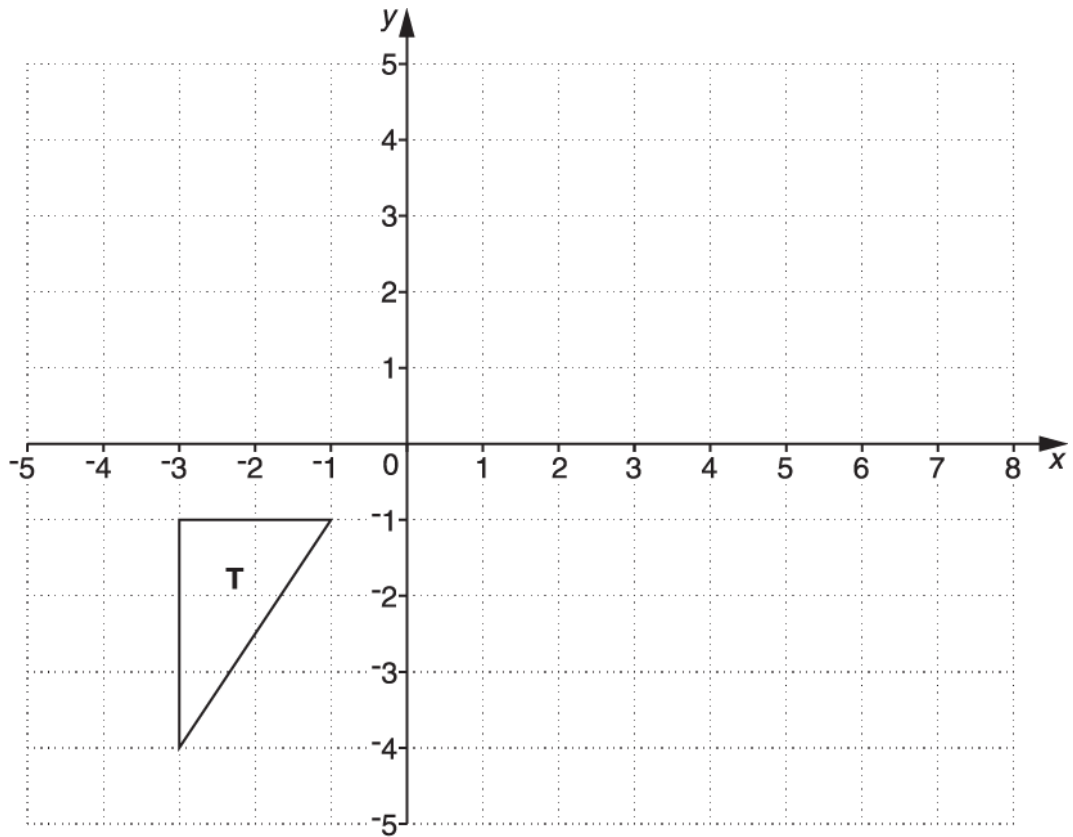1. The grid shows triangle **T**.

Triangle **T** is transformed by four translations given by the following vectors.

$$\begin{pmatrix} 15 \\ -6 \end{pmatrix} \text{ then } \begin{pmatrix} 22 \\ 9 \end{pmatrix} \text{ then } \begin{pmatrix} -15 \\ 6 \end{pmatrix} \text{ then } \begin{pmatrix} -17 \\ -9 \end{pmatrix}$$
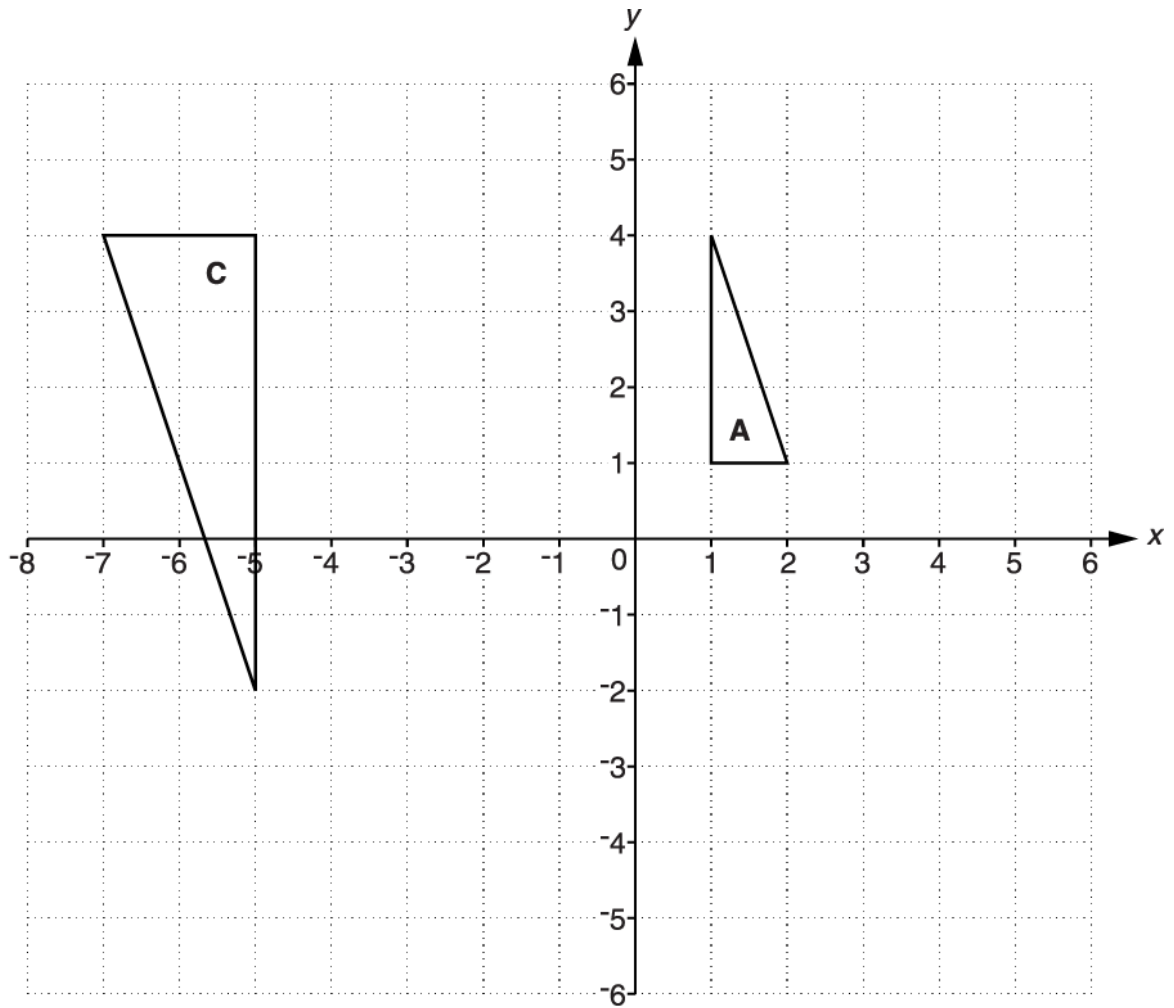
Draw the image of triangle **T** after these four translations.

Label the image **C**.

[3]

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2. Triangles **A** and **C** are drawn on the grid below.
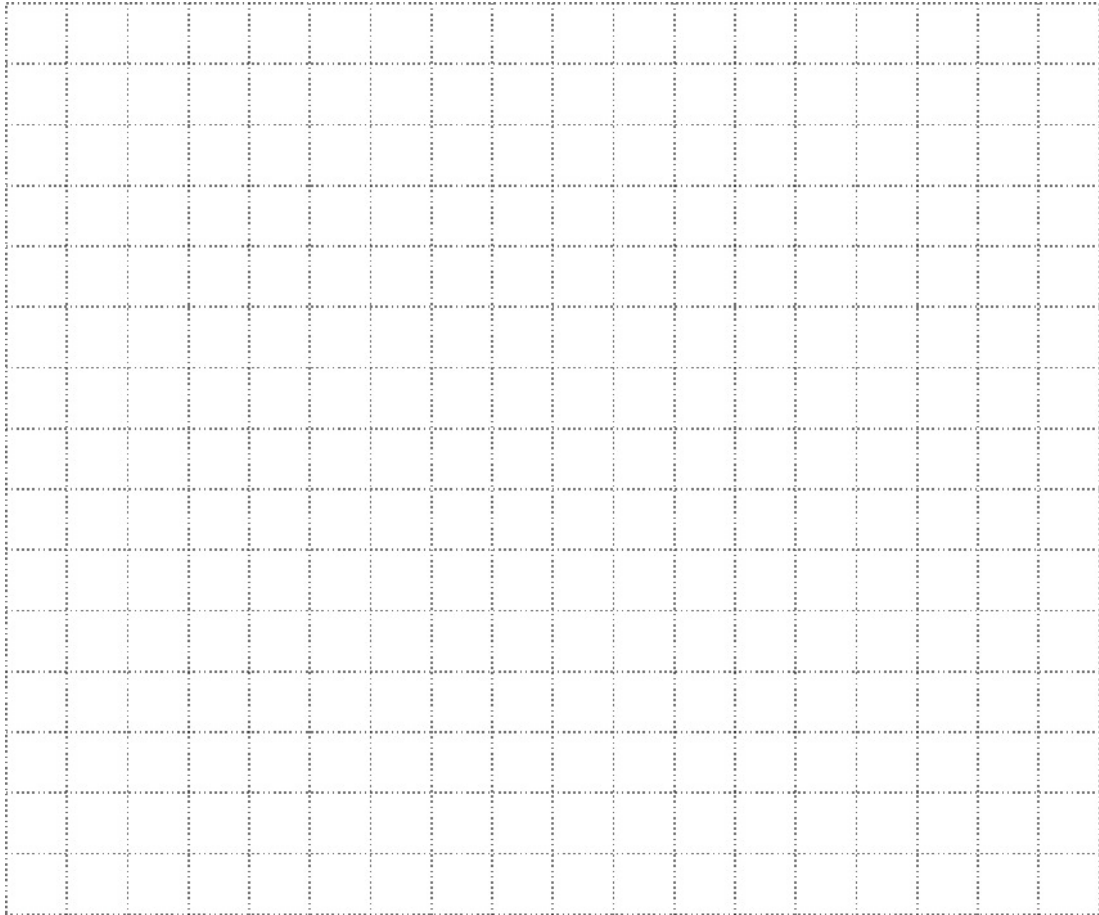

Triangle **B** is the image of triangle **A** after:

- a rotation of 90° clockwise about the origin, followed by
- a translation of $\begin{pmatrix} -5 \\ -1 \end{pmatrix}$.

Draw and label triangle **B** on the diagram.

[4]

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3. Here is a grid.

Find the **single** transformation that is equivalent to

- reflection in $x = {}^-1$

followed by

- reflection in $x = 2$.

You may use the grid to help you.

_____[3]

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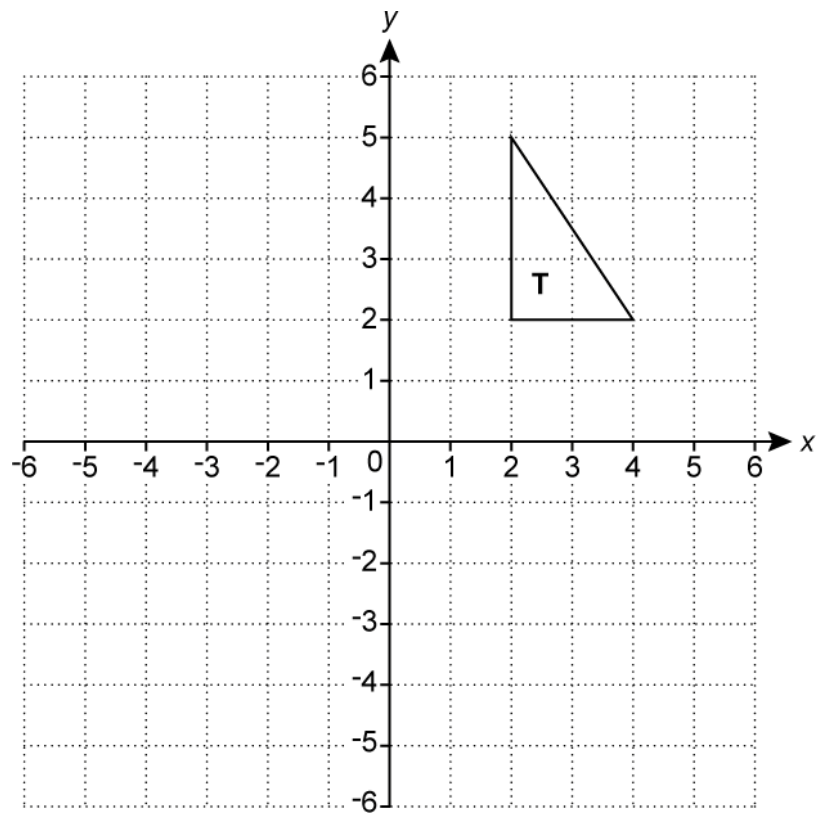4.   Triangle **A** is drawn on the grid below.
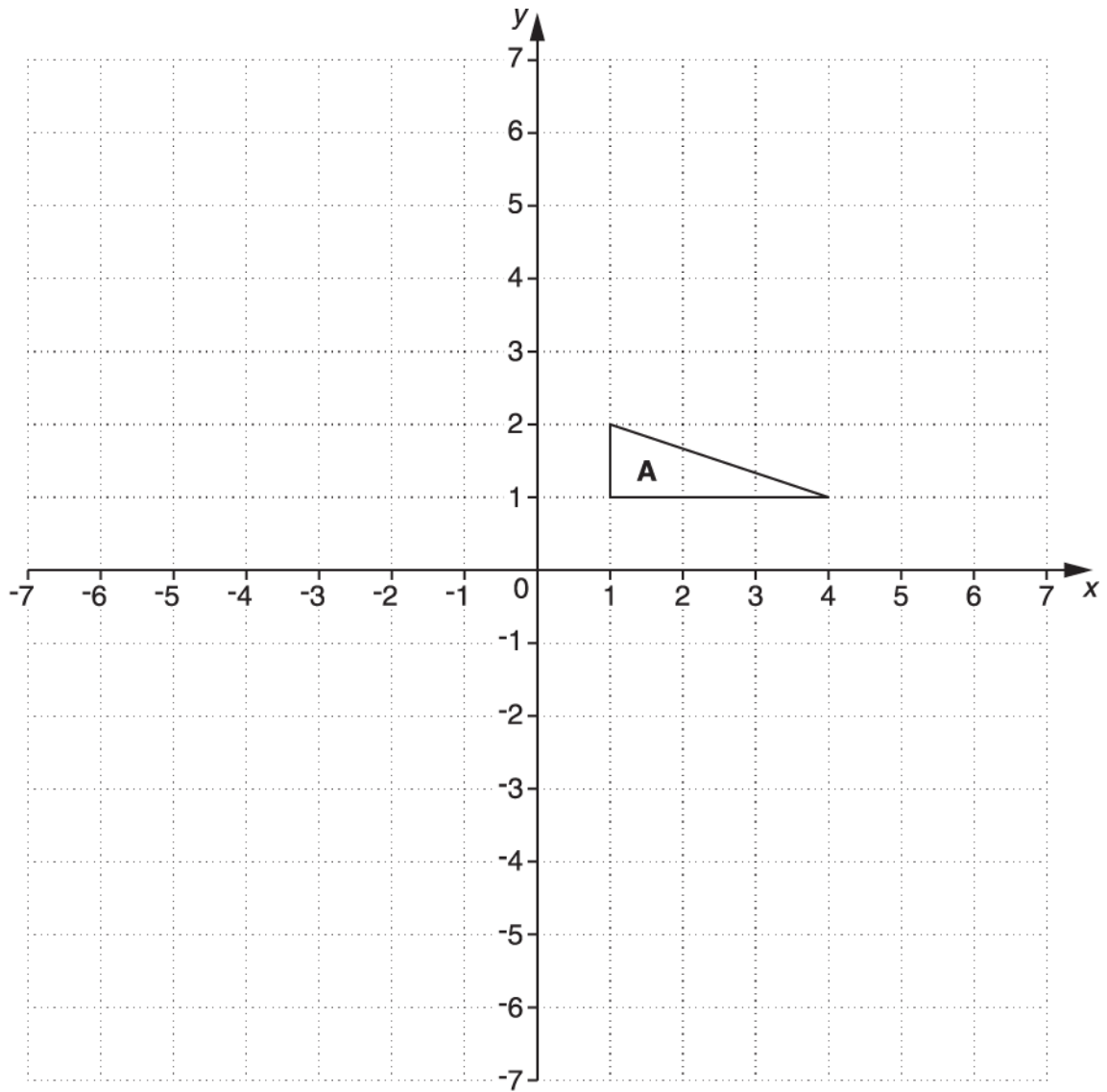
Describe fully the **single** transformation that is equivalent to:

- a rotation of 90° anticlockwise about (0, 0), followed by
- a reflection in the *x*-axis.

You may use the grid to help you.

_____

_____[3]

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5.   Triangle **T** is drawn on a coordinate grid.

Describe fully the **single** transformation that represents the following.

(i) A rotation with centre (0, 0) of 180° followed by
     a rotation with centre (0, 0) of 90° clockwise.

---**[2]**

(ii) A reflection in the *x*-axis followed by a reflection in the *y*-axis.

---**[3]**

<center>END OF QUESTION PAPER</center>

Question			Answer/Indicative content	Marks	Part marks and guidance	
1			Correct translation (4, –1), (2, –1), (2, –4)	3	**M1** for attempt to add the vectors **A1** for $\begin{pmatrix} 5 \\ 0 \end{pmatrix}$ **Examiner's Comments** This saw many correct solutions but the weakest candidates did not know how to start. It was pleasing to be able to award method marks to those who showed evidence of adding the four vectors even if they did not reach the correct resultant.	eg 'along 5' Condone poor notation eg $\dfrac{5}{0}$
			Total	**3**		

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Question			Answer/Indicative content	Marks	Part marks and guidance	
2			Triangle B correctly positioned Vertices (⁻4, ⁻2), (⁻4, ⁻3), (⁻1, ⁻2)	4	**B3** for triangle B with two vertices correct Or for correct rotation followed by translation by 5 left or 1 down Or for correct translation following 90° anticlockwise rotation about origin **OR** **B2** for correct rotation of A clockwise about origin followed by incorrect or no translation Or for 90° anticlockwise rotation about origin followed by translation by 5 left or 1 down **OR** **B1** for rotation of A 90° anticlockwise about origin followed by incorrect or no translation **OR** **SC2** for correct translation following 180° rotation about origin **OR** **SC1** for translation of 5 left or 1 down following 180° rotation about origin **Examiner's Comments** Many candidates performed the two transformations correctly and drew triangle B in the correct position. Those that didn't reach the correct answer had usually performed the rotation correctly, but made an error in one or both of the directions of the translation. Only very few candidates started by doing an anticlockwise rotation.	Use overlay Accept intention if triangles not labelled Red triangle scores 4 marks, horizontal or vertical translation of red scores B3, any other translation of red scores B2 Green triangle scores B3, horizontal or vertical translation of green scores B2, any other translation of green scores B1 Blue triangle scores SC2, horizontal or vertical translation of blue scores SC1, any other translation of blue scores SC0
			Total	4		

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Question			Answer/Indicative content	Marks	Part marks and guidance	
3			translation $\begin{pmatrix} 6 \\ 0 \end{pmatrix}$	3	**B2** for $\begin{pmatrix} 6 \\ 0 \end{pmatrix}$ or **B1** for brackets missing or 6 right / in *x* direction **and** **B1** for translation After **B0** **M1** for two objects 6 units horizontally apart or one correct reflection in either *x* = −1 or *x* = 2 **Examiner's Comments** Many candidates seemed to be unfamiliar with the use of an unlabelled grid. However we do have to ask a certain number of unstructured questions. Some picked up the method mark with their own grid and some shapes correctly reflected, but even then could not express the transformation in the correct form. Many responses showed the '*x*' lines as vertical.	If more than one transformation stated scores **B0** Condone a point as an object
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance	
4			Reflection in $y = {}^-x$ oe	3	B1 for reflection **only** B2 for $y = {}^-x$ Or B1 for $y = x$ Award **B0** if second transformation mentioned or implied After **B0** award **SC1** for triangle with vertices ($^-1$, $^-1$), ($^-2$, $^-1$), ($^-1$, $^-4$) seen **Examiner's Comments** Many candidates used the grid provided and carried out the two transformations correctly. They then often had difficulty in describing the equivalent single transformation. Some ignored the word single and used some combination of the two original transformations, usually clockwise rotation and reflection in the x-axis. Those who recognised that the single transformation was a reflection often had difficulty in describing the mirror line: even if they had drawn it on the diagram the equation was often given as $y = x$.	These marks are only available if single transformation only mentioned SC1 can be awarded if more than one transformation stated Clear intention of correct triangle
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance		
5		i	rotation (0,0) oe	1	if **0** scored **M1** for the triangle / dots on the grid correctly rotated twice	Double tran sformation can only score **M1**	
			90° [anticlockwise] oe	1	for centre allow origin and O and for angle allow e.g. –270°, 270° clockwise		
					Examiner's Comments		
					When giving a full description of a transformation in this part, candidates need to give all the details. In this case it was a rotation, so both the centre and angle with direction need to be included with the word 'rotation'. It would help the candidate if the positions of the triangles after each rotation could have been indicated on the diagram.		

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Question			Answer/Indicative content	Marks	Part marks and guidance		
		ii	Rotation	1	if **0** scored **M1** for the triangle / dots on the grid correctly reflected twice	Allow enlargement (0,0) [sf=] −1 for **3 marks**	
			(0,0) oe	1			
			180°	1	or **SC2** for "rotation (0,0) oe, 90°" written twice	Other double transformations can only score **M1**	
					for centre allow origin and O		
					Examiner's Comments		
					In this part, indicating the positions of each transformation and then drawing the final triangle would again have helped to decide the single transformation. The most common error however was to think the solution must be another reflection and usually the line $y = -x$ was given as this wrong answer.		
			Total	5			