

**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  $1\text{cm}$  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]

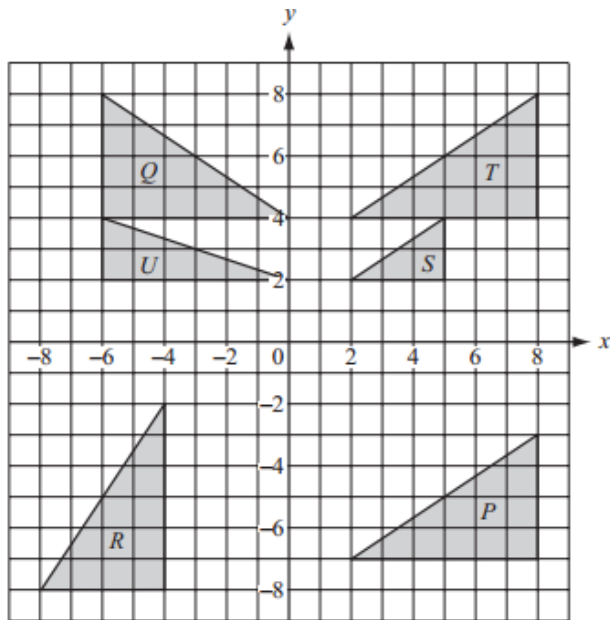
**Answer the whole of this question on one sheet of graph paper.**

- (a) Draw and label  $x$  and  $y$  axes from  $-8$  to  $+8$ , using a scale of  $1\text{ cm}$  to  $1$  unit on each axis. [1]
- (b) Draw and label triangle  $ABC$  with  $A(2, 2)$ ,  $B(5, 2)$  and  $C(5, 4)$ . [1]
- (c) On your grid:
- (i) translate **triangle**  $ABC$  by the vector  $\begin{pmatrix} 3 \\ -9 \end{pmatrix}$  and label this image  $A_1B_1C_1$ ; [2]
- (ii) reflect **triangle**  $ABC$  in the line  $x = -1$  and label this image  $A_2B_2C_2$ ; [2]
- (iii) rotate **triangle**  $ABC$  by  $180^\circ$  about  $(0, 0)$  and label this image  $A_3B_3C_3$ . [2]

- (c) The matrix  $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$  represents a **single** transformation.
- (i) Describe fully this transformation. [3]
  - (ii) Find the co-ordinates of the image of the point (5, 3) after this transformation. [1]
- (d) Find the matrix which represents a reflection in the line  $y = x$ . [2]

**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]



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]

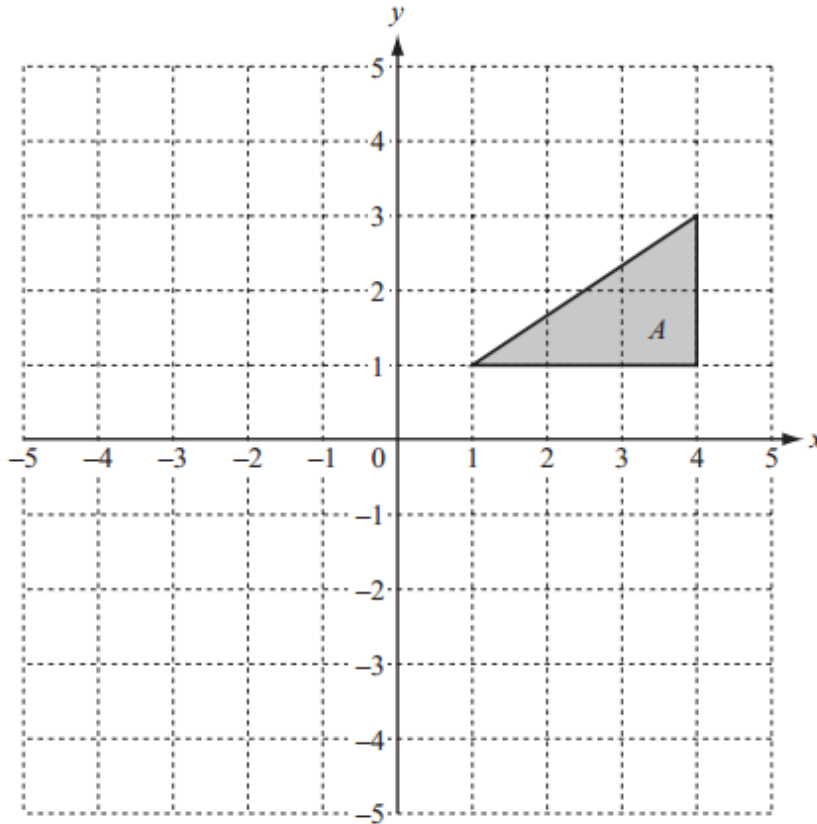
(iii)  $T$  onto  $R$ , [2]

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

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

(i)  $T$  onto  $R$ , [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  $90^\circ$  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]

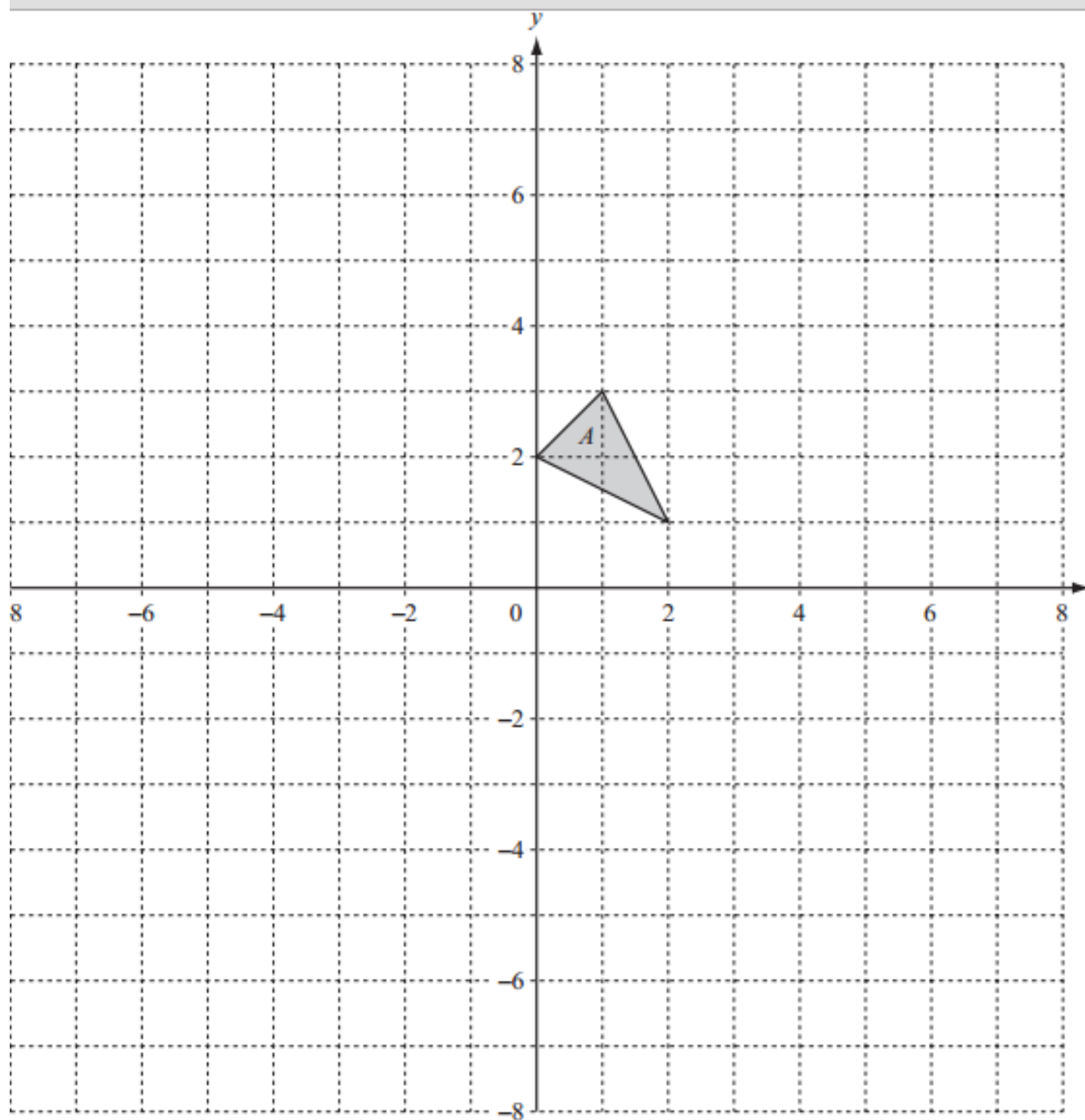
(b) Rotation through  $90^\circ$  anticlockwise about the origin is represented by the matrix  $\mathbf{M} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ .

- (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]



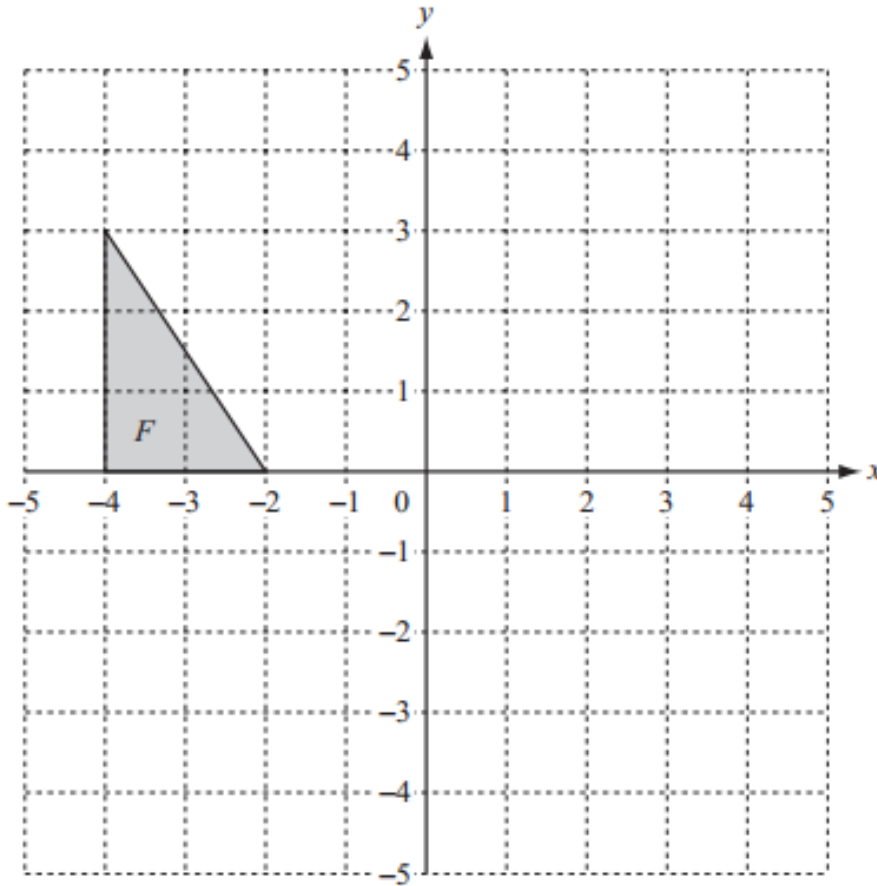
Draw the images of the following transformations on the grid above.

- (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  $90^\circ$  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]

- (b) The area of triangle  $E$  is  $k \times$  area of triangle  $A$ .  
Write down the value of  $k$ .

Answer(b)  $k =$  ..... [1]

(c)



- (i) Draw the image of triangle  $F$  under the transformation represented by the matrix  $\mathbf{M} = \begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$ . [3]

- (ii) Describe fully this single transformation.

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

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

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