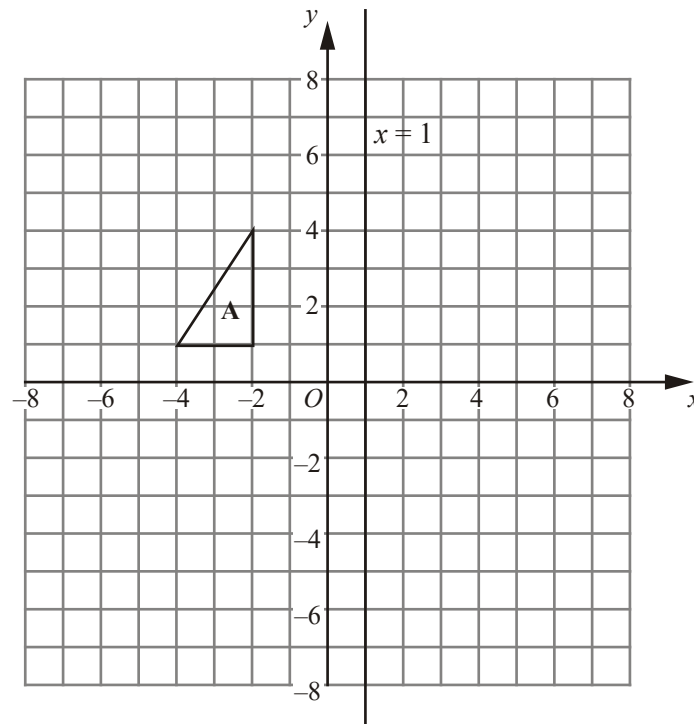


- (c) Reflect triangle **Q** in the line $y = x$.

Label the new triangle **C**.

(2)
(Total 5 marks)

10.



Triangle **A** is reflected in the x -axis to give triangle **B**.

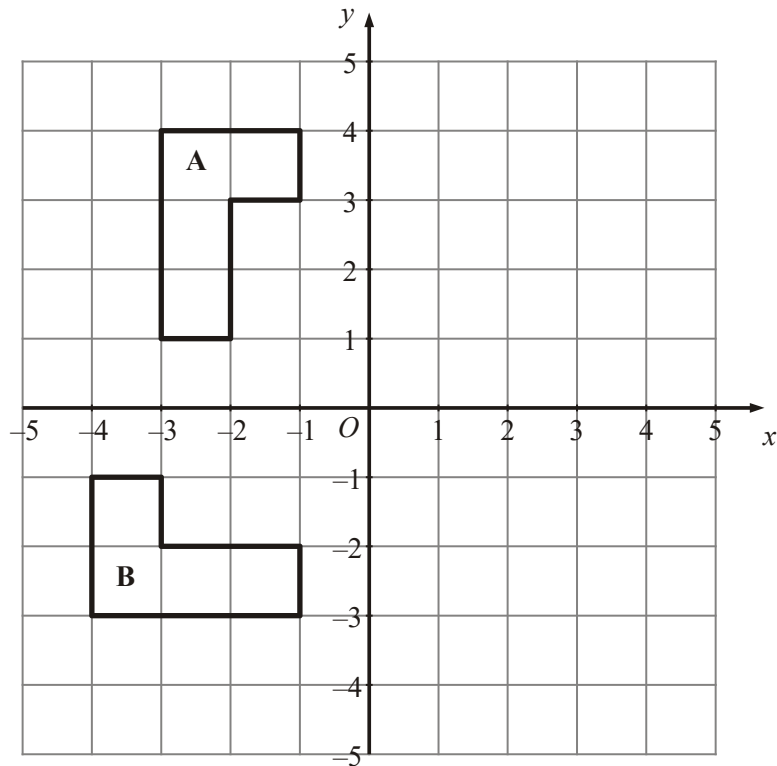
Triangle **B** is reflected in the line $x = 1$ to give triangle **C**.

Describe the **single** transformation that takes triangle **A** to triangle **C**.

.....

(Total 3 marks)

11.



(a) Reflect shape **A** in the y axis.

(2)

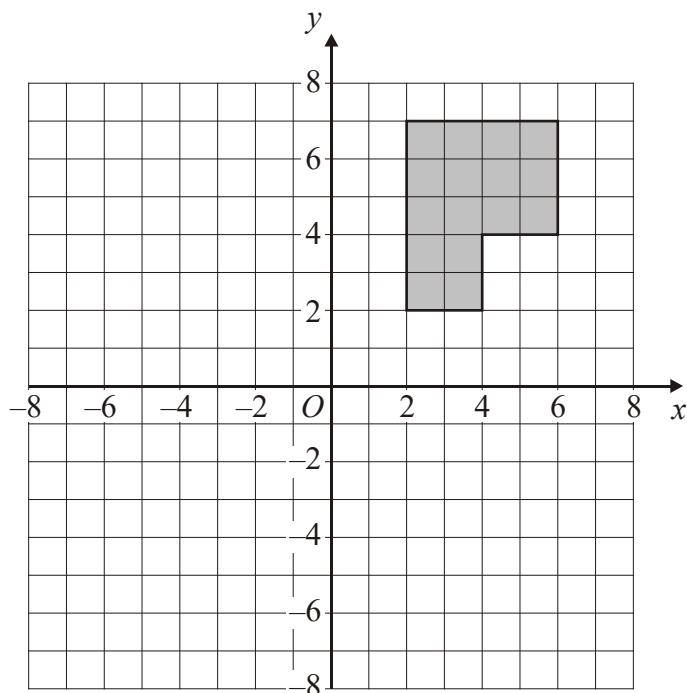
(b) Describe fully the **single** transformation which takes shape **A** to shape **B**.

.....

(3)

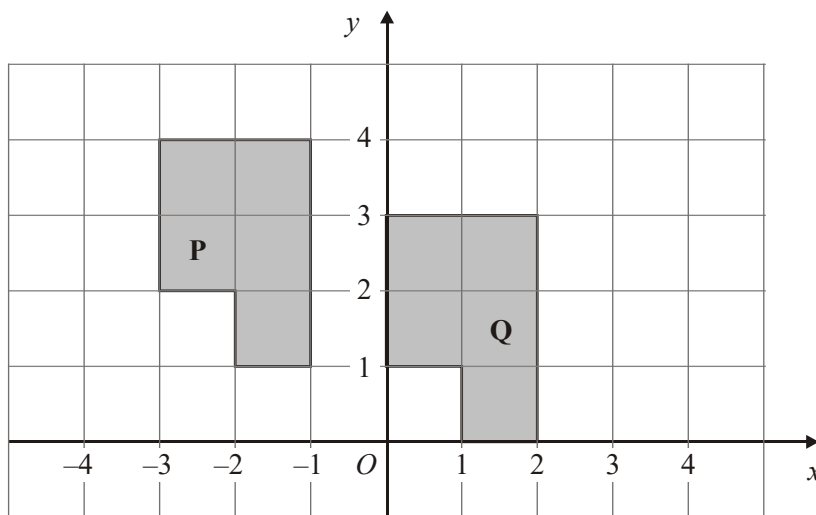
(Total 5 marks)

12.



(a) Rotate the shaded shape 90° clockwise about the point O .

(2)



(b) Describe fully the single transformation that will map shape **P** onto shape **Q**.

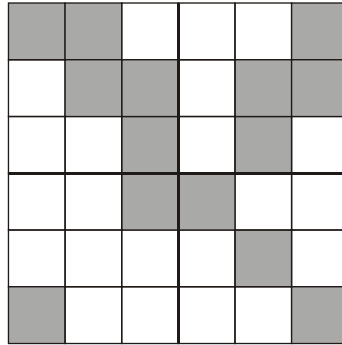
.....

(2)

(Total 4 marks)

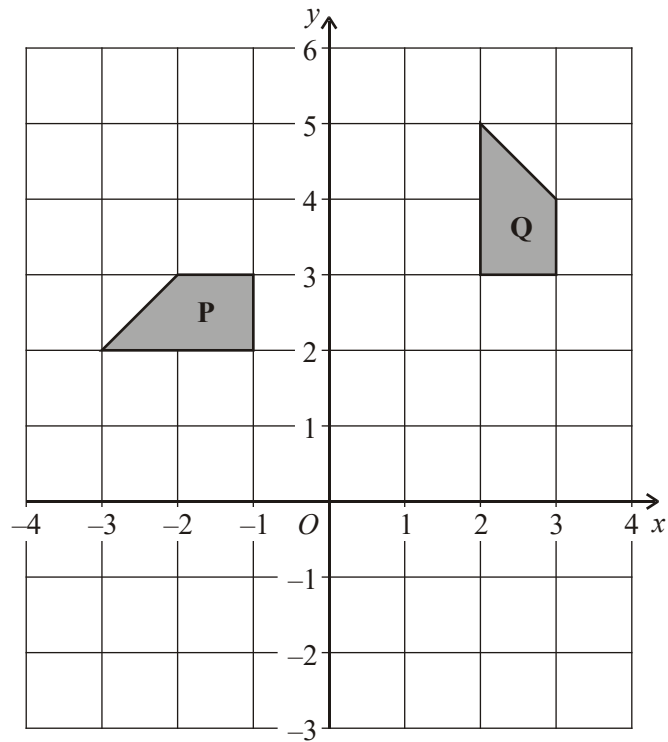
13. A pattern is to be drawn.
It will have rotational symmetry of order 4.
The pattern has been started.

By shading **six** more squares, complete the pattern.



(Total 3 marks)

14.



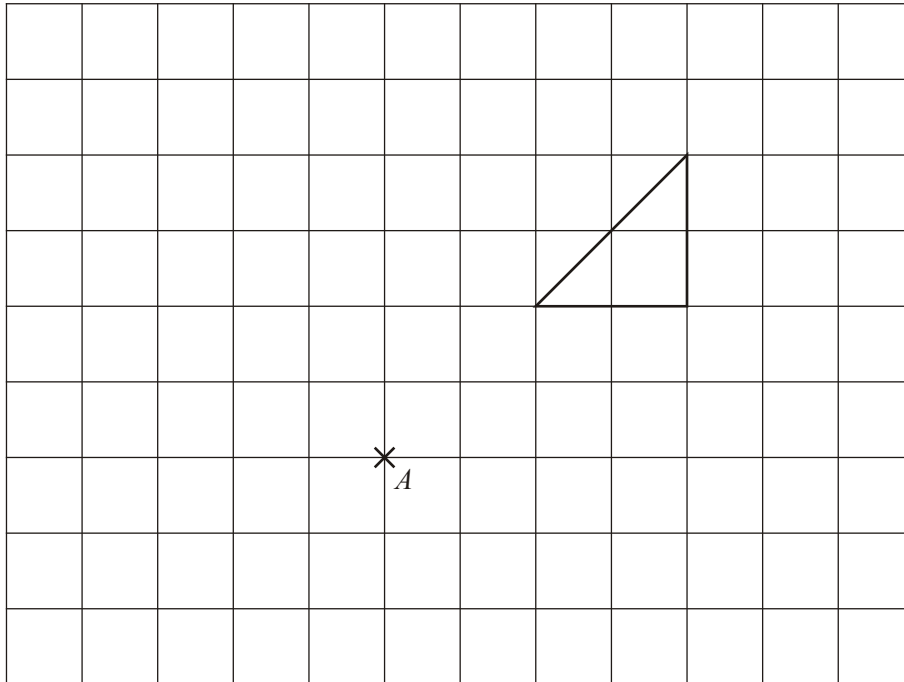
Describe fully the single transformation that maps shape **P** onto shape **Q**.

.....

.....

(Total 3 marks)

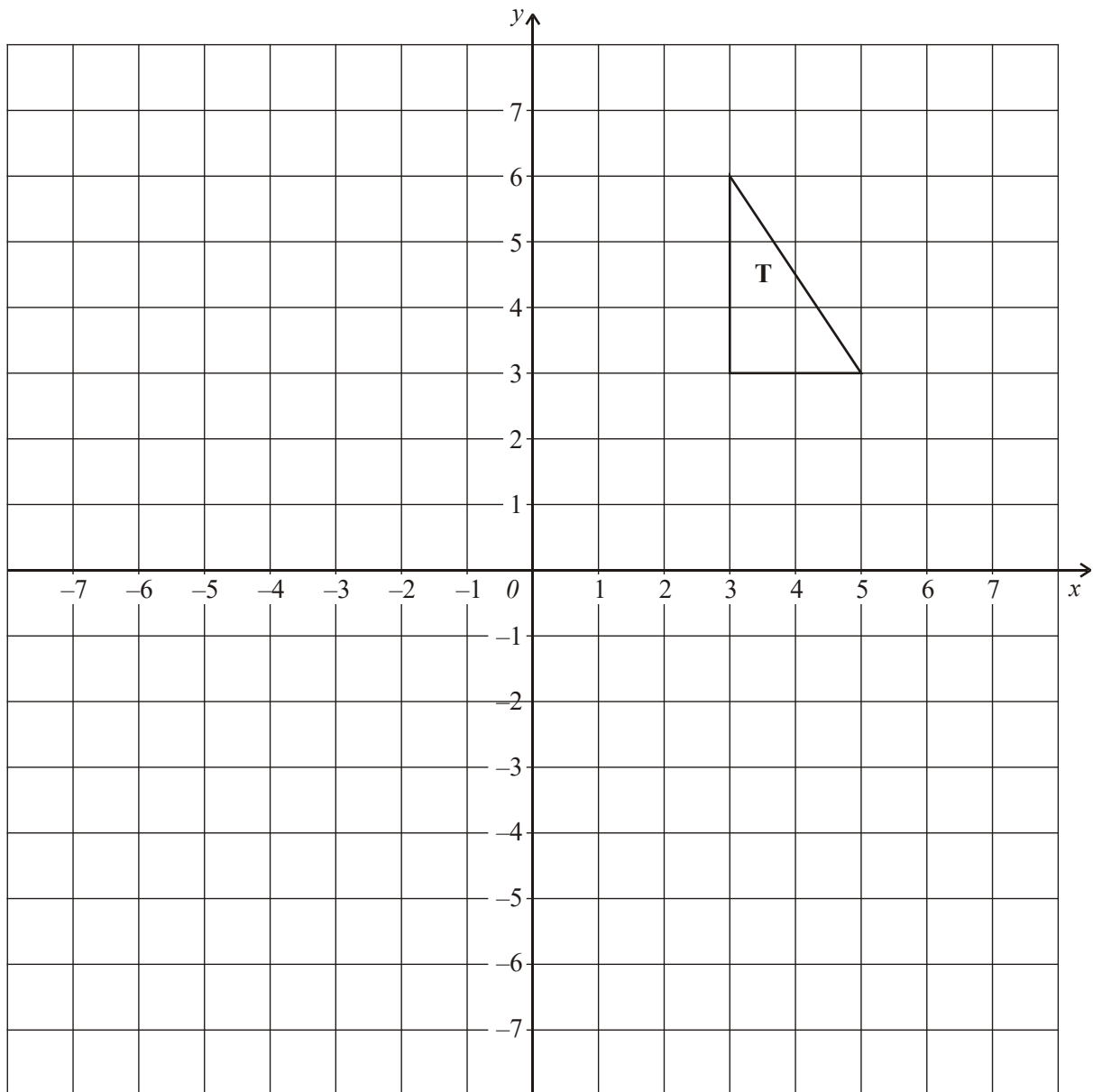
15.



Rotate the shaded triangle through 45° , anticlockwise, about the point A .

(Total 2 marks)

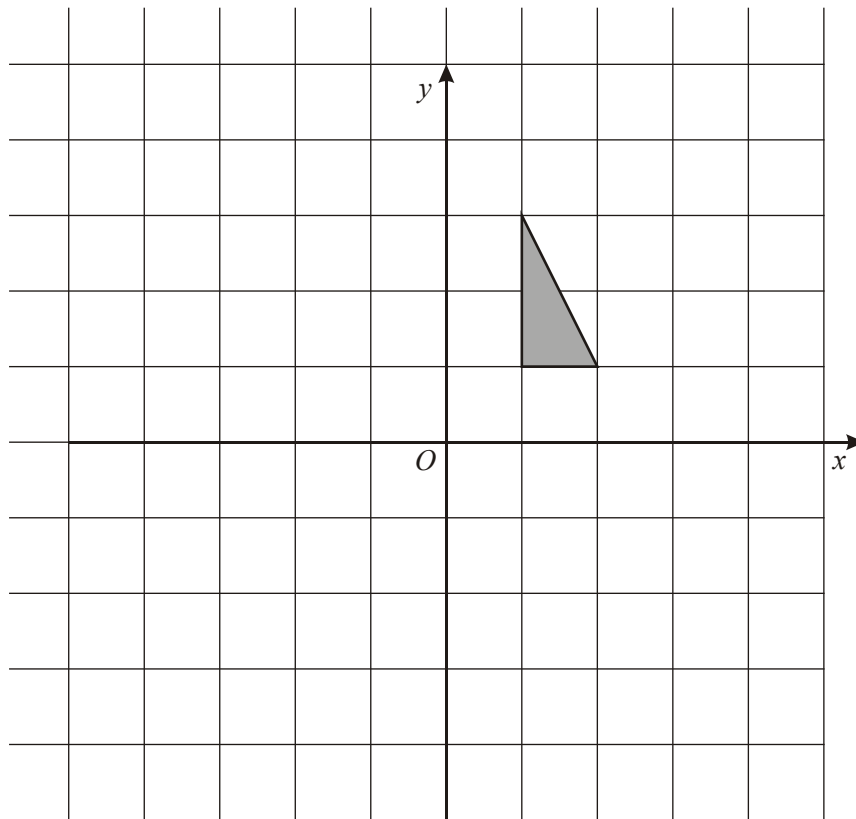
16.



Rotate triangle **T** through 90° clockwise about the point (2, 1).

(Total 2 marks)

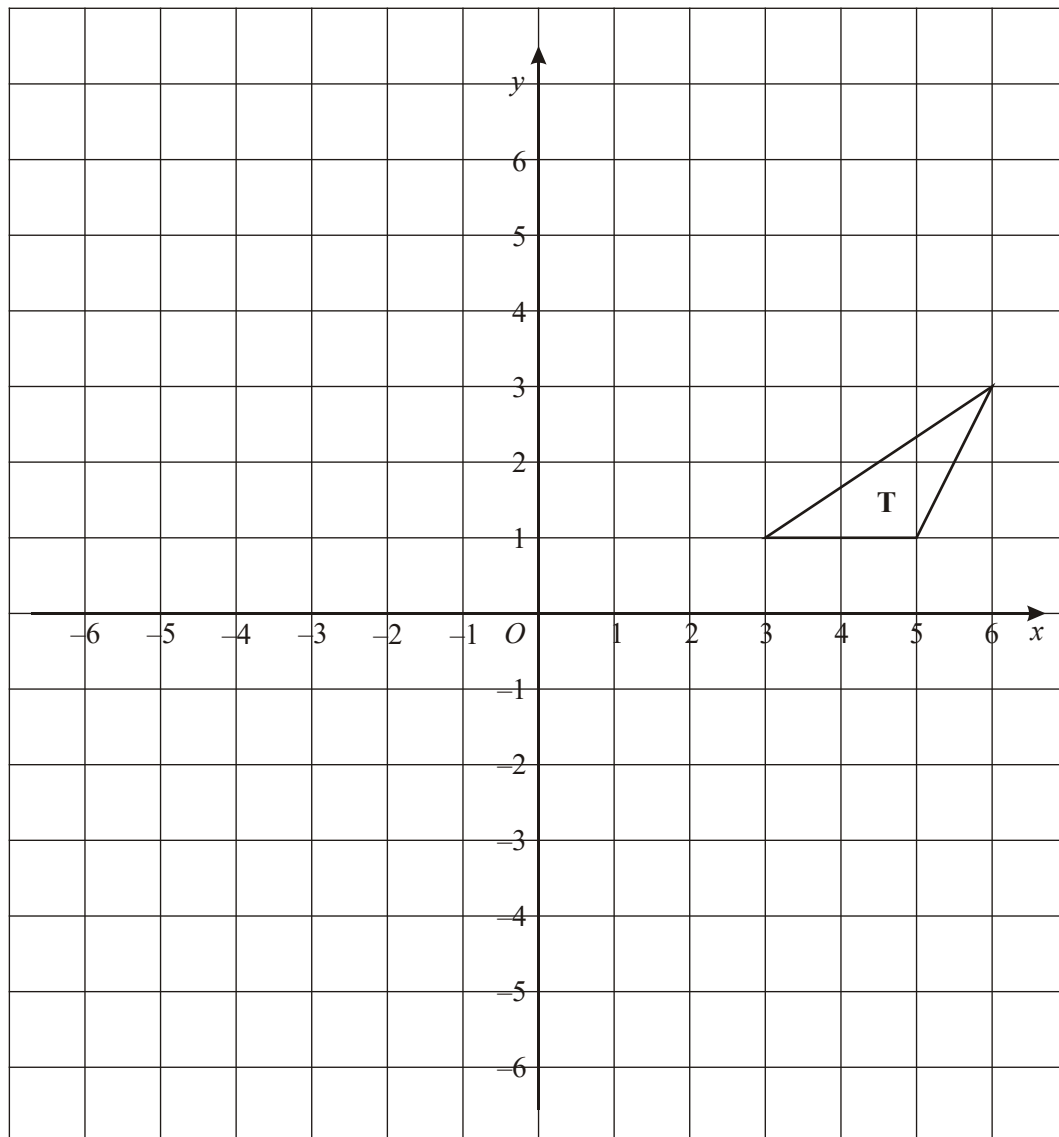
17.



Rotate the triangle a half turn about the point O .

(Total 2 marks)

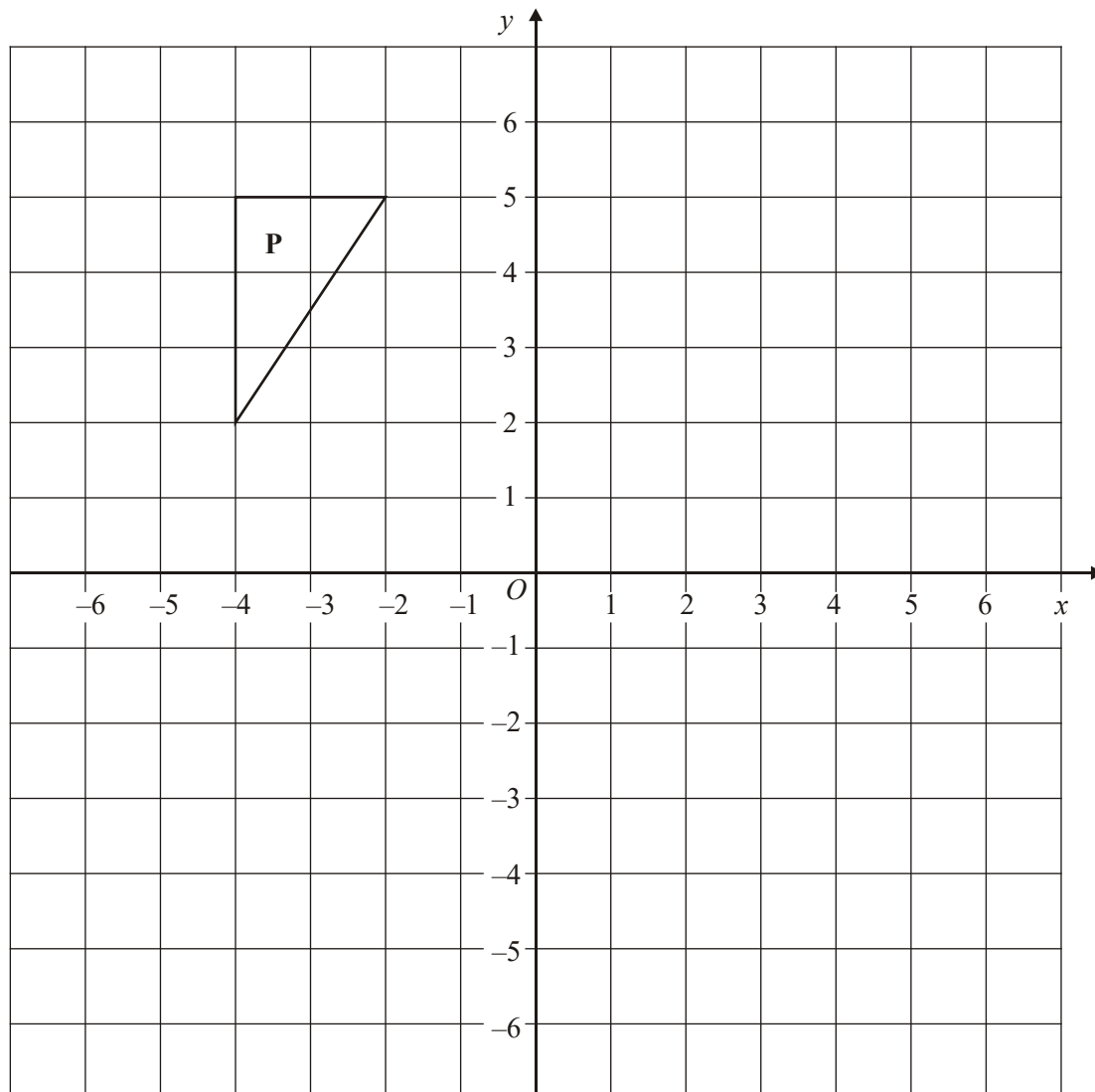
18.



Rotate triangle **T** 90° clockwise about the point (2, 2).

(Total 2 marks)

19.



- (a) Rotate triangle **P** 90° clockwise about the point (0, 2)
Label the new triangle **Q**.

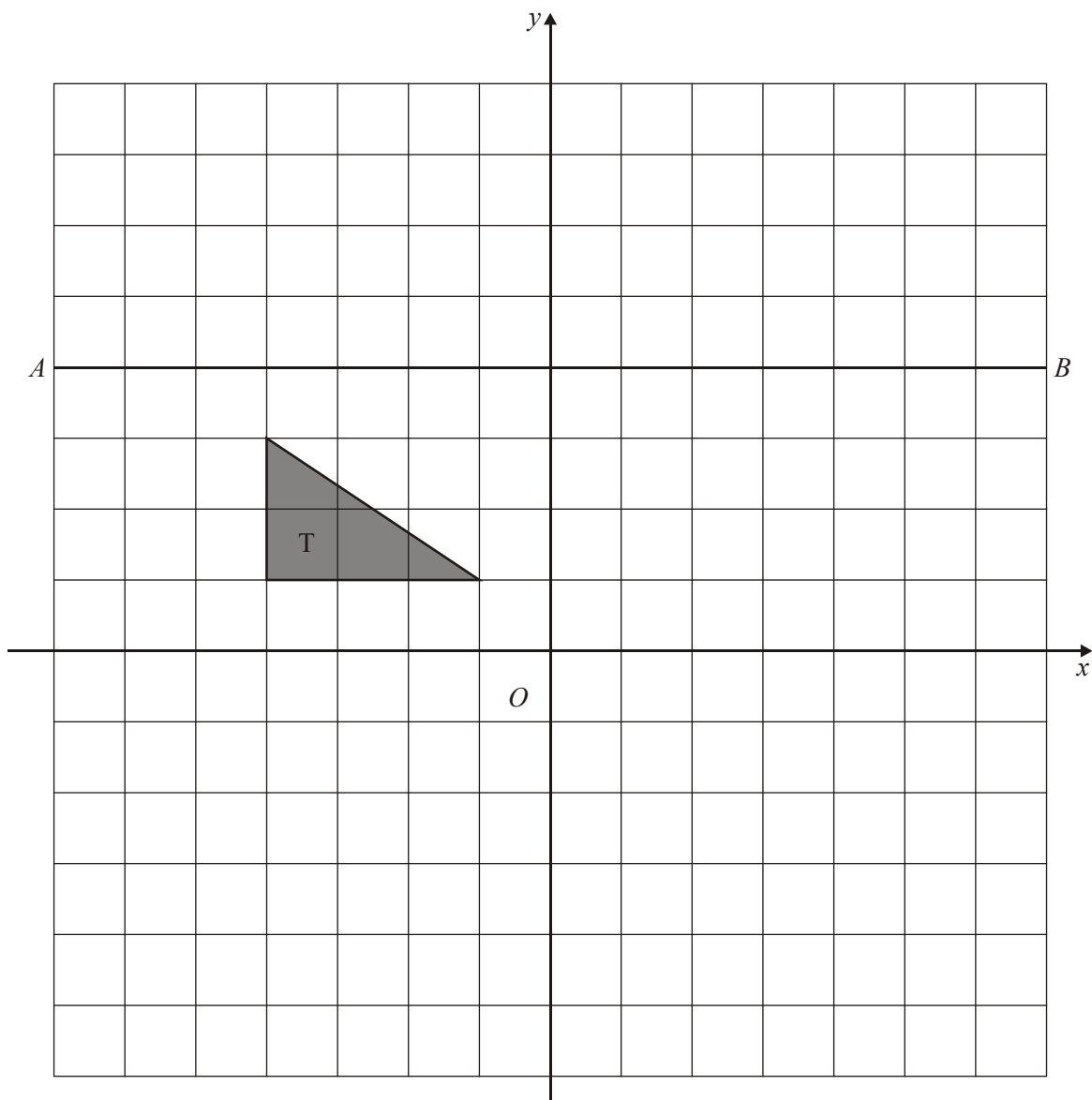
(2)

- (b) Translate triangle **P** by the vector $\begin{pmatrix} 5 \\ -6 \end{pmatrix}$

Label the new triangle **R**.

(1)
(Total 3 marks)

20.



Rotate the triangle a quarter turn anticlockwise, centre O .

(Total 2 marks)

1. (a) 2

B1 for 180° rotation (wrong centre)
B1 cao

- (b) 3

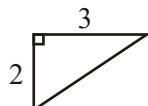
B1 for any enlargement sf other than 1
B1 for all sides halved
B1 for position

[5]

2. (a) Triangle with vertices at $(0, 0)$ $(0, -2)$ and $(3, 0)$ 2

M1 for correct orientation
A1 cao

- (b) Rotation, 180°, centre $(0, 1)$ 2
Enlargement sf -1 centre $(0, 1)$



B2 for 180° 'rotation' centre $(0, 1)$ or
for Enlargement sf -1 centre $(0, 1)$
(B1 for any two of the three parts)
NB: B0 if additional transformation is included

[4]

3. (a) correct reflection 2

B2 (B1 reflection in line other than $x = 3$)

- (b) reflection in $y = x$ 2

B2 cao Accept the word "reflected"
(B1 any statement including the word "reflection")

[4]

4. (a) Overlay 3

*B3 fully correct
(B2 correct orientation in correct quadrant)
(B1 any rotation about O;
or correct orientation in incorrect quadrant).*

(b) Translation 1

B1 cao

[4]

5. Overlay 3

*B3 fully correct
(B2 correct orientation in correct quadrant)
(B1 any rotation about O; correct orientation in incorrect quadrant).*

[3]

6. (a) reflection 2

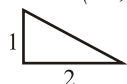
B1 for reflection

line $y = x$

*B1 for line $y = x$
(if B0 then B1 for line $y = x$ drawn on diagram)*

(b) Triangle with vertices at $(-1, 3)$, $(-3, 3)$ and $(-3, 4)$ 2

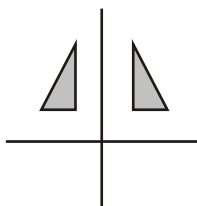
M1 for correct orientation or for a rotation of 90° clockwise about $(-1, 1)$



A1 cao

[4]

7. (a)

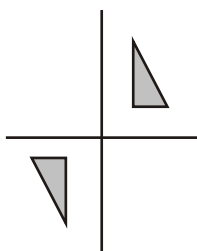


Reflection in y -axis

B1 cao

1

(b)



Rotation by half turn about $(0, 0)$ 2
B2 cao
(B1 for half turn not about $(0, 0)$.)

(c) Enlargement 3
 Scale factor 3
 Centre $(0,0)$
B1 for 'enlargement'
B1 for "scale factor 3" or 3 seen
B1 for 'centre $(0, 0)$ '

[6]

8. Rotation 90° clockwise centre $(-2, 3)$ 3
B1 for rotation
B1 for 90 clockwise or -90 or +270 or 270 anticlockwise or
quarter clockwise or three quarters anticlockwise
B1 for $(-2, 3)$
(B0 for a combination of transformations)

[3]

9. (a) Triangle A 2
 Triangle with vertices $(-1, 5)$, $(-1, 3)$, $(3, 3)$
B2 for triangle with vertices $(-1, 5)$, $(-1, 3)$, $(3, 3)$
(B1 for triangle with correct orientation or for triangle rotated
 $\pm 90^\circ$ centre $(-1, 1)$)

(b) Triangle B 1
 Triangle with vertices $(1, -2)$, $(5, -2)$, $(5, -4)$
B1 for triangle with vertices $(1, -2)$, $(5, -2)$, $(5, -4)$

- (c) Triangle C
 Triangle with vertices (1, 1.5), (1, 4), (2, 4) 2
B2 for triangle with vertices (1, 1.5), (1, 4), (2, 4)
(B1 for the triangle with correct orientation or for any two of the vertices (1, 1.5), (1, 4), (2, 4))
SC: B1 for a triangle with vertices (1, 1.5), (1, k), (2, k)

[5]

10. B at (-2, -1), (-4, -1), (-2, -4)
 C at (4, -1), (6, -1), (4, -4)
 Rotation 180° about (1, 0) 3
B1 for rotation
B1 for 180°
B1 for centre (1, 0)
 OR
B1 Enlargement
B1 Scale Factor -1 Accept -1 on its own if it is clear candidate is describing an enlargement
B1 Centre (1, 0)
Ignore diagram unless no marks scored, in which case
SC B1 for showing both B and C correctly
NB Award no marks for the description if more than one transformation is given


[3]

11. (a) 2
B2 correct reflection
(B1 correct reflection in the line $x = k$, $k \neq 0$)

- (b) Rotation 90° about the centre (0, 0) 3
B1 for rotation
B1 for 90° (anticlockwise) or 270 clockwise or 1/4 turn (anticlockwise) or 3/4 turn clockwise
B1 for (0,0) or O or origin
NB: a combination of transformations gets B0

[5]

12. (a) Vertices at $(2, -2), (7, -2), (7, -6), (4, -6), (4, -4), (2, -4)$ 2
B2 for a fully correct rotation
[B1 for correct shape with correct orientation
***OR** a 90° anticlockwise rotation about O*
***OR** a 180° rotation about O*
***OR** for any 3 correct sides in the correct position]*
- (b) Translation by $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$ 2
B1 for translation
B1 (indep) for $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$ or 3 right and 1 down
- [4]**
13. Correct diagram 3
 Shade squares
B3 (B1 for each correct quadrant)
- [3]**
14. Rotation of 90° , clockwise about $(1, 1)$ 3
M1 for rotation (do not accept more than one transformation)
A1 for 90° clockwise (or 270° anticlockwise)
A1 for about $(1, 1)$
SC: B2 for 'turn' or 'rotational symmetry' with everything else correct
(SC: B1 for 'turn' or 'rotational symmetry' with one other fully correct statement)
- [3]**
15. See overlay 2
B2 for a correct rotation
(B1 for vertical hypotenuse, i.e correct orientation)
(SC: B1 for correct clockwise rotation through 45°)
- [2]**

16. $(4, 0)$ $(7, 0)$ $(4, -2)$ 2
B2 fully correct (2 mm tolerance on each side)
(B1 correct orientation or anticlockwise rotation of 90° about $(2, 1)$)
[2]
17. rotation 2

B2 for correct 180° rotation $[(-1, -1), (-2, -1), (-1, -3)]$
(B1 for correct orientation or rotations in all 4 quadrants)
s.c. B1 for rotation 90° centre $(0, 0)$
[2]
18. rotation 2
 $(1, 1)$, $(1, 1)$, $(3, -2)$
B2 for correct rotation
(B1 for correct orientation or for a correct rotation anticlockwise about $(2, 2)$)
[2]
19. (a) Triangle at $(0, 6)$ $(3, 6)$ and $(3, 4)$ 2
B2 for correct rotation
(B1 for 90° clockwise rotation about any centre or 90° anticlockwise rotation about $(0, 2)$)
- (b) Triangle $(3, -1)$, $(1, -1)$ and $(1, -4)$ 1
B1 for correct translation
[3]
20. $(-1, -1)$, $(-1, -4)$, $(-3, -4)$ 2
B2 fully correct
(B1 correct orientation or a correct rotation through 90° clockwise about the origin)
[2]

1. Most candidates undertook a rotation in part (a), though there were some errors in the final positioning of the triangle. Those candidates who used tracing paper had much greater success in the correct positioning of the triangle. There were very few correct solutions to part (b). Most candidates chose to draw a triangle of a scale factor 2 rather than $\frac{1}{2}$; there were, however, many errors in these attempts, since not all three sides were doubled in length, with a significant number *adding* $\frac{1}{2}$ cm to each side. It is clear that of all the transformations, enlargement is the one in which candidates are the weakest.

2. Paper 3

The first part of this question was well attempted, with nearly all candidates gaining some credit. The most common error was in placing the corner of the triangle at $(1, -1)$. In part (b) it was encouraging to see far fewer candidates using “turn” instead of “rotation”. Most gave a realistic attempt at a detailed description, resulting in the award of marks, far better than in previous years. The most common omission was the mention of the centre of rotation. There was clear evidence that candidates who used tracing paper achieved greater success in this question.

Paper 5

Most candidates correctly marked the position of triangle D and described the correct single transformation in part (b) although some descriptions were not full enough or involved a wrong angle of rotation. Fewer descriptions involved more than one transformation, which is an improvement on previous years.

3. Most candidates were able to reflect shape A in a line, but not always the correct line. Many reflected A in the line $x = 2$. In part (b) many candidates correctly identified it as a reflection. However, many candidates also spoilt their answers: the question clearly asked for a description of a *single* transformation. Those candidates who gave descriptions relating to more than one transformation could not be given any marks, since such a choice meant that it was ambiguous as to which transformation the candidate wanted to be considered as the “single” transformation. Centres are advised to emphasise this in preparing future candidates.
4. Despite this being a grade D question, it was encouraging to find that nearly half the candidates were able to score at least one mark by rotating the shape about O or, more commonly, obtaining the correct orientation of the shape with the ‘arrow’ pointing upwards somewhere on the grid. Just under a tenth of the candidates were able to score all 3 marks. It was disappointing to find that fewer than a quarter of the candidates were able to translate the shape by 2 units to the right and 3 units up, with a common incorrect response being to translate it 3 units to the right and 3 units up.

5. The majority of the candidates were rotating the shape into the correct quadrant, but many did so inaccurately, positioning the shape one square out. There is clear evidence to suggest that those candidates who used tracing paper to perform the rotation were far more successful than those who judged it “by eye”. The weakest candidates either performed a reflection, or did a clockwise rotation.

6. **Paper 5523**

This question was answered surprisingly poorly. In part (a), very few candidates gave a fully correct description of the transformation. The most common error was to describe it as a rotation and the word ‘flipped’ was used by many candidates. ‘Reflection’ was not seen as often as expected and was frequently on its own or accompanied by a centre or angle instead of the equation of the line. In part (b), the most common response was to rotate the triangle 90° anticlockwise but about an incorrect centre. Even though the point $(-1, 1)$ was marked on the diagram with a cross the triangle was frequently rotated about $(1, 1)$ or $(0, 0)$. Some used the correct angle and centre but rotated the triangle clockwise.

Paper 5525

In part (a), many candidates were able to identify the transformation as a reflection (comparatively few describing this as ‘mirrored’ or ‘symmetrical’). Some attempted to give more complex transformations involving two stages; whilst others, having difficulty in defining the equation of the line $y = x$, listed the coordinates $(1, 1)$, $(2, 2)$, $(3, 3)$... In part (b), the vast majority of candidates were able to draw triangle C with the correct orientation and most could locate it correctly. A common error in the location of triangle C was to have $(-1, 1)$ as a vertex.

7. Foundation Tier

Part (a) was well attempted the majority of students successfully reflecting the triangle. A common mistake was to reflect in the wrong axis or show the triangle moved one unit to the left. Candidates had less success with part (b) the rotations were often in the wrong quadrant, or had used an incorrect centre of rotation or were in the correct quadrant with the shape incorrectly aligned. Most students gained 1 mark for this response. A small minority of candidates drew a triangle in each quadrant, with no labelling and so scored no marks. Part (c) was least well answered it was rare indeed to see any candidate refer to the centre of enlargement, marks were gained for $\times 3$ or tripled rather than using the term “scale factor 3”.

Enlarged or inlarged was seen fairly often and the incorrect spelling was allowed on this occasion. Larger or made bigger were often seen but were deemed not worthy of credit.

Intermediate Tier

Part (a) was answered very well although a small number of candidates reflected the shape in the wrong line, most commonly the x -axis. The rotation in part (b) was less successful. The most common error was for the shape to be rotated by a quarter turn clockwise instead of by a half turn. Some of those candidates who did rotate by a half turn did so about a centre other than $(0, 0)$. Most candidates gained at least one mark in part (c) but many failed to mention the centre of enlargement. Some candidates failed to refer to ‘enlargement’ with other, incorrect, words often used instead. There was less evidence of candidates using a combination of transformations than in the past.

8. Higher Tier

Many candidates were able to identify the transformation as a rotation, but few were able to describe accurately the angle of the rotation and/or the centre of rotation. Typical errors here were to: describe the rotation as a ‘turn’; omit the direction of the rotation or give the angle of rotation as 180° ; omit the centre of rotation or give incorrect coordinates, e.g. $(0, 0)$; describe the transformation as a combination of transformations, typically a rotation followed by a translation.

Intermediate Tier

Far too many candidates ignored the request for a single transformation and gave a combination of transformations, most often a rotation and a translation, which gained them no credit. Candidates who recognised that just a rotation was needed frequently made mistakes with the angle or direction of the rotation or with the centre. Some candidates used ‘turn’ instead of ‘rotation’ but this gained no credit.

9. Foundation

In part (a) most candidates were able to rotate triangle P but frequently this was not about the point $(-1, 1)$. The triangle was often drawn in the correct orientation with one vertex at the centre of rotation. Many candidates rotated by 90° , rather than 180° . Part (b) was answered very poorly indeed. Many candidates could not cope with the vector and the triangle was often moved to the right with one vertex at $(6, -1)$. A significant number of reflections were also seen. Almost half of the candidates reflected the triangle correctly in part (c). A few candidates achieved this by drawing lines perpendicular to the line $y = x$ but most did not show any such lines. Where just one mark was awarded this was usually for drawing the triangle in the correct orientation but in the wrong position. A common error was a reflection in a horizontal line.

Higher

In part (a), about half the candidates were able to score both marks for this question. Common incorrect answers here were based on rotating the triangle about the wrong point, typically $(-1, -1)$ or $(0, 0)$. A smaller number of candidates reflected the triangle in the x -axis or rotated it by only $\pm 90^\circ$. In part (b), a significant number of candidates did not understand how to interpret the translation vector $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$. Common errors here were based on incorrect translations, typically $\begin{pmatrix} 6 \\ 0 \end{pmatrix}$ or $\begin{pmatrix} -1 \\ 6 \end{pmatrix}$. A small number of candidates reflected the triangle in the y -axis.

- 10.** Many candidates could not carry out the transformations correctly. The main error was to reflect the triangle in the y axis followed by a reflection in the line $x = 1$. A different error was to identify the correct axis but to carry out the reflection incorrectly with the image being 2 squares below the x axis instead of the correct 1 unit. A few candidates gave two transformations and consequently gained no marks for the description. Some gave the centre as $(0, 1)$ rather than the correct $(1, 0)$

11. Foundation

Most candidates (85%) accurately reflected shape A in the y axis. A small proportion attempted rotations or translations instead. Fully correct descriptions of a single transformation in part (b) were rarely seen with only 4% of candidates gaining all 3 marks. Many answers were spoiled by candidates giving a combination of transformations. Where candidates did give a single transformation it was usually a rotation and the angle was often given correctly. Few candidates gave the centre of rotation. Almost 60% of candidates were awarded at least 1 mark for their answer to part (b) of this question. Again, it proved to be a good discriminator.

Higher

Most candidates were able to reflect the given shape correctly in the y -axis in part (a).

In part (b) many candidates failed to score full marks as a result of the omission of one piece of information; usually the centre of rotation.

A significant number of candidates failed to score any marks at all by offering a combination of transformations; usually a rotation followed by a translation.

12. Specification A**Foundation**

Many candidates, in part (a), were able to gain at least one mark for correctly rotating the given shape through 90° in a clockwise direction, although many failed to score both marks as a result of their rotation not having been made about the required centre. Some candidates attempted rotations in each of the quadrants and usually failed to score at all, having made at least one further error.

In part (b), very few candidates scored full marks. Whilst many gained a mark for comments such as “move 3 units to the right and 1 unit down” only a minority correctly mentioned ‘translation’ in their description. Sometimes incorrect use of a column vector contradicted earlier statements and marks were lost. Surprisingly many candidates miscounted how many squares to the right P had been translated; -4 or 2 were often seen.

Another common response was “across/along 3 units and down 1”. This gained no marks.

A few gave responses such as left 3 and up 1 mapping Q to P by mistake.

Higher

Part (a) was answered extremely well with most candidates rotating the shape 90° clockwise, usually using O as the centre of rotation.

Most errors resulted from rotating the shape 90° clockwise about the wrong centre although some candidates rotated it 90° anticlockwise about O . Full marks were surprisingly rare in part (b). Many failed to identify the transformation as a translation. Some candidates used words such as ‘transformed’ or ‘moved’ but many did not attempt to name the transformation and simply described the movement by using words or a vector. Vectors were often correct although sometimes the signs were incorrect. Other common errors included writing coordinates instead of a vector and describing the movement as ‘across 3 and down 1’.

Specification B**Foundation**

This question was not done well. In part (a), just over a third of the candidates were able to score 2 marks for the correct rotation of the shape. A significant number of candidates lost a mark by incorrectly positioning the shape after the 90° clockwise rotation, or by embedding their answer within other rotations- typically all three of 90° , 180° and 270° rotations. In part (b), very few candidates were able to write down the name of the transformation or describe accurately how this should be done. A common incorrect answer here was 3 ‘across’ and 1 down.

Higher

Part (a) was well answered with the vast majority of candidates putting the image in the correct place. There were a few inaccuracies – usually the correct shape a square out as well as some confusion over the sense.

Candidates were generally less successful with part (b). There was a lack of knowledge of the technical vocabulary required, so answers such as ‘moved along’ were very common. Translation was often given as ‘transformation’ and ‘transportation’. Candidates could give answers in vector form or as a movement parallel to the axes. Of those that opted for the latter, many lost marks through vagueness by writing such as ‘3 along the x direction and 1 down the y direction’ because they had to specify the sense. ‘3 to the right along the x direction and 1 down’ was acceptable for 1 mark. Of those that used vectors, some transposed the x and y components or wrote the x and y components as a fraction, presumably having an idea of gradient in their heads. Lastly there was some confusion evident in using the vector as the name of the transformation or in writing the vector as coordinates.

13. Paper 8

Very few candidates scored three marks, with very little evidence of tracing paper being used. Many earned a mark for the top right hand quadrant but then shaded five more squares by reflecting the top half of the diagram.

Paper 9

A significant number of candidates completed the pattern correctly. Often 1 mark only was scored for the correct ‘first quadrant’, confusing rotational symmetry with line symmetry, when candidates reflected in a horizontal axis.

- 14.** Candidates must specify the type of transformation. In a number of cases, just the direction and centre of rotation were given. The most common errors were omitting the direction of rotation and giving the wrong centre. The question asked for a single rotation. This was ignored by a significant minority of candidates who therefore failed to gain marks on this question.
- 15.** A significant number (30%) were able to rotate the triangle through 45° realising the orientation of the transformation; inaccurate drawing lost many the second mark. The frequent error was to rotate the triangle through 90° in either direction, but usually anti-clockwise.

16. Many candidates gained at least one mark here, for a correct orientation of their rotated shape, but just 29% gained full marks. A small number of candidates accurately rotated the given shape about the point (2, 1) in an anti-clockwise direction by mistake; these were awarded one mark only. A few candidates rotated the shape through 270° , 180° as well as 90° about the origin, and were awarded no marks.

17. Rotating the triangle through a half turn about the origin would have been an easier task by making use of tracing paper to perform the rotation. As it was, nearly half the candidates were able to provide the correct orientation of the triangle on the grid, scoring one mark, but only half of these candidates were able to put the triangle in the correct position on the grid. Some candidates rotated the triangle by a quarter turn, either clockwise or anticlockwise, whilst others rotated the triangle and provided a triangle in each of the four quadrants, failing to indicate which of the three drawn triangles was their answer, thereby losing one mark.

18. Two thirds of the candidates gained at least one of the two marks in this question for rotating the triangle correctly through 90° clockwise. A small number correctly rotated the triangle through 90° in an anticlockwise direction about (2, 2) and also gained one mark. A number of weaker candidates reflected the triangle by mistake.

19. The vast majority of candidates were able to gain some credit for the rotation. A significant number of candidates, however, did not use the correct centre and so failed to gain full credit. A minority of candidates used the correct centre but rotated anticlockwise rather than clockwise. Success with the translation was very varied; approximately 60% of candidates were able to carry this out correctly.

20. No report available.