Vectors and transformations – 2022 O Level Math D 4024

1. Nov/2022/Paper_4024/11/No.21

$$\mathbf{A} = \begin{pmatrix} 3 & 1 \\ -4 & 2 \end{pmatrix} \qquad \mathbf{A} + 2\mathbf{B} = \begin{pmatrix} 1 & 5 \\ 10 & 12 \end{pmatrix}$$

(a) Find **B** .

$$\begin{pmatrix} & \\ & \end{pmatrix}$$ [2]

(b) Find $\mathbf{A}^{-1}$.

$$\begin{pmatrix} & \\ & \end{pmatrix}$$ [2]

2. Nov/2022/Paper_4024/12/No.23

Adam and Ben buy tickets for the cinema and the theatre.

(a) Adam buys 5 cinema tickets and 4 theatre tickets.
Ben buys 7 cinema tickets and 9 theatre tickets.

Complete the matrix, **X**, to represent this information.

Cinema Theatre

$\mathbf{X} = \begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$ Adam / Ben

[1]

(b) Cinema tickets cost \$11 each and theatre tickets cost \$30 each.
The matrix **Y** represents this information.

$$\mathbf{Y} = \begin{pmatrix} 11 \\ 30 \end{pmatrix}$$

(i) $\mathbf{P} = \mathbf{XY}$

Find the matrix **P**.

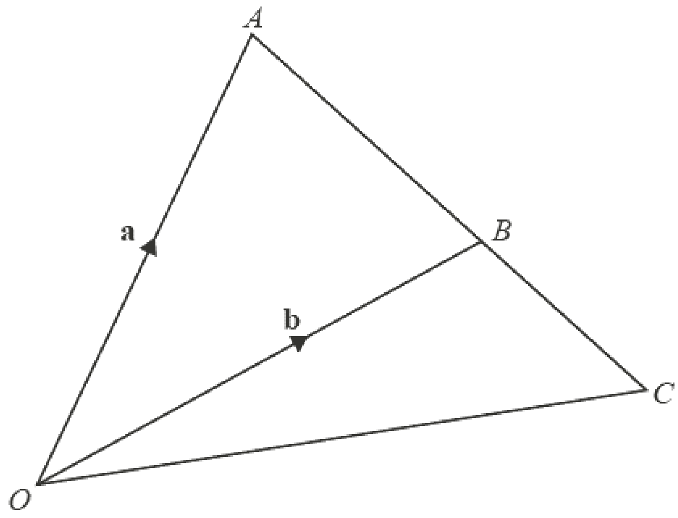
P = [2]

(ii) Explain what the elements in matrix **P** represent.

....

.... [1]

3. Nov/2022/Paper_4024/12/No.26



NOT TO SCALE

OAC is a triangle and B is a point on AC such that $AB : BC = 3 : 2$.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

(a) Find $\overrightarrow{OC}$ in terms of **a** and **b**, giving your answer in its simplest form.

$\overrightarrow{OC} =$ .... [3]

(b) D is a point on OC such that $\overrightarrow{OD} = \mathbf{b} - \frac{2}{5}\mathbf{a}$.

Show that $OABD$ is a trapezium.

[2]

4. Nov/2022/Paper_4024/21/No.6

(a) The position vector of point A is $\begin{pmatrix} 4 \\ 7 \end{pmatrix}$ and the position vector of point B is $\begin{pmatrix} 9 \\ 2 \end{pmatrix}$.

(i) Find the column vector $\overrightarrow{AB}$.

$\overrightarrow{AB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(ii) Find $\left|\overrightarrow{AB}\right|$.

$\left|\overrightarrow{AB}\right| =$ .... [2]

(iii) $ABCD$ is a parallelogram with sides AB, BC, CD and DA.

$\overrightarrow{BC} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

Find the coordinates of point C and point D.

$C =$ (...................... , ...)

$D =$ (...................... , ...) [2]

(b) P is the point $(r, 4)$ and Q is the point (t, u).

The midpoint of line PQ is $(1, 3)$.
The gradient of line PQ is $-\frac{1}{4}$.

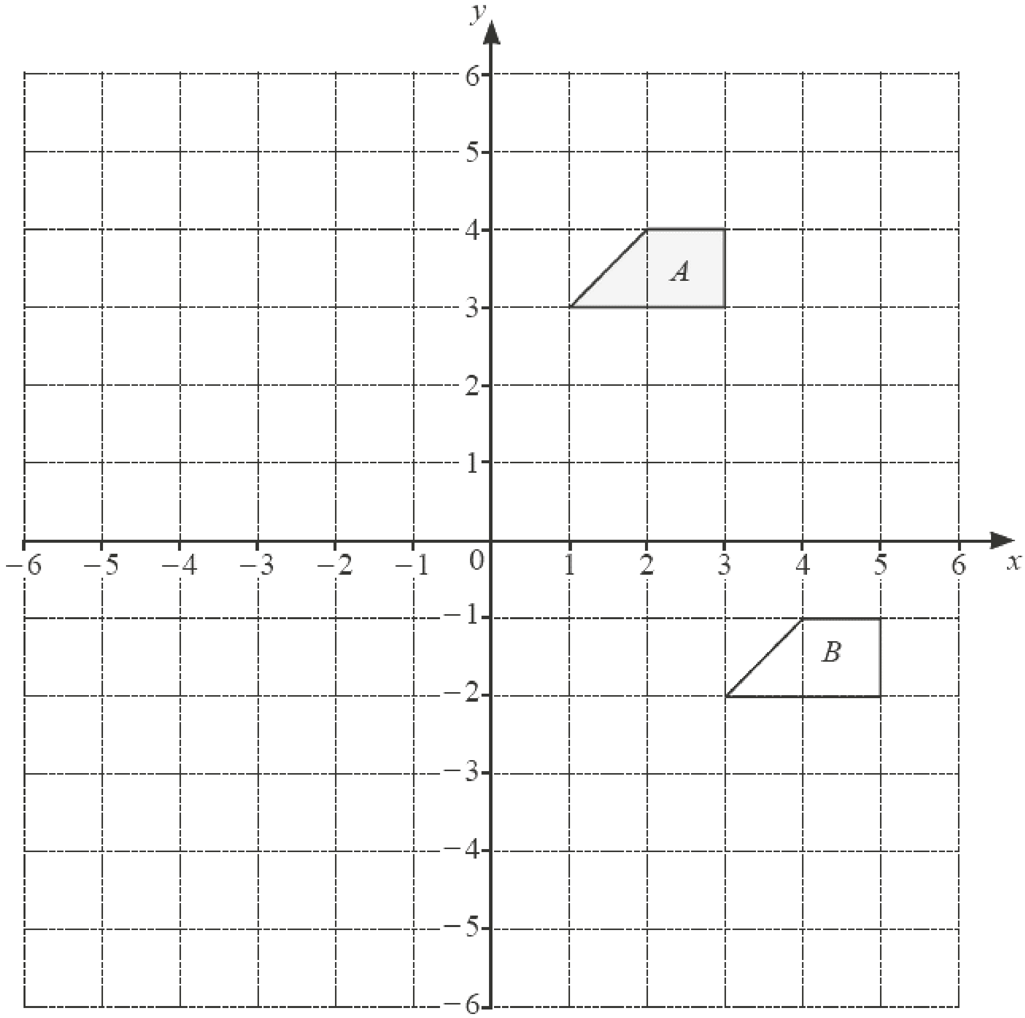
Find the value of each of r, t and u.

$r =$ ....

$t =$ ....

$u =$ .... [4]

5. Nov/2022/Paper_4024/21/No.7



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

....

.... [2]

(b) Reflect shape A in the x-axis. [1]

(c) Enlarge shape A by scale factor 2, centre (5, 4). [2]

(d) Transformation P is represented by the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

P maps shape *A* onto shape *C*.

(i) Draw and label shape *C*.

[2]

(ii) Describe fully the **single** transformation that maps shape *A* onto shape *C*.

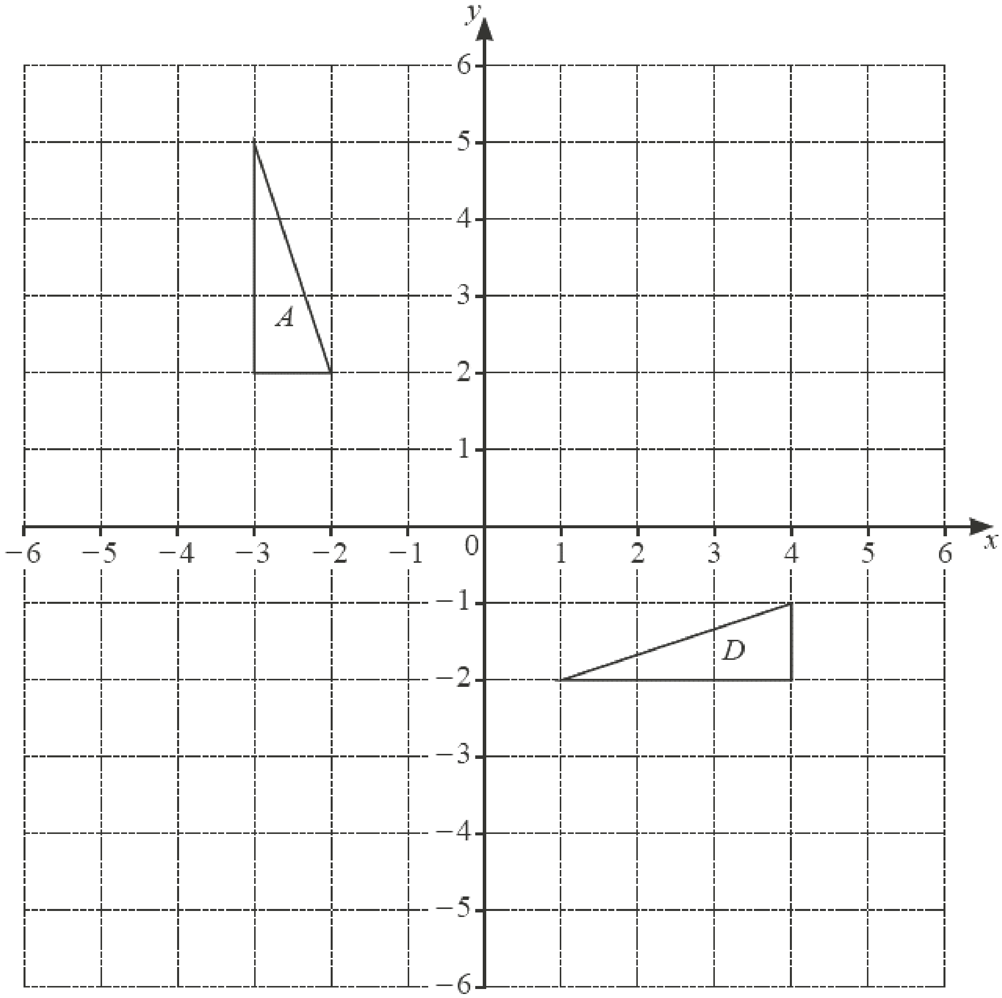
....

.... [3]

(iii) Find the matrix representing the transformation that maps shape *C* onto shape *A*.

$\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

6. Nov/2022/Paper_4024/22/No.6



(a) Reflect triangle A in the line $x = 1$.

Label the image B. [2]

(b) Triangle A is mapped onto triangle D by a combination of two transformations.
Triangle A is first mapped onto triangle C by transformation Y.

Triangle C is then mapped onto triangle D by a translation of $\begin{pmatrix} 6 \\ 1 \end{pmatrix}$.

Describe fully transformation Y.

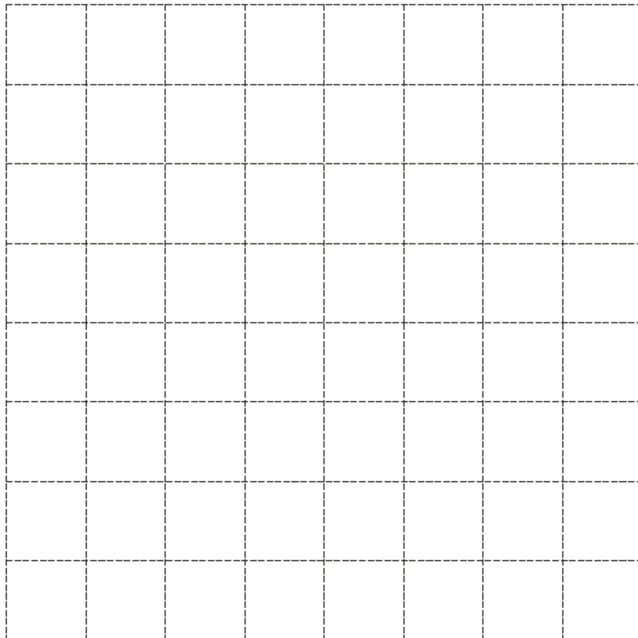
....

.... [5]

7. June/2022/Paper_4024/11/No.16

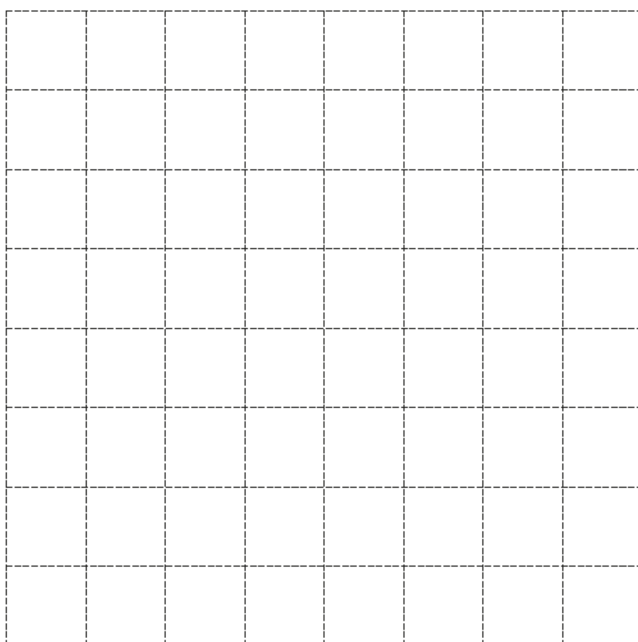
$\mathbf{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \qquad \mathbf{q} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$

(a) On the unit grid below, draw and label vector **p**.



[1]

(b) On the unit grid below, draw and label vector 2**q**.



[1]

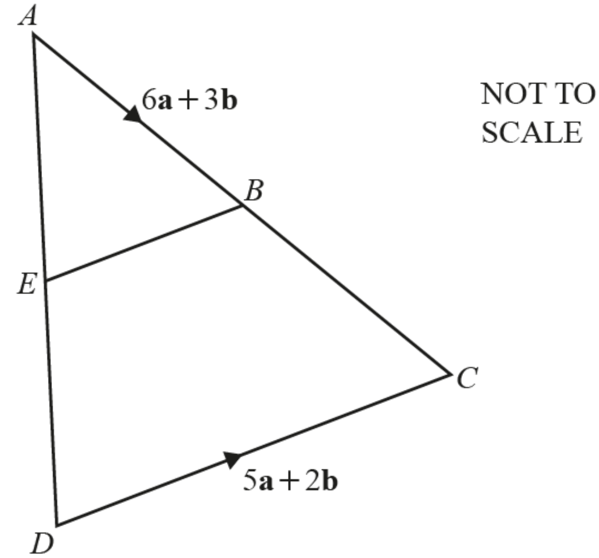
8. June/2022/Paper_4024/11/No.24

$$\mathbf{M} = \begin{pmatrix} 1 & 0 \\ 4 & 3 \end{pmatrix} \qquad \mathbf{N} = \begin{pmatrix} k & 0 \\ 1 & 4 \end{pmatrix}$$

Given that $\mathbf{MN} = \mathbf{NM}$, find the value of k.

$k =$ .... [3]

9. June/2022/Paper_4024/11/No.25



In triangle ACD, B is the midpoint of AC and E is the midpoint of AD.
$\overrightarrow{AB} = 6\mathbf{a} + 3\mathbf{b}$ and $\overrightarrow{DC} = 5\mathbf{a} + 2\mathbf{b}$.

(a) Express, as simply as possible, in terms of **a** and **b**.

(i) $\overrightarrow{AC}$

$\overrightarrow{AC} =$ .... [1]

(ii) $\overrightarrow{AD}$

$\overrightarrow{AD} =$ .... [2]

(b) Show that $\overrightarrow{EB}$ is parallel to $\overrightarrow{DC}$.

....

....

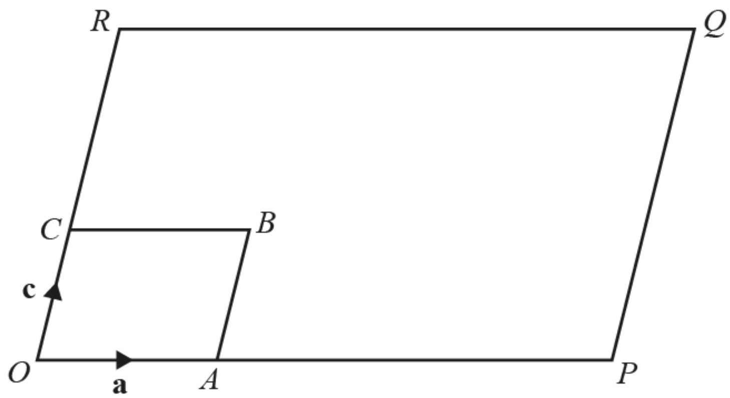
....

....

....

.... [3]

10. June/2022/Paper_4024/12/No.25



NOT TO SCALE

$OABC$ and $OPQR$ are parallelograms.
A is a point on OP and C is a point on OR.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.
$OA : OP = 1 : 4$ and $OC : CR = 2 : 3$.

(a) Find $\overrightarrow{OR}$ in terms of $\mathbf{c}$.

$\overrightarrow{OR}$ = ... [1]

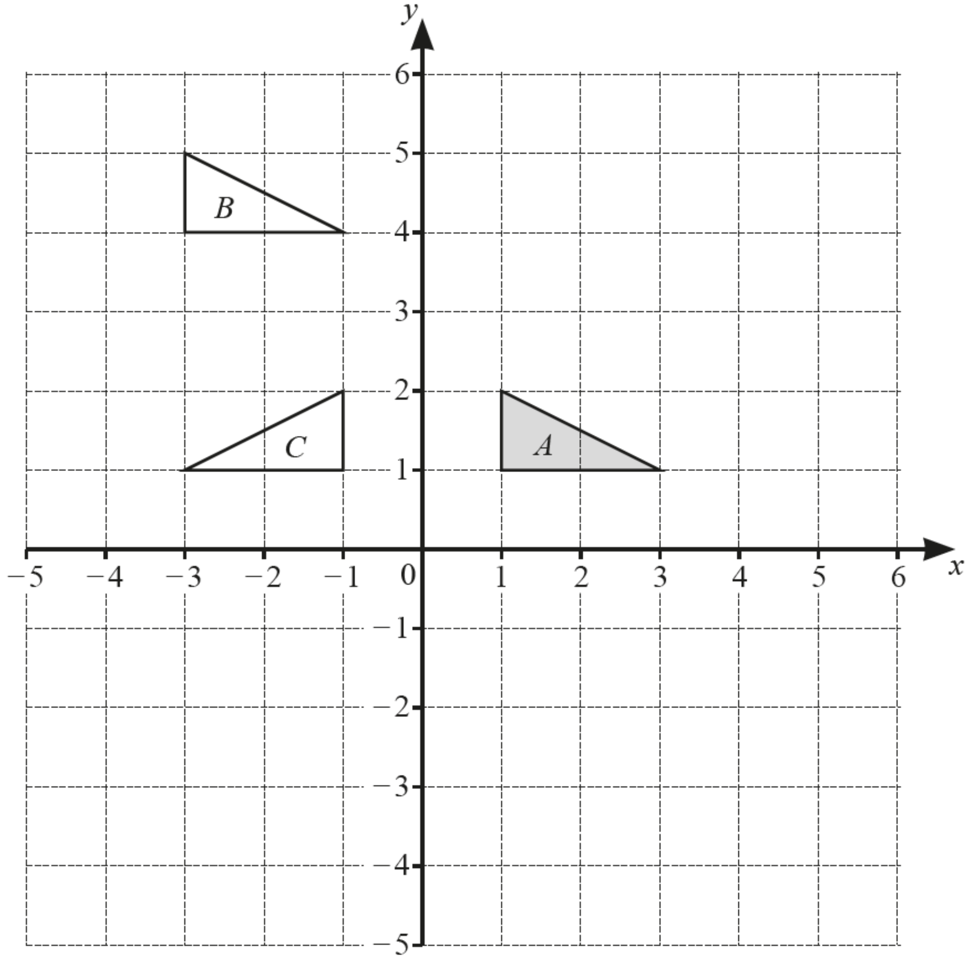
(b) Find $\overrightarrow{CQ}$, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{c}$.

$\overrightarrow{CQ}$ = ... [2]

(c) Find the ratio area $OABC$: area $OPQR$.

.... : .... [1]

11. June/2022/Paper_4024/21/No.10



The diagram shows triangles A, B and C.

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

.... [2]

(b) Find the matrix representing the transformation that maps triangle A onto triangle C.

$\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

(c) Triangle A is mapped onto triangle D by an enlargement with centre (2, 3) and scale factor 3.

Draw triangle D. [2]

12. June/2022/Paper_4024/22/No.8

(a) The matrix **A** satisfies the following equation.

$$\begin{pmatrix} 2 & 3 \\ 5 & 2 \end{pmatrix} - 3\mathbf{A} = \begin{pmatrix} 5 & 3 \\ -4 & -1 \end{pmatrix}$$

Find **A**.

$\mathbf{A} = \begin{pmatrix} & \\ & \end{pmatrix}$ [2]

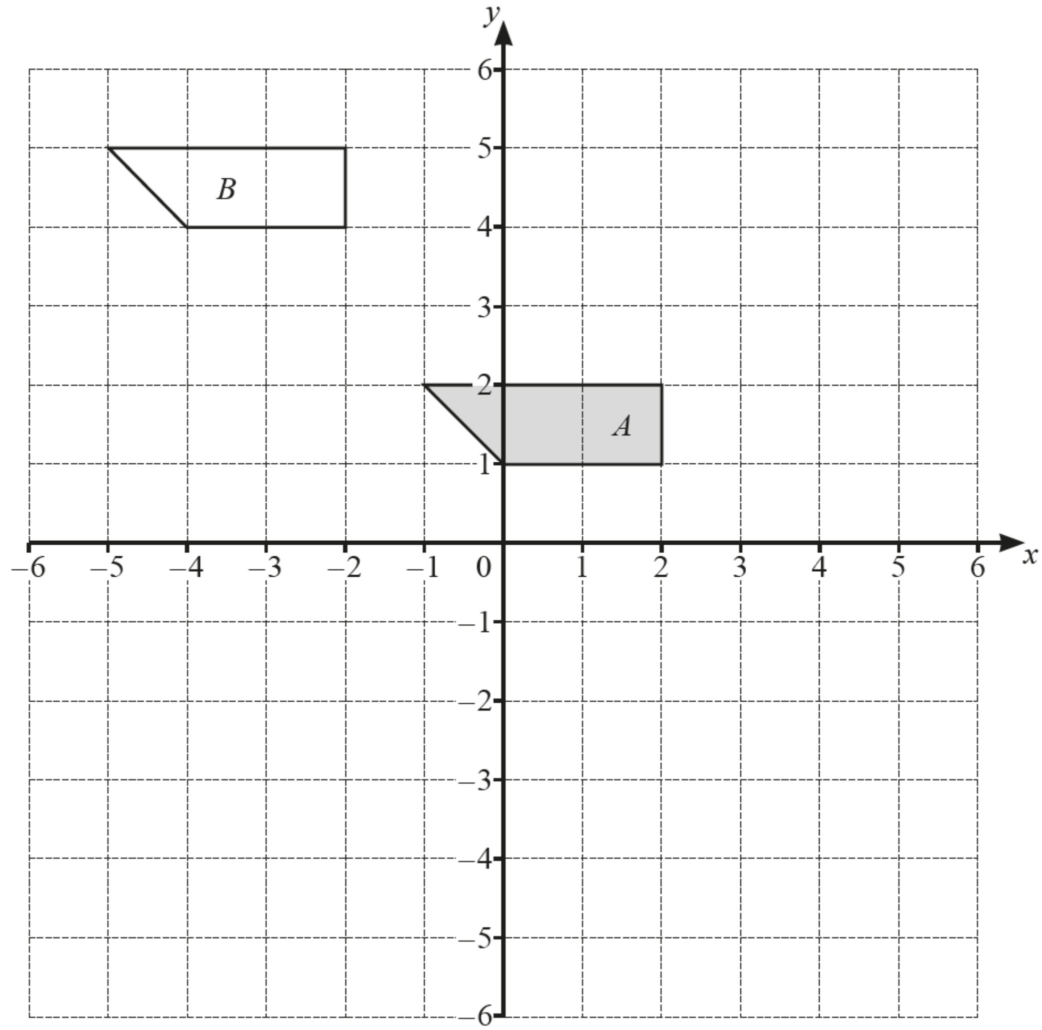
(b) $\mathbf{B} = \begin{pmatrix} 2 & -2 \\ 4 & p \end{pmatrix}$

The determinant of **B** is 2.

Find the value of p and hence write down $\mathbf{B}^{-1}$.

$\mathbf{B}^{-1} = \begin{pmatrix} & \\ & \end{pmatrix}$ [3]

(c)



The diagram shows shape *A* and shape *B*.

(i) Describe fully the **single** transformation that maps shape *A* onto shape *B*.

.... [2]

(ii) The transformation represented by the matrix $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$ maps shape *A* onto shape *C*.

Draw and label shape *C*. [2]