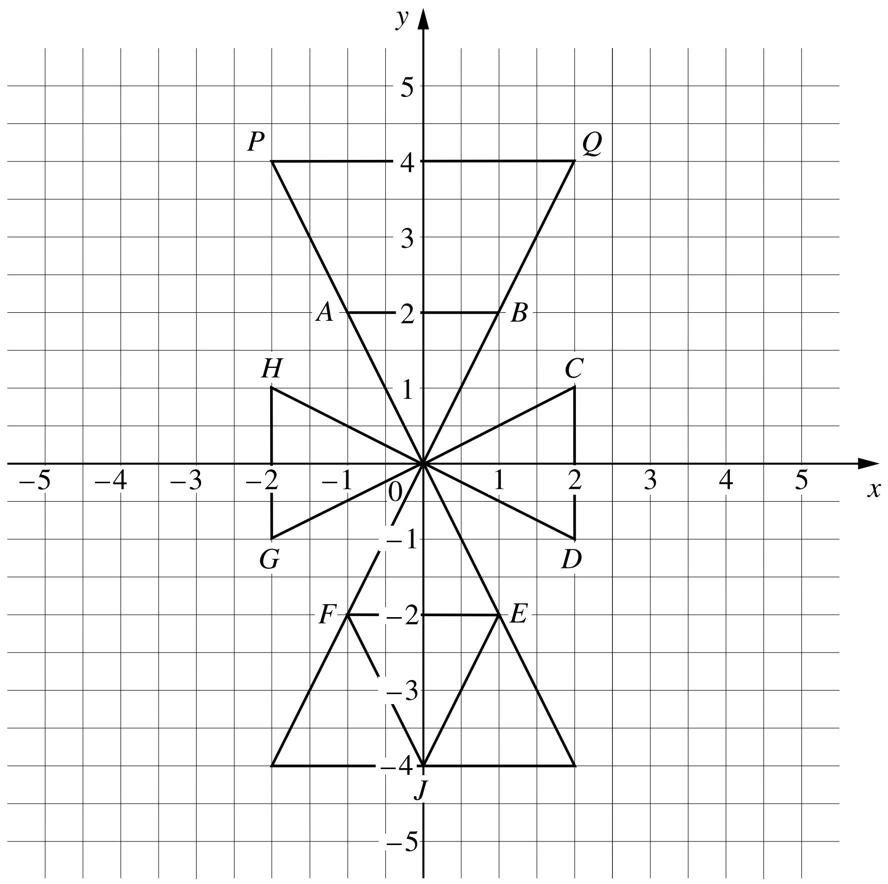
7



(a) Describe fully a single transformation which maps both

(i) *A* onto *C* **and** *B* onto *D*, [2]

(ii) *A* onto *D* **and** *B* onto *C*, [2]

(iii) *A* onto *P* **and** *B* onto *Q*. [3]

(b) Describe fully a single transformation which maps triangle *0AB* onto triangle *JFE*. [2]

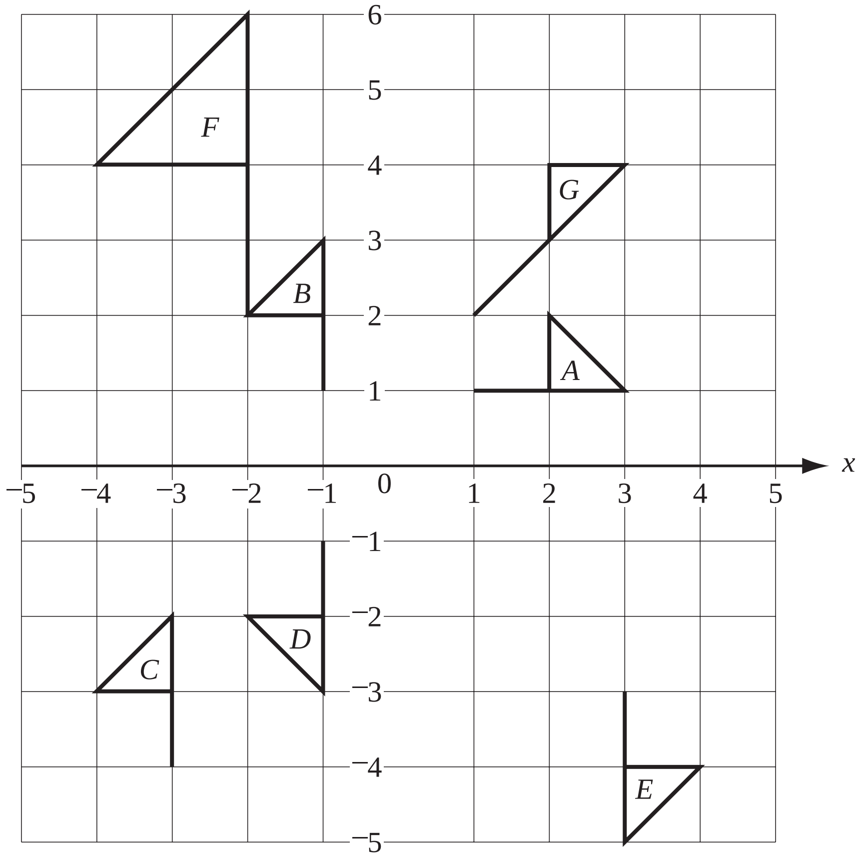
(c) The matrix **M** is $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$.

(i) Describe the transformation which **M** represents. [2]

(ii) Write down the co-ordinates of *P* after transformation by matrix **M**. [2]

(d) **(i)** Write down the matrix **R** which represents a rotation by 90° anticlockwise about *0*. [2]

(ii) Write down the letter representing the new position of *F* after the transformation **RM**(*F*). [2]



(a) Describe fully the **single** transformation which maps

(i) shape A onto shape B, [2]

(ii) shape B onto shape C, [2]

(iii) shape A onto shape D, [2]

(iv) shape B onto shape E, [2]

(v) shape B onto shape F, [2]

(vi) shape A onto shape G. [2]

(b) A transformation is represented by the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

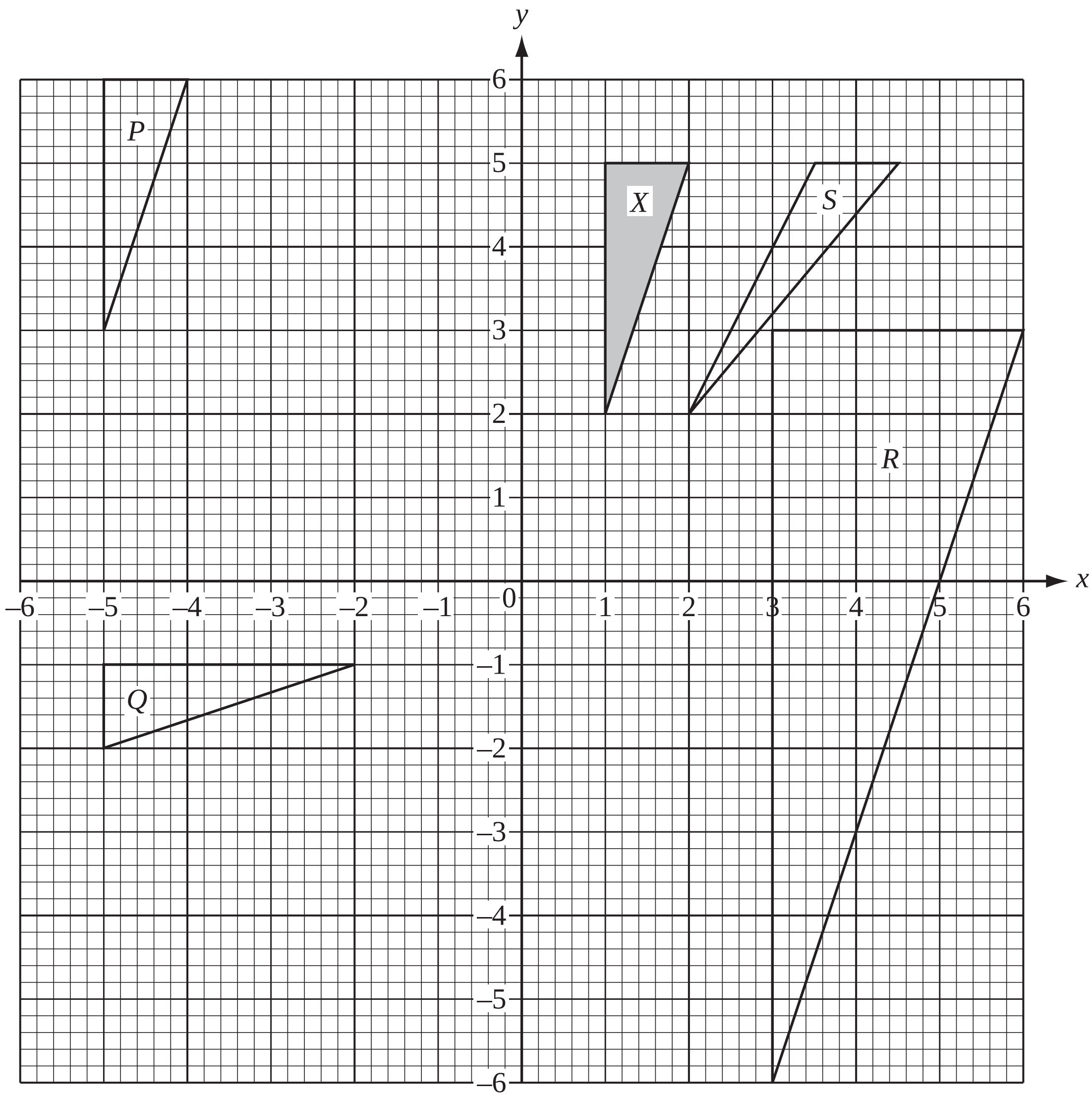
Which shape above is the image of shape A after this transformation? [2]

(c) Find the 2 by 2 matrix representing the transformation which maps

(i) shape B onto shape D, [2]

(ii) shape A onto shape G. [2]

3



(a) Describe fully the single transformation which maps

(i) triangle *X* onto triangle *P*, [2]

(ii) triangle *X* onto triangle *Q*, [2]

(iii) triangle *X* onto triangle *R*, [3]

(iv) triangle *X* onto triangle *S*. [3]

(b) Find the 2 by 2 matrix which represents the transformation that maps

(i) triangle *X* onto triangle *Q*, [2]

(ii) triangle *X* onto triangle *S*. [2]

Transformation M is reflection in the line $y = x$.

(a) The point A has co-ordinates (2, 1).

Find the co-ordinates of

(i) T(A), [1]

(ii) MT(A). [2]

(b) Find the 2 by 2 matrix **M**, which represents the transformation M. [2]

(c) Show that, for any value of k, the point Q $(k - 2, k - 3)$ maps onto a point on the line $y = x$ following the transformation TM(Q). [3]

(d) Find $\mathbf{M}^{-1}$, the inverse of the matrix **M**. [2]

(e) **N** is the matrix such that $\mathbf{N} + \begin{pmatrix} 0 & 3 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 4 \\ 0 & 0 \end{pmatrix}$.

(i) Write down the matrix **N**. [2]

(ii) Describe completely the **single** transformation represented by **N**. [3]

2 **Answer the whole of this question on a sheet of graph paper.**

(a) Draw and label x and y axes from −6 to 6, using a scale of 1 cm to 1 unit. [1]

(b) Draw triangle ABC with A (2,1), B (3,3) and C (5,1). [1]

(c) Draw the reflection of triangle ABC in the line $y = x$. Label this $A_1B_1C_1$. [2]

(d) Rotate **triangle** $\boldsymbol{A_1B_1C_1}$ about (0,0) through 90° anti-clockwise. Label this $A_2B_2C_2$. [2]

(e) Describe fully the single transformation which maps triangle ABC onto triangle $A_2B_2C_2$. [2]

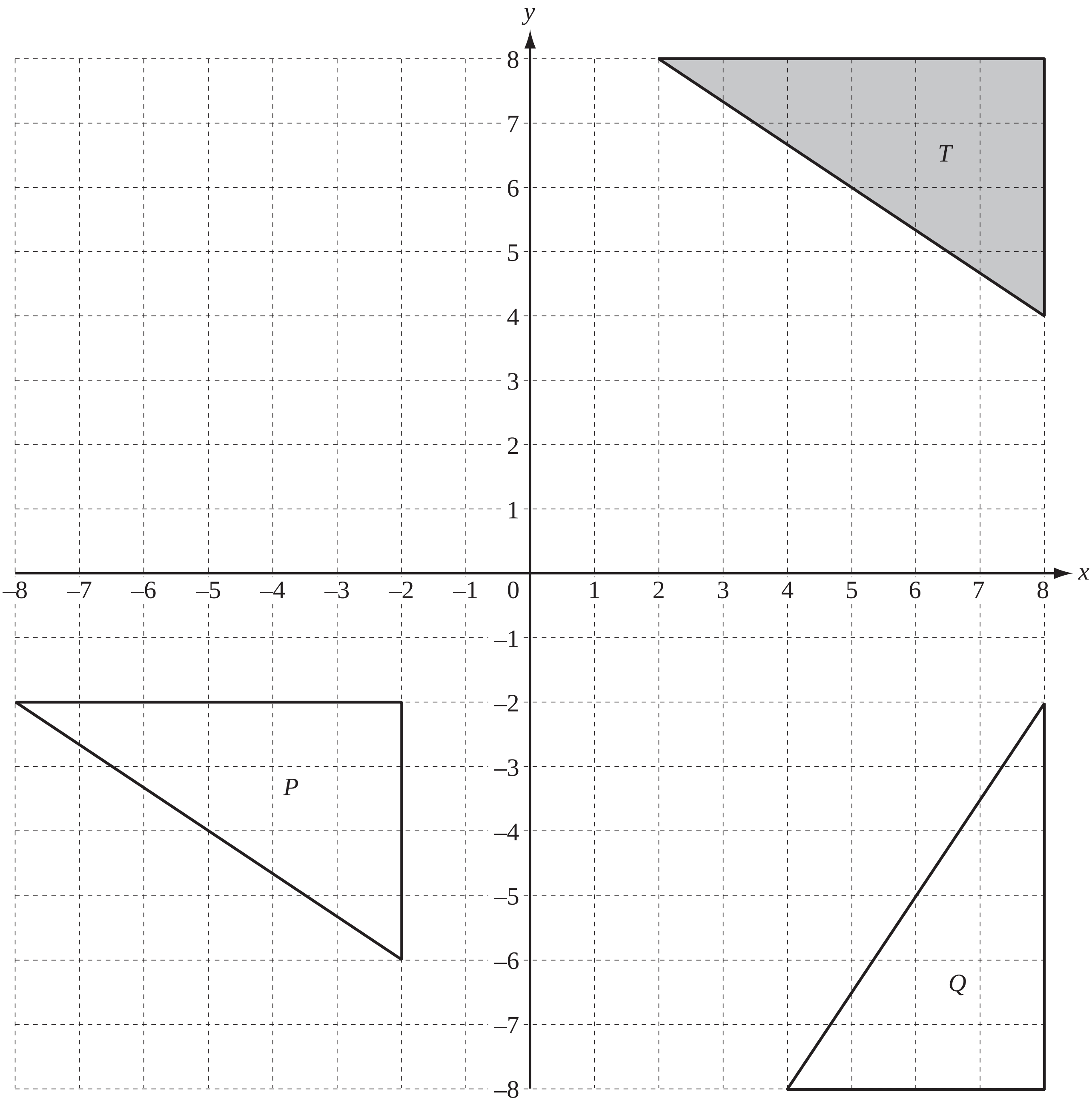
(f) A transformation is represented by the matrix $\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$.

(i) Draw the image of triangle ABC under this transformation. Label this $A_3B_3C_3$. [3]

(ii) Describe fully the single transformation represented by the matrix $\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$. [2]

(iii) Find the matrix which represents the transformation that maps triangle $A_3B_3C_3$ onto triangle ABC. [2]

3



(a) On the grid, draw the enlargement of the triangle *T*, centre (0, 0), scale factor $\frac{1}{2}$. [2]

(b) The matrix $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ represents a transformation.

(i) Calculate the matrix product $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 8 & 8 & 2 \\ 4 & 8 & 8 \end{pmatrix}$.

Answer(b)(i) [2]

(ii) On the grid, draw the image of the triangle *T* under this transformation. [2]

(iii) Describe fully this **single** transformation.

Answer(b)(iii) .... [2]

(c) Describe fully the **single** transformation which maps

(i) triangle *T* onto triangle *P*,

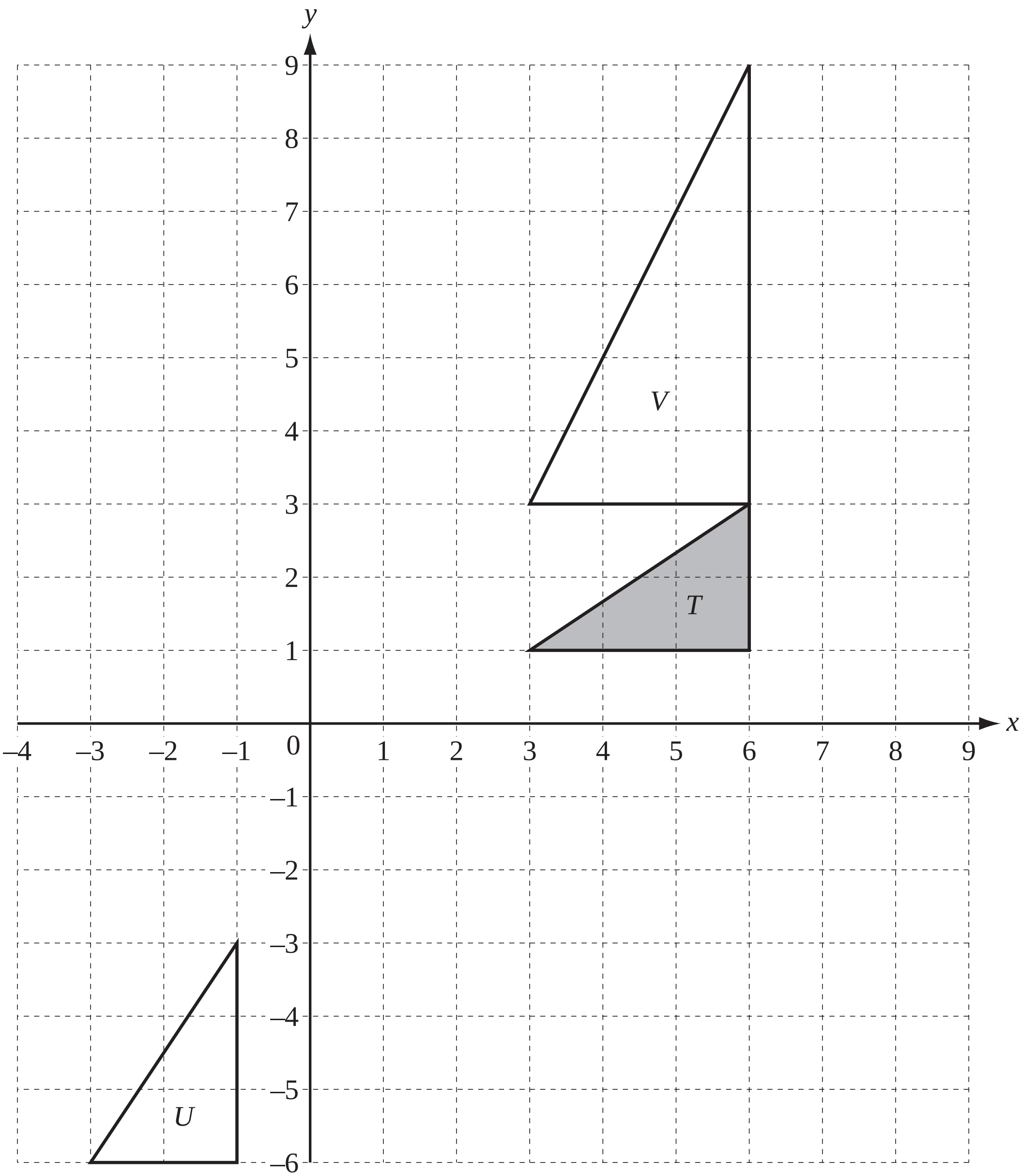
Answer(c)(i) .... [2]

(ii) triangle *T* onto triangle *Q*.

Answer(c)(ii) .... [3]

(d) Find the 2 by 2 matrix which represents the transformation in **part (c)(ii)**.

Answer(d) $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]



(a) On the grid, draw

(i) the translation of triangle *T* by the vector $\begin{pmatrix} -7 \\ 3 \end{pmatrix}$, [2]

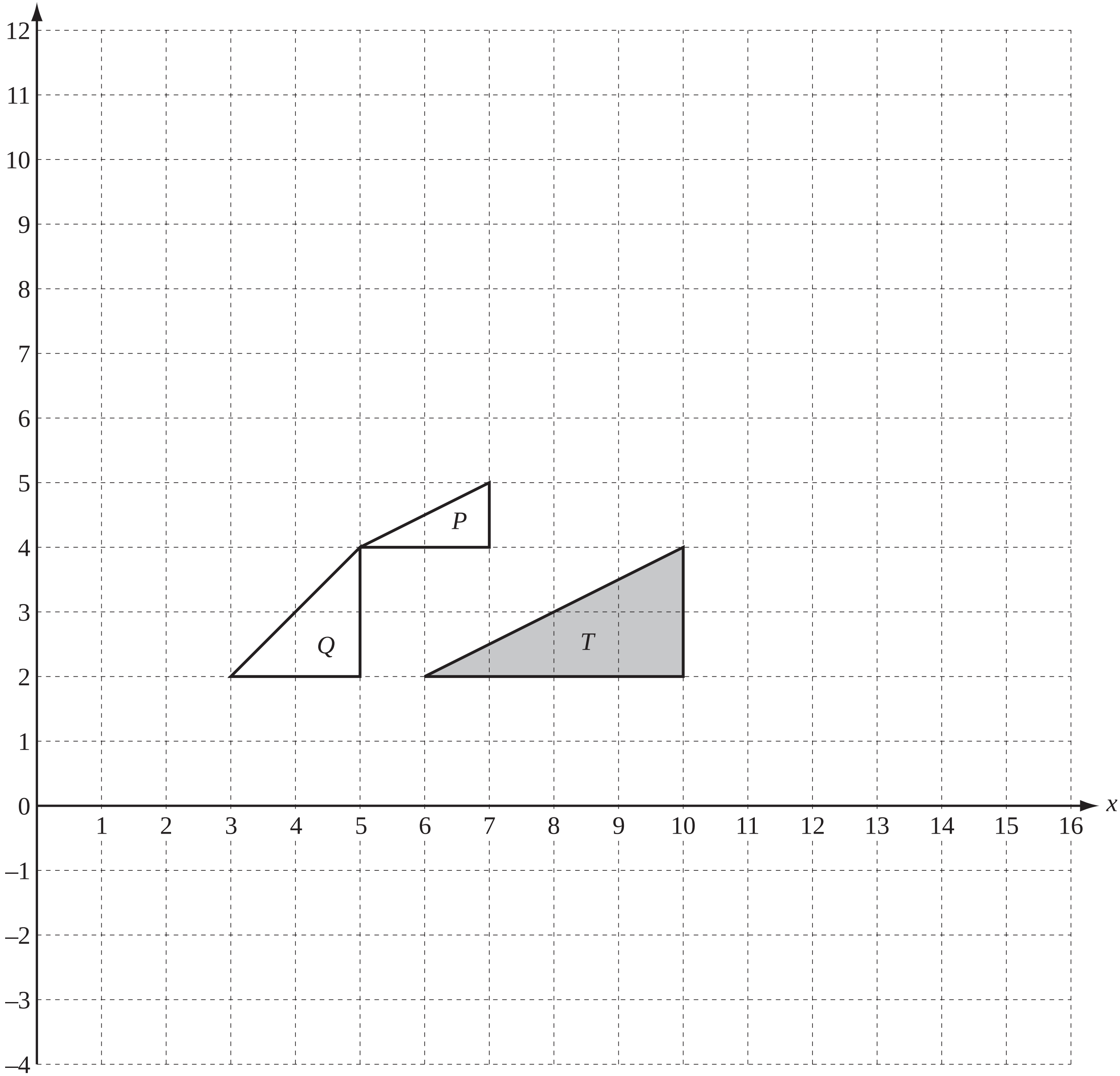
(ii) the rotation of triangle *T* about (0, 0), through 90° clockwise. [2]

(b) Describe fully the **single** transformation that maps

(i) triangle *T* onto triangle *U*,

Answer(b)(i) .... [2]

(ii) triangle *T* onto triangle *V*.



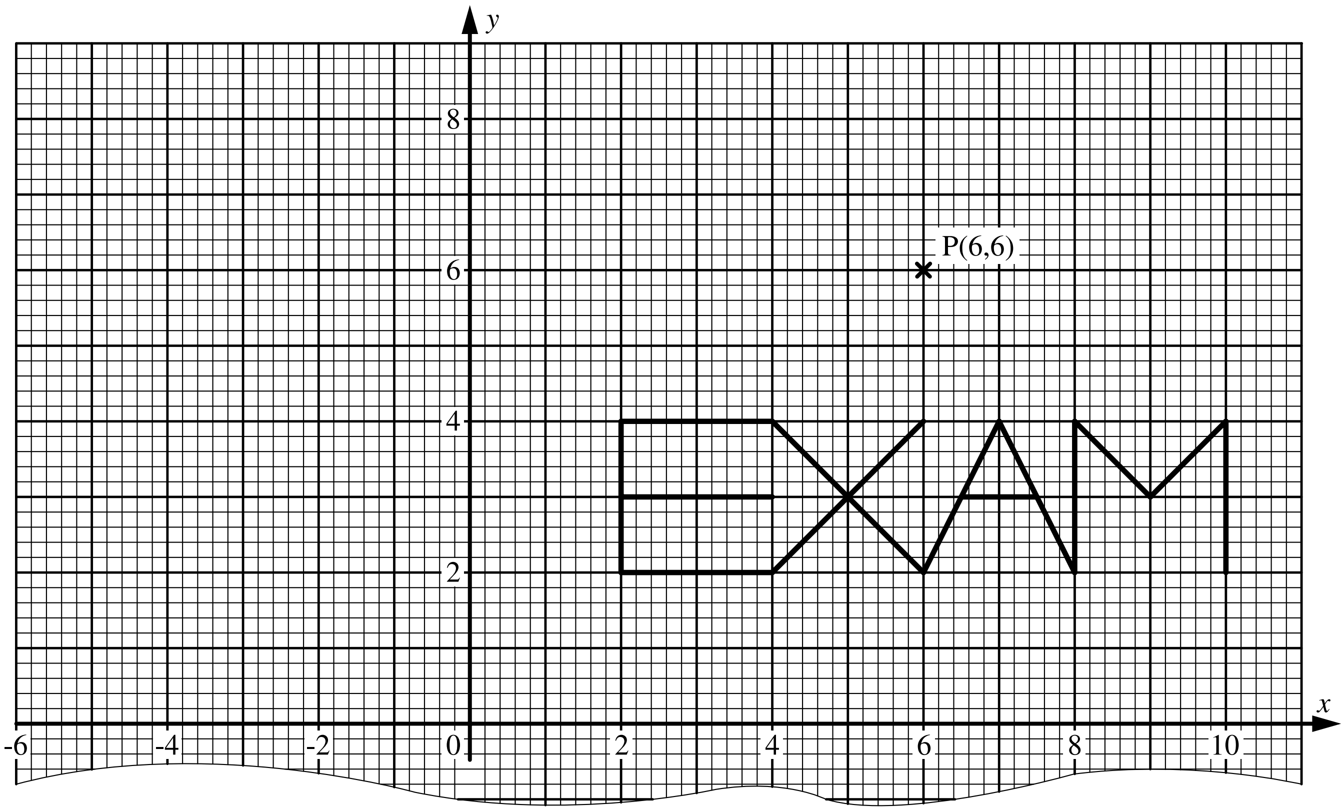
(a) Draw the reflection of triangle T in the line $y = 6$.

Label the image A. [2]

(b) Draw the translation of triangle T by the vector $\begin{pmatrix} -4 \\ 6 \end{pmatrix}$.

Label the image B. [2]

3



Answer the whole of this question on a sheet of graph paper.

(a) Using a scale of 1 cm to represent 1 unit on each axis, draw an x-axis for $-6 \leqslant x \leqslant 10$ and a y-axis for $-8 \leqslant y \leqslant 8$.
Copy the word EXAM onto your grid so that it is **exactly** as it is in the diagram above.
Mark the point P (6,6). [2]

(b) Draw accurately the following transformations.

(i) Reflect the letter **E** in the line $x = 0$. [2]

(ii) Enlarge the letter **X** by scale factor 3 about centre P (6,6). [2]

(iii) Rotate the letter **A** 90° anticlockwise about the origin. [2]

(iv) Stretch the letter **M** vertically with scale factor 2 and x-axis invariant. [2]

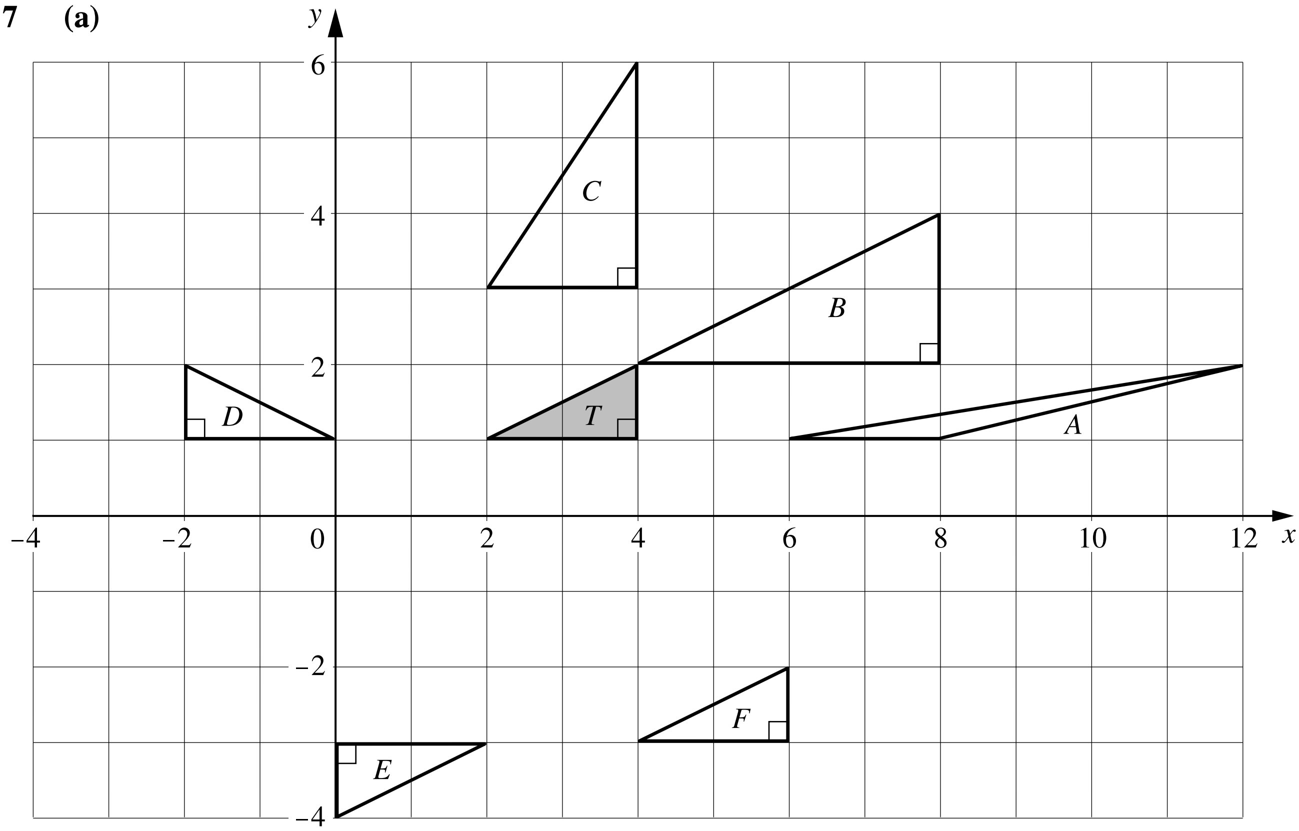
(c) **(i)** Mark and label the point Q so that $\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$. [1]

(ii) Calculate $|\overrightarrow{PQ}|$ correct to two decimal places. [2]

(iii) Mark and label the point S so that $\overrightarrow{PS}$ $\begin{pmatrix} -4 \\ -1 \end{pmatrix}$. [1]

(iv) Mark and label the point R so that $PQRS$ is a parallelogram. [1]

7 **(a)**



Use one of the letters A, B, C, D, E or F to answer the following questions.

(i) Which triangle is T mapped onto by a **translation**? Write down the translation vector. [2]

(ii) Which triangle is T mapped onto by a **reflection**? Write down the equation of the mirror line. [2]

(iii) Which triangle is T mapped onto by a **rotation**? Write down the coordinates of the centre of rotation. [2]

(iv) Which triangle is T mapped onto by a **stretch** with the x-axis invariant?
Write down the scale factor of the stretch. [2]

(v) $\mathbf{M} = \begin{pmatrix} 1 & 4 \\ 0 & 1 \end{pmatrix}$. Which triangle is T mapped onto by **M**?

Write down the name of this transformation. [2]

(b) $\mathbf{P} = \begin{pmatrix} 1 & 3 \\ 5 & 7 \end{pmatrix}$, $\mathbf{Q} = (-1 \quad -2)$, $\mathbf{R} = (1 \quad 2 \quad 3)$, $\mathbf{S} = \begin{pmatrix} -1 \\ 2 \\ 3 \end{pmatrix}$.

Only some of the following matrix operations are possible with matrices **P**, **Q**, **R** and **S** above.

PQ, **QP**, **P + Q**, **PR**, **RS**

Write down and calculate each matrix operation that is possible. [6]

4 **Answer the whole of this question on a sheet of graph paper.**

(a) Draw x- and y-axes from –8 to 8 using a scale of 1cm to 1 unit.
Draw triangle ABC with A (2, 2), B (5, 2) and C (5, 4). [2]

(b) Draw the image of triangle ABC under a translation of $\begin{pmatrix} -9 \\ 3 \end{pmatrix}$.

Label it $A_1B_1C_1$. [2]

(c) Draw the image of triangle ABC under a reflection in the line $y = -1$.
Label it $A_2B_2C_2$. [2]

(d) Draw the image of triangle ABC under an enlargement, scale factor 2, centre (6,0).
Label it $A_3B_3C_3$. [2]

(e) The matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ represents a transformation.

(i) Draw the image of triangle ABC under this transformation. Label it $A_4B_4C_4$. [2]

(ii) Describe fully this single transformation. [2]

(f) **(i)** Draw the image of triangle ABC under a stretch, factor 1.5, with the y-axis invariant.
Label it $A_5B_5C_5$. [2]

(ii) Find the 2 by 2 matrix which represents this transformation. [2]

7 **Answer the whole of this question on a sheet of graph paper.**

(a) Draw x and y axes from 0 to 12 using a scale of 1 cm to 1 unit on each axis. [1]

(b) Draw and label triangle T with vertices (8, 6), (6, 10) and (10, 12). [1]

(c) Triangle T is reflected in the line $y = x$.

(i) Draw the image of triangle T. Label this image P. [2]

(ii) Write down the matrix which represents this reflection. [2]

(d) A transformation is represented by the matrix $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$

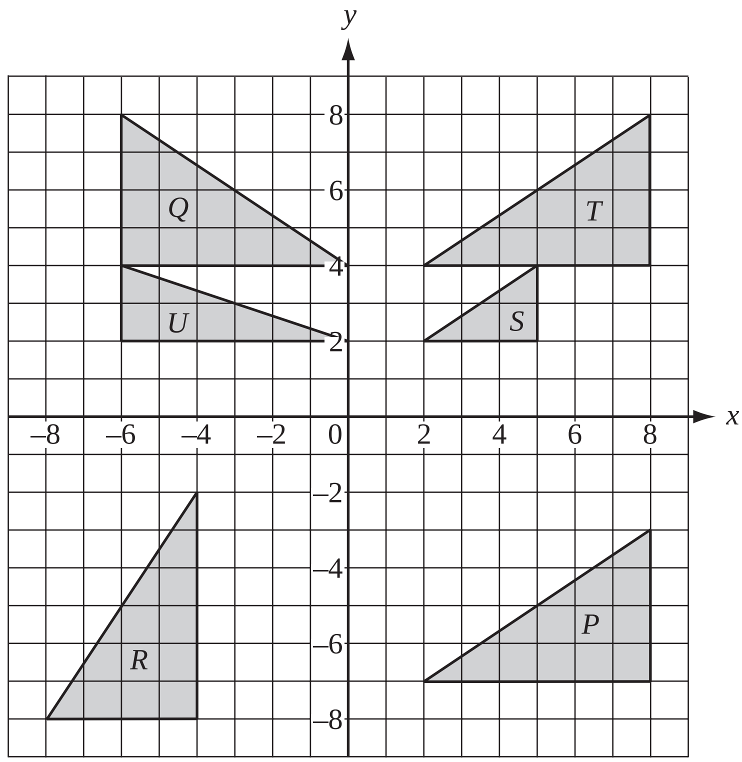
(i) Draw the image of triangle T under this transformation. Label this image Q. [2]

(ii) Describe fully this single transformation. [3]

(e) Triangle T is stretched with the y-axis invariant and a stretch factor of $\frac{1}{2}$.

Draw the image of triangle T. Label this image R. [2]

7



The diagram shows triangles *P*, *Q*, *R*, *S*, *T* and *U*.

(a) Describe fully the **single** transformation which maps triangle

(i) *T* onto *P*, [2]

(ii) *Q* onto *T*, [2]

(iii) *T* onto *R*, [2]

(iv) *T* onto *S*, [3]

(v) *U* onto *Q*. [3]

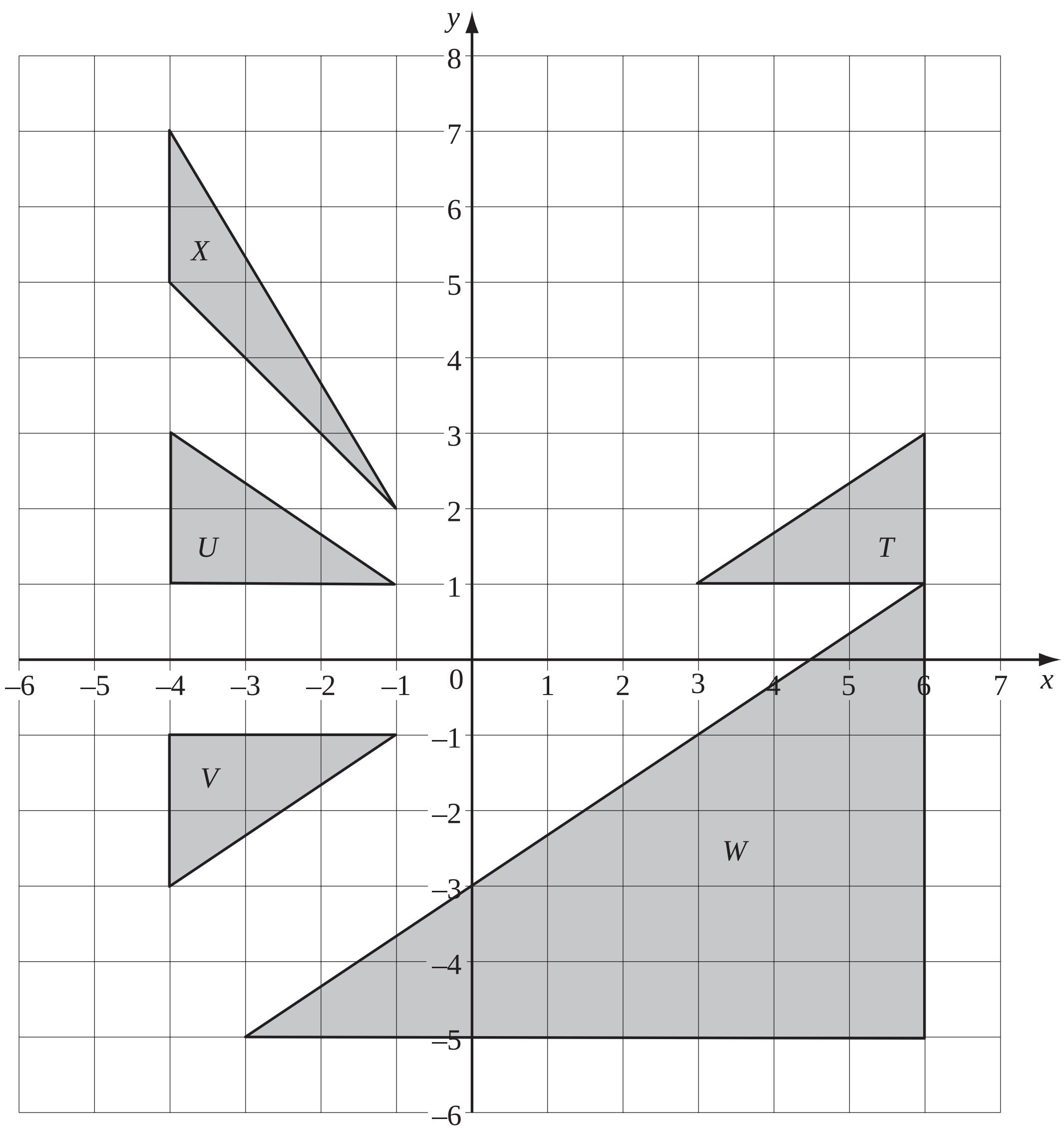
(b) Find the 2 by 2 matrix representing the transformation which maps triangle

(i) *T* onto *R*, [2]

(ii) *U* onto *Q*. [2]

For Examiner's Use

2



(a) Describe fully the **single** transformation which maps

(i) triangle *T* onto triangle *U*,

Answer(a)(i) .... [2]

(ii) triangle *T* onto triangle *V*,

Answer(a)(ii) .... [3]

For Examiner's Use

(iii) triangle *T* onto triangle *W*,

Answer(a)(iii) .... [3]

(iv) triangle *U* onto triangle *X*.

Answer(a)(iv) .... [3]

(b) Find the matrix representing the transformation which maps

(i) triangle *U* onto triangle *V*,

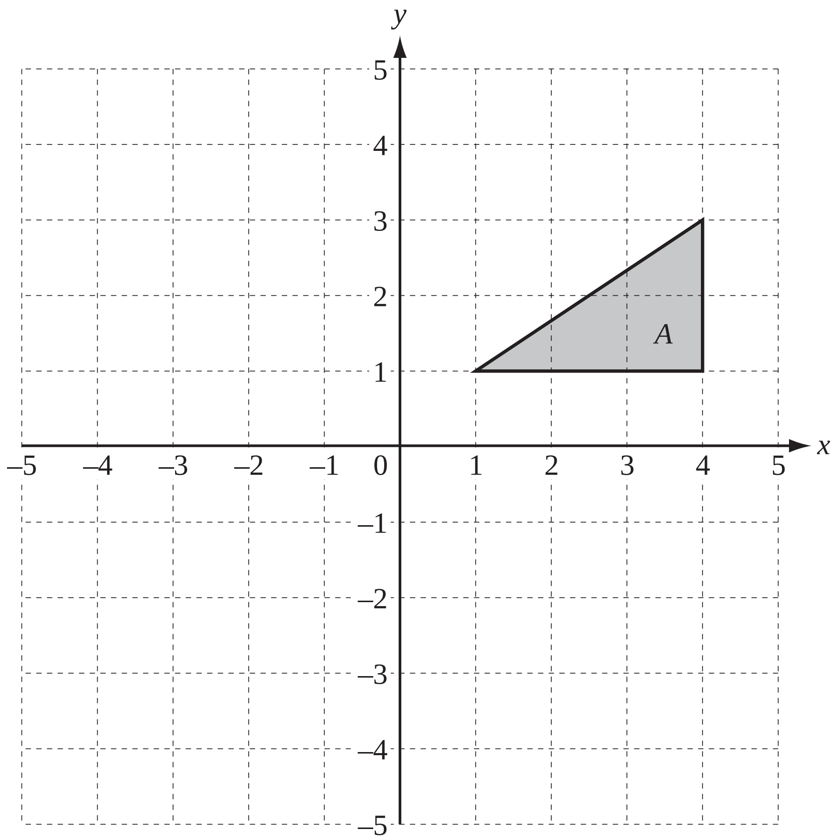
Answer(b)(i) $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) triangle *U* onto triangle *X*.

Answer(b)(ii) $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

For Examiner's Use

2 **(a)**



(i) Draw the image when triangle A is reflected in the line $y = 0$.
Label the image B. [2]

(ii) Draw the image when triangle A is rotated through 90° anticlockwise about the origin.
Label the image C. [2]

(iii) Describe fully the **single** transformation which maps triangle B onto triangle C.

Answer(a)(iii) .... [2]

(b) Rotation through 90° anticlockwise about the origin is represented by the matrix $\mathbf{M} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

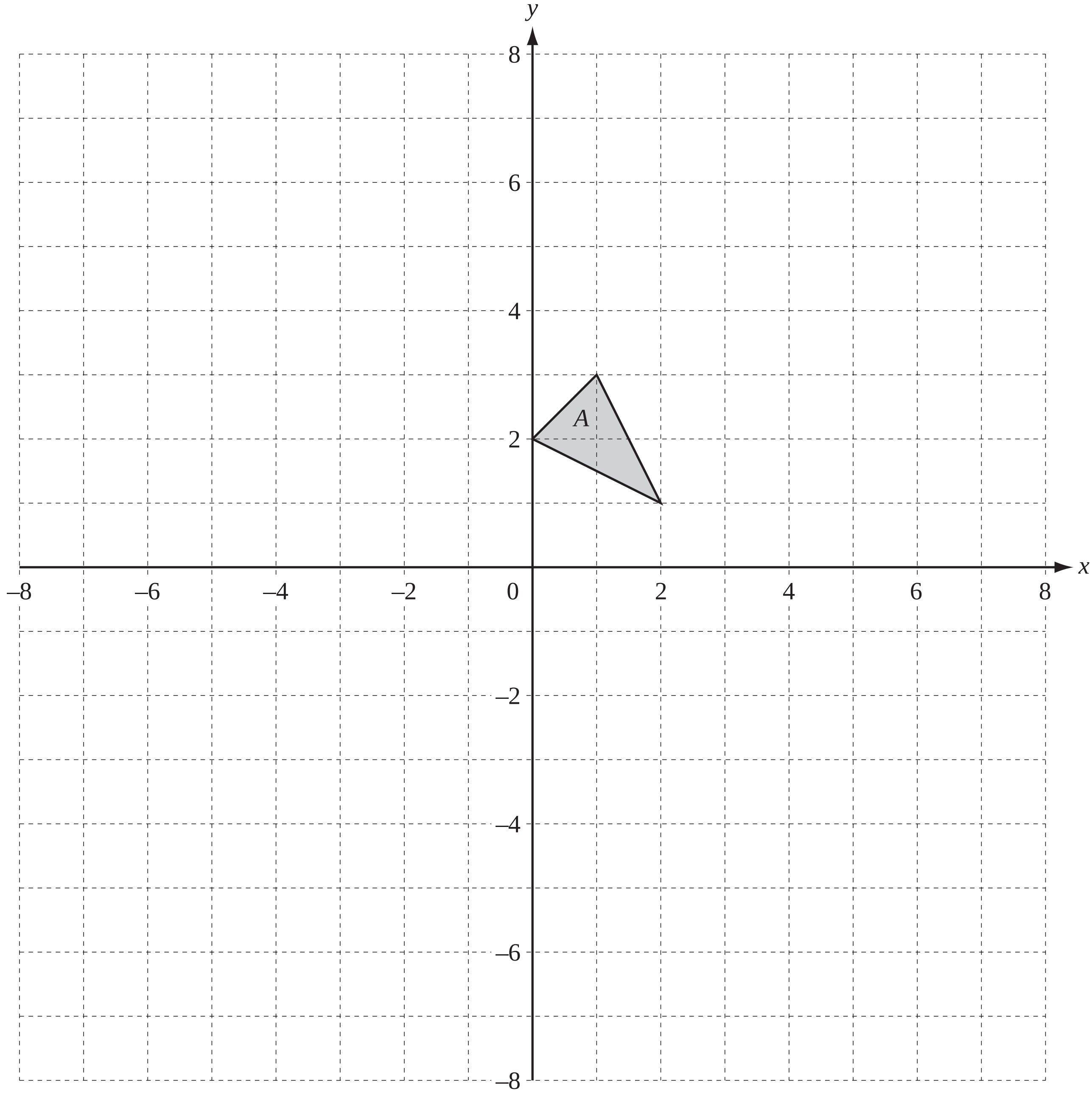
(i) Find $\mathbf{M}^{-1}$, the inverse of matrix $\mathbf{M}$.

Answer(b)(i) $\mathbf{M}^{-1} = \begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) Describe fully the **single** transformation represented by the matrix $\mathbf{M}^{-1}$.

Answer(b)(ii) .... [2]

8 **(a)**



Draw the images of the following transformations on the grid above.

(i) Translation of triangle *A* by the vector $\begin{pmatrix} 3 \\ -7 \end{pmatrix}$. Label the image *B*. [2]

(ii) Reflection of triangle *A* in the line $x = 3$. Label the image *C*. [2]

(iii) Rotation of triangle *A* through 90° anticlockwise around the point (0, 0).
Label the image *D*. [2]

(iv) Enlargement of triangle *A* by scale factor –4, with centre (0, 1).
Label the image *E*. [2]

where n is a positive integer and $\binom{\ }{r} = \frac{n!}{(n-r)!r!}$.