1 $\mathbf{a} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 7 \\ -4 \end{pmatrix}$

Work out.

(a) $4\mathbf{a}$
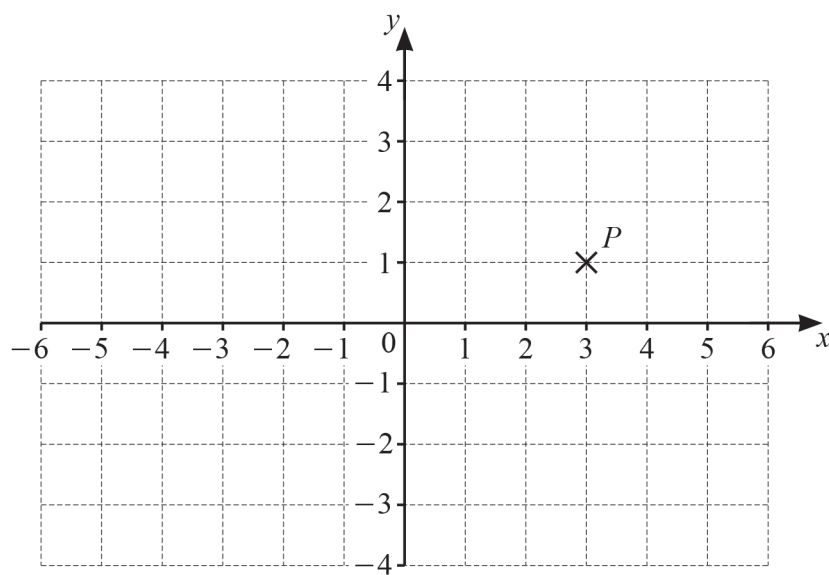
$\begin{pmatrix} \\ \end{pmatrix}$ [1]

(b) $2\mathbf{a} - \mathbf{b}$

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

[Total: 3]

2

(a) Write down the coordinates of point *P*.

(...................... , ...) [1]

(b) On the grid, plot point *Q* at (−4, 2). [1]

(c) $\overrightarrow{PR} = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$
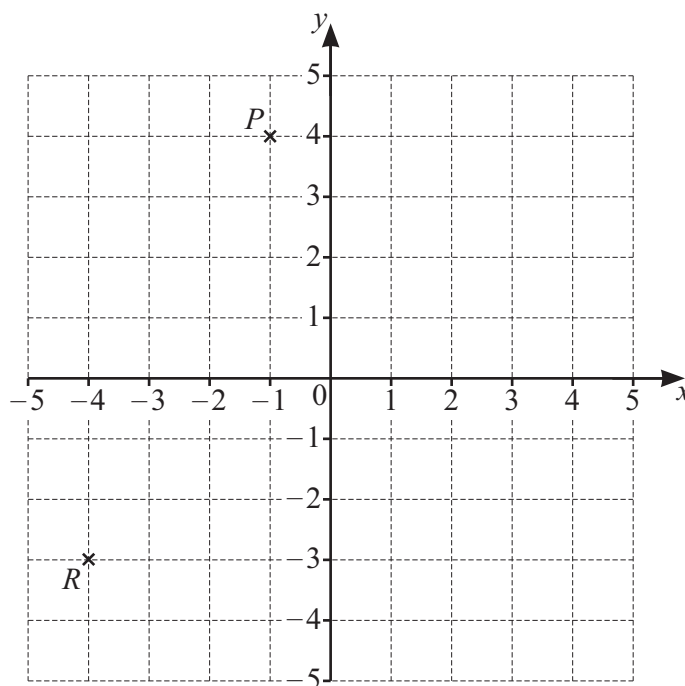
On the grid, plot point *R*. [1]

(d) On the grid, draw the line $y = 3$. [1]

[Total: 4]

3   The grid shows point *P* and point *R*.

(a)   Write down the coordinates of point *P*.

(.................... , ...) [1]

(b) $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$

Mark point *Q* on the grid.   [1]

(c)   Find $\overrightarrow{QR}$.

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

(d)   Complete this statement.

$\overrightarrow{PQ} + \overrightarrow{QR} = \overrightarrow{\ldots\ldots\ldots}$

[1]

[Total: 4]

4   *A* has coordinates $(-2, 7)$, *B* has coordinates $(1, -5)$ and *C* has coordinates $(5, 4)$.

   (a)   Find the coordinates of the midpoint of the line *AB*.

(.............................. , ...)   [2]

   (b)   Find $\overrightarrow{AC}$.

$$\overrightarrow{AC} = \begin{pmatrix} \\ \end{pmatrix}$$ [2]

   (c)   Find $\left|\overrightarrow{AC}\right|$.

....   [2]

   (d)   Find the equation of the line *AB*.
   Give your answer in the form $y = mx + c$.

y = ...   [3]

(e) Find the equation of the line perpendicular to *AB* that passes through *C*.
Give your answer in the form $y = mx + c$.

$y =$ .... [3]

[Total: 12]

5 Work out.

$$3 \begin{pmatrix} -4 \\ 7 \end{pmatrix}$$

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

[Total: 1]

6 $\mathbf{a} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$

Work out.

(a) $8\mathbf{b}$

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

(b) $\mathbf{a} - \mathbf{b}$

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

[Total: 2]

7   Point L has coordinates $(-3, 6)$ and $\overrightarrow{LM} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$.

Find the coordinates of point M.

(................... , ...)   [1]
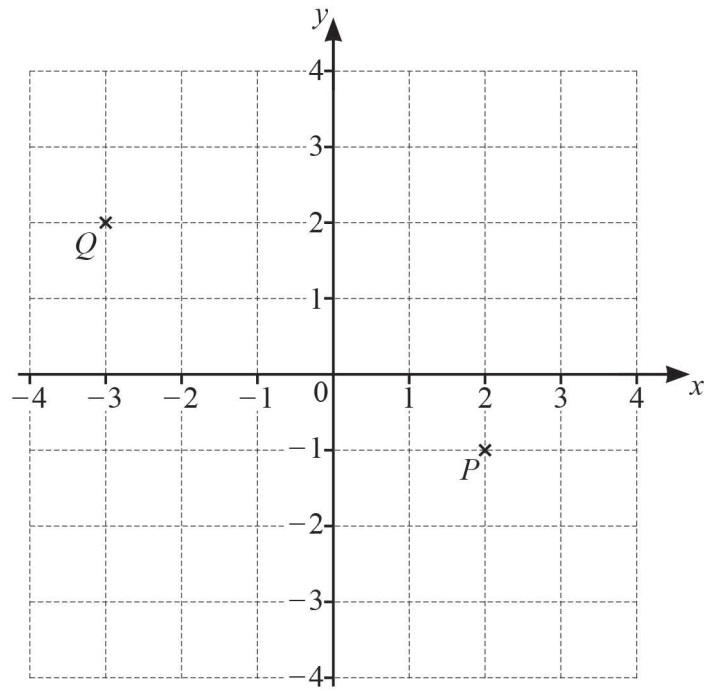
[Total: 1]

8   Work out.

(a) $2 \begin{pmatrix} -3 \\ 7 \end{pmatrix}$

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

(b) $\begin{pmatrix} 8 \\ -6 \end{pmatrix} + \begin{pmatrix} -5 \\ 2 \end{pmatrix}$

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

[Total: 2]
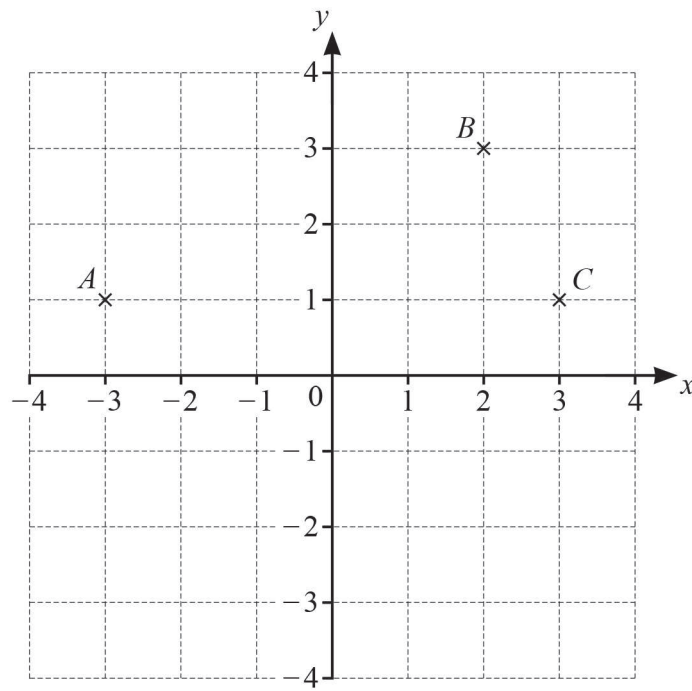
9

(a) Write $\overrightarrow{PQ}$ as a column vector.

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

(b) Write $3\overrightarrow{PQ}$ as a single vector.

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

[Total: 2]

10

Points *A*, *B* and *C* are shown on the grid.

(a) Write down the coordinates of point *C*.

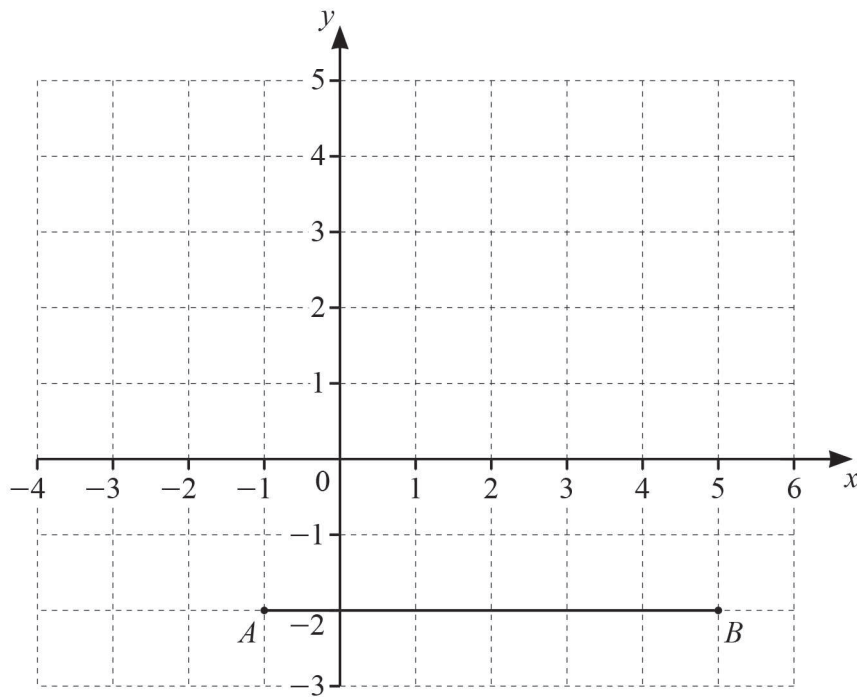(............................. , ...) [1]

(b) On the grid, plot point *D* so that *ABCD* is a parallelogram. [1]

(c) On the grid, plot point *E* so that $\overrightarrow{EA} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$. [2]

[Total: 4]

11 The diagram shows a line AB on a 1 cm^2 grid.

(a) Write down the coordinates of point A.

(..................... , ...) [1]

(b) Write down the vector $\overrightarrow{AB}$.

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

(c) $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$

Mark point C on the grid. [1]

(d) **(i)** Work out $\overrightarrow{AB} + \overrightarrow{BC}$.

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

(ii) Complete this statement.

$$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{\cdots\cdots\cdots\cdots}$$

[1]

(e) *A*, *B* and *C* are three vertices of a parallelogram, *ABCD*.

    (i) Mark point *D* on the diagram and draw the parallelogram *ABCD*. [1]

    (ii) Work out the area of the parallelogram.
         Give the units of your answer.

.... [2]

[Total: 8]

12 $\mathbf{p} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -2 \\ 7 \end{pmatrix}$

(a) Find $2\mathbf{p} + \mathbf{q}$.

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

(b) Find $|\mathbf{p}|$.

.... [2]

[Total: 4]

13 *A* is the point (4, 1) and $\overrightarrow{AB} = \begin{pmatrix} -3 \\ 1 \end{pmatrix}$.

Find the coordinates of *B*.

(.................. , ...) [1]

[Total: 1]

14 The diagram shows four shapes *A*, *B*, *C* and *D* and a point *P* on a 1 cm² grid.
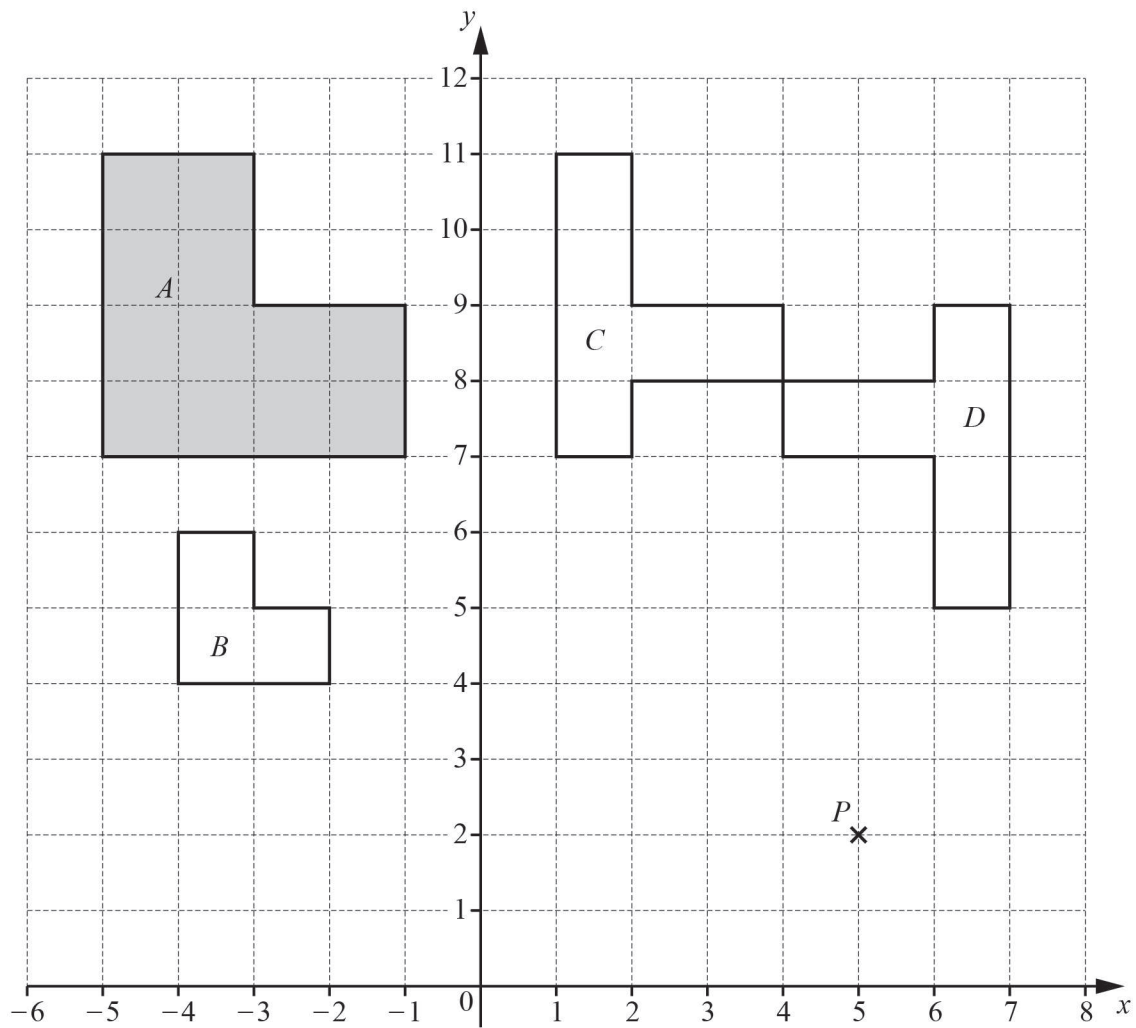
(a) Find

   (i) the perimeter of shape *A*,

   .... cm   [1]

   (ii) the area of shape *A*.

   .... cm²   [1]

(b) **(i)** Write down the co-ordinates of point *P*.

   (.............................. , ...)   [1]

(ii) Find the co-ordinates of the image of point *P* when

    A   *P* is reflected in the *y*-axis,

(.............................. , ...) [1]

B *P* is reflected in the line *y* = 6.

(............................. , ...) [2]

(iii) Find the vector that translates point *P* to the point (49, −12).

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

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

(i) shape *A* onto shape *B*,

....

.... [3]

(ii) shape *C* onto shape *D*.

....

.... [3]

[Total: 14]

15 Work out.

(a) $\begin{pmatrix} -2 \\ 5 \end{pmatrix} - \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

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

(b) $7 \begin{pmatrix} -3 \\ 4 \end{pmatrix}$

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

[Total: 2]

16 $\mathbf{a} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 5 \\ 4 \end{pmatrix}$ $\mathbf{c} = \begin{pmatrix} 14 \\ 9 \end{pmatrix}$

(a) Find $3\mathbf{a} - 2\mathbf{b}$.

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

(b) Find $|\mathbf{a}|$.

.... [2]
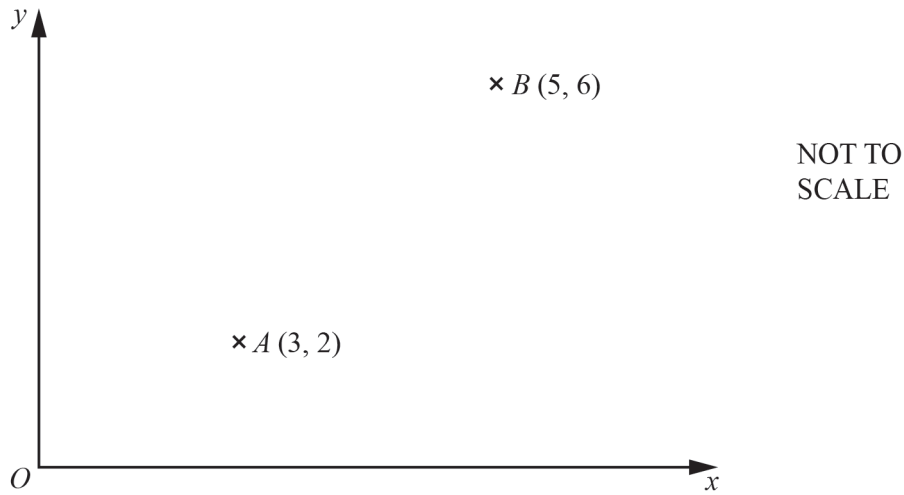
(c) $m\mathbf{a} + n\mathbf{b} = \mathbf{c}$

Write down two simultaneous equations and solve them to find the value of m and the value of n.
Show all your working.

$m = $ ....

$n = $ .... [5]

[Total: 9]

17

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

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

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

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

(c) *B* is the mid-point of the line *AC*.

Find the co-ordinates of *C*.

(............................. , ...) [2]

(d) Find the equation of the straight line that passes through *A* and *B*.

.... [3]

(e) The straight line that passes through *A* and *B* cuts the *y*-axis at *D*.

Write down the co-ordinates of *D*.

(............................. , ...) [1]

[Total: 9]

18
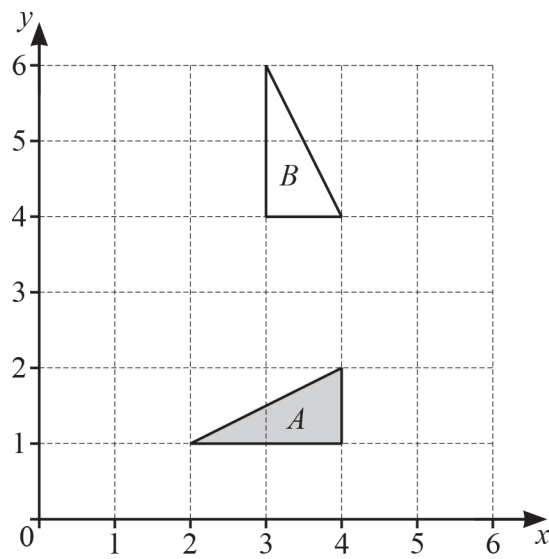
Describe fully the **single** transformation that maps triangle *A* onto triangle *B*.

....

.... [3]

[Total: 3]

19 Triangles *A*, *B* and *C* are shown on the grid.
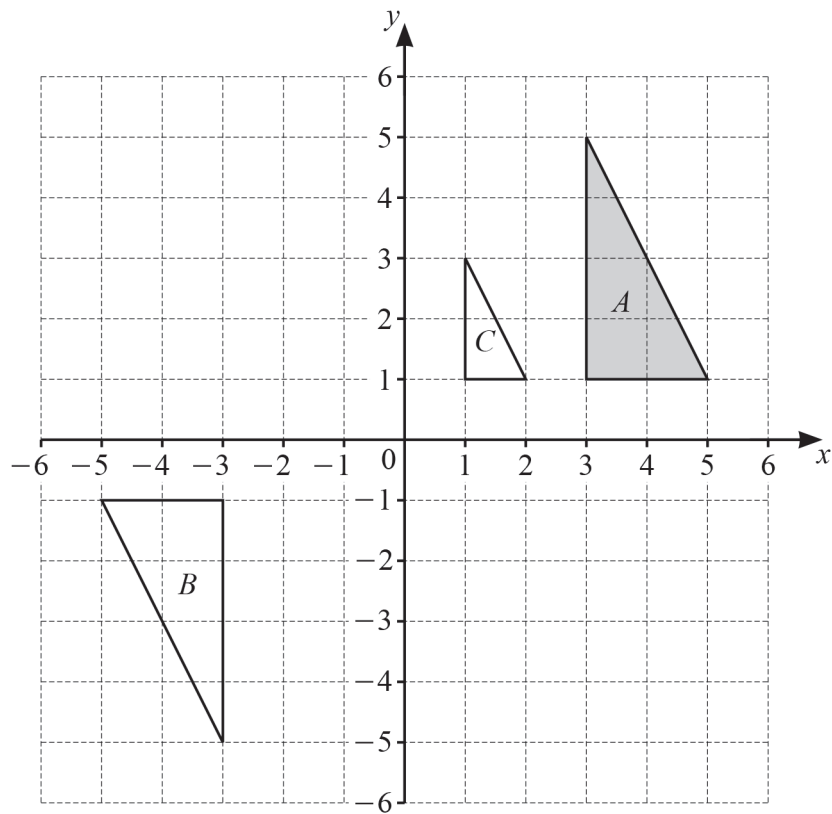
(a) Describe fully the **single** transformation that maps

    (i) triangle *A* onto triangle *B*,

    ....

    .... [3]

    (ii) triangle *A* onto triangle *C*.

    ....

    .... [3]

(b) On the grid,

    (i) reflect triangle *A* in the line $y = 0$,   [2]

    (ii) translate triangle *A* by the vector $\begin{pmatrix} -7 \\ 1 \end{pmatrix}$.   [2]

[Total: 10]

20
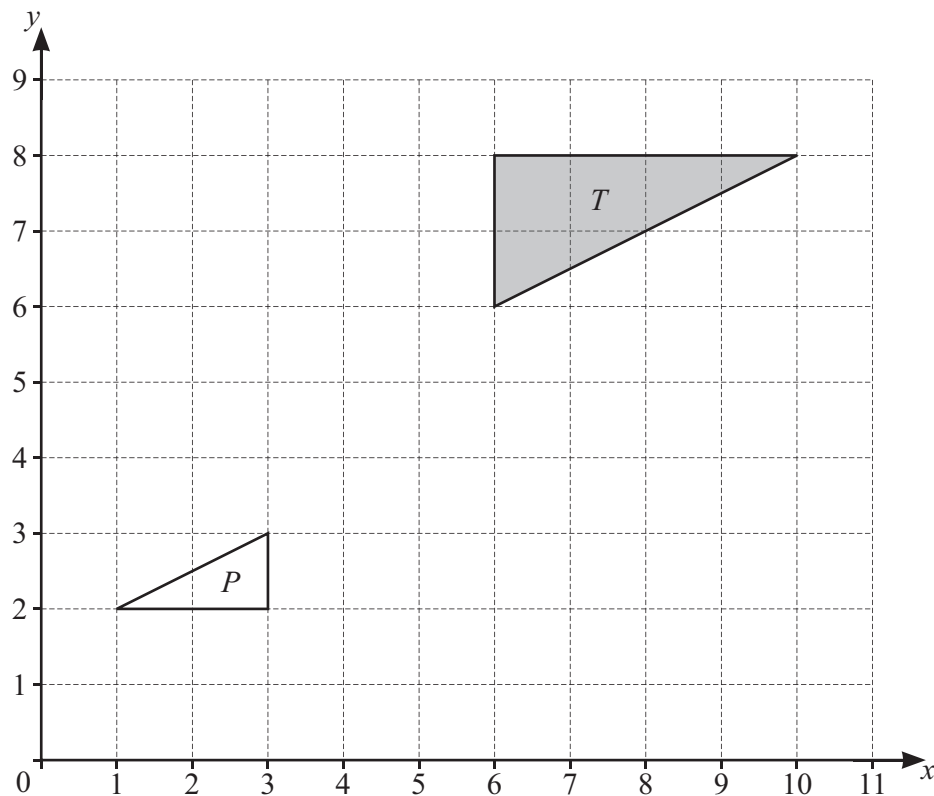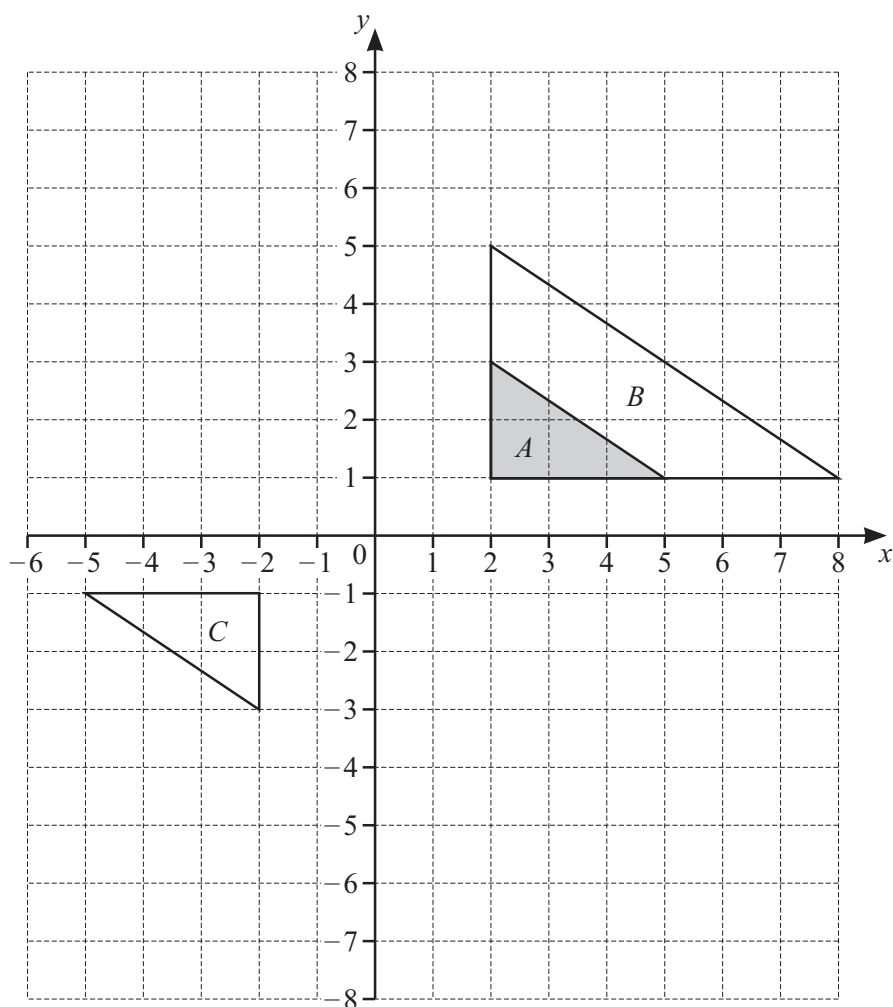

Describe fully the **single** transformation that maps triangle *T* onto triangle *P*.

....

.... [3]

21 The grid shows triangles *A*, *B* and *C*.

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

....

.... [3]

(b) Describe fully the **single** transformation that maps triangle *A* onto triangle *C*.

....

.... [3]
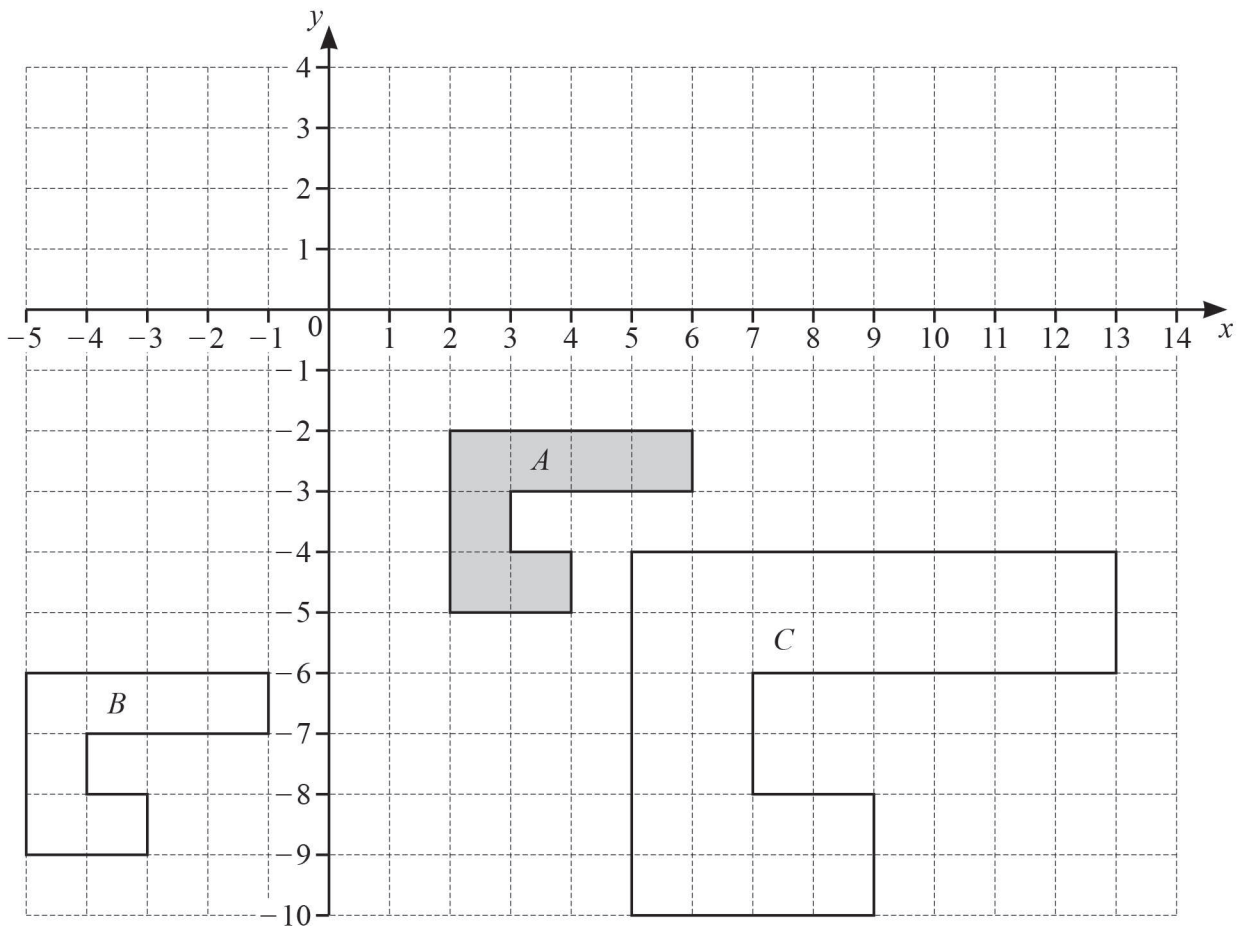
(c) Draw the image of

(i) triangle *A* after a translation by the vector $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$, [2]

(ii) triangle *A* after a reflection in the line $y = -2$. [2]

22 The grid shows three shapes, *A*, *B* and *C*.

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

    (i) shape *A* onto shape *B*,

    ....

    .... [2]

    (ii) shape *A* onto shape *C*.

    ....

    .... [3]
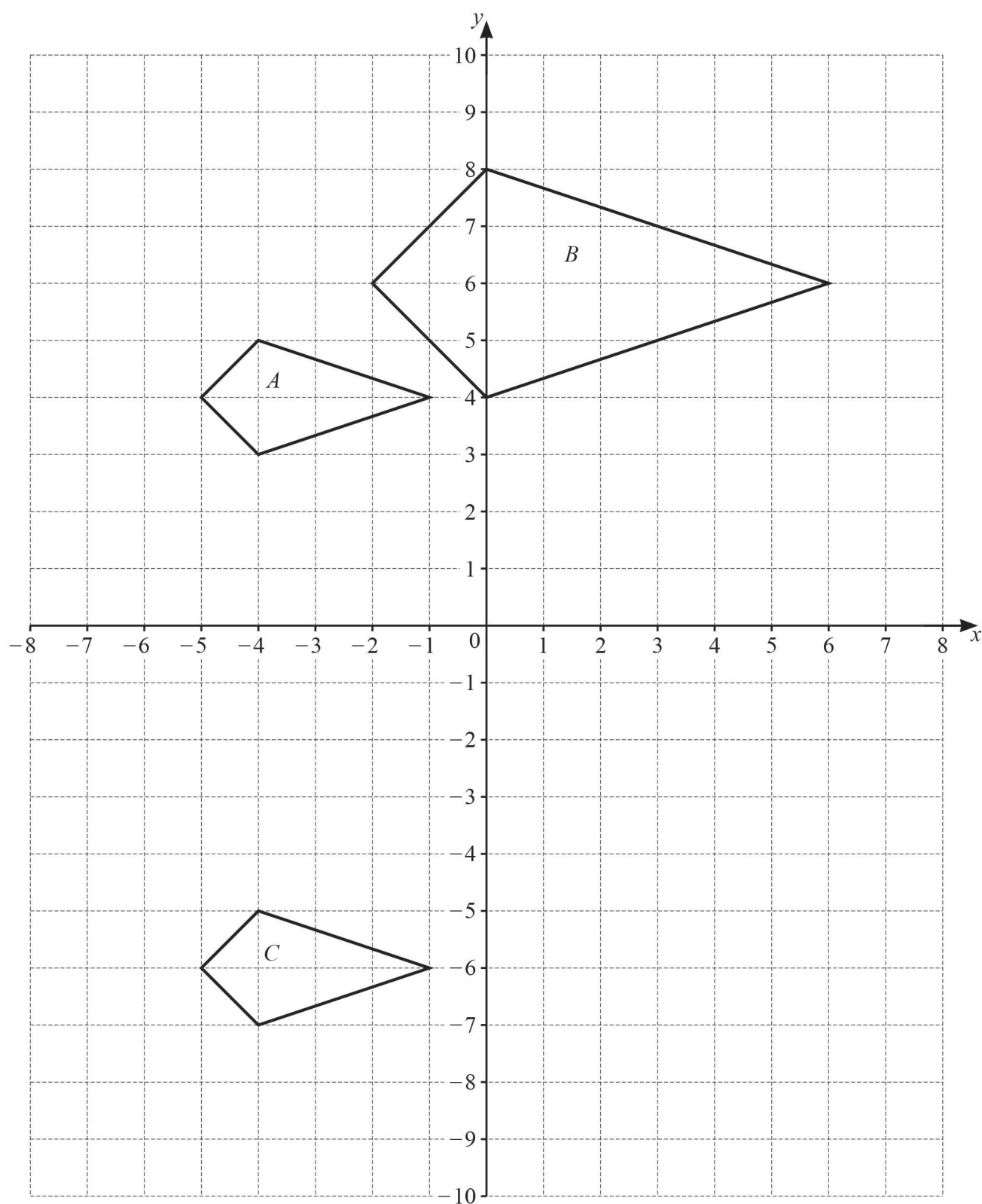
(b) On the grid, draw the image of shape *A* after a rotation, 90° clockwise, centre (6, −3). [2]

[Total: 7]

23 The diagram shows three quadrilaterals on a 1 cm² grid.

(a) Write down the mathematical name of quadrilateral *A*.

[1]

(b) Find the area of quadrilateral *A*.

.... cm^2 [1]

(c) Describe fully the **single** transformation that maps quadrilateral *A* onto
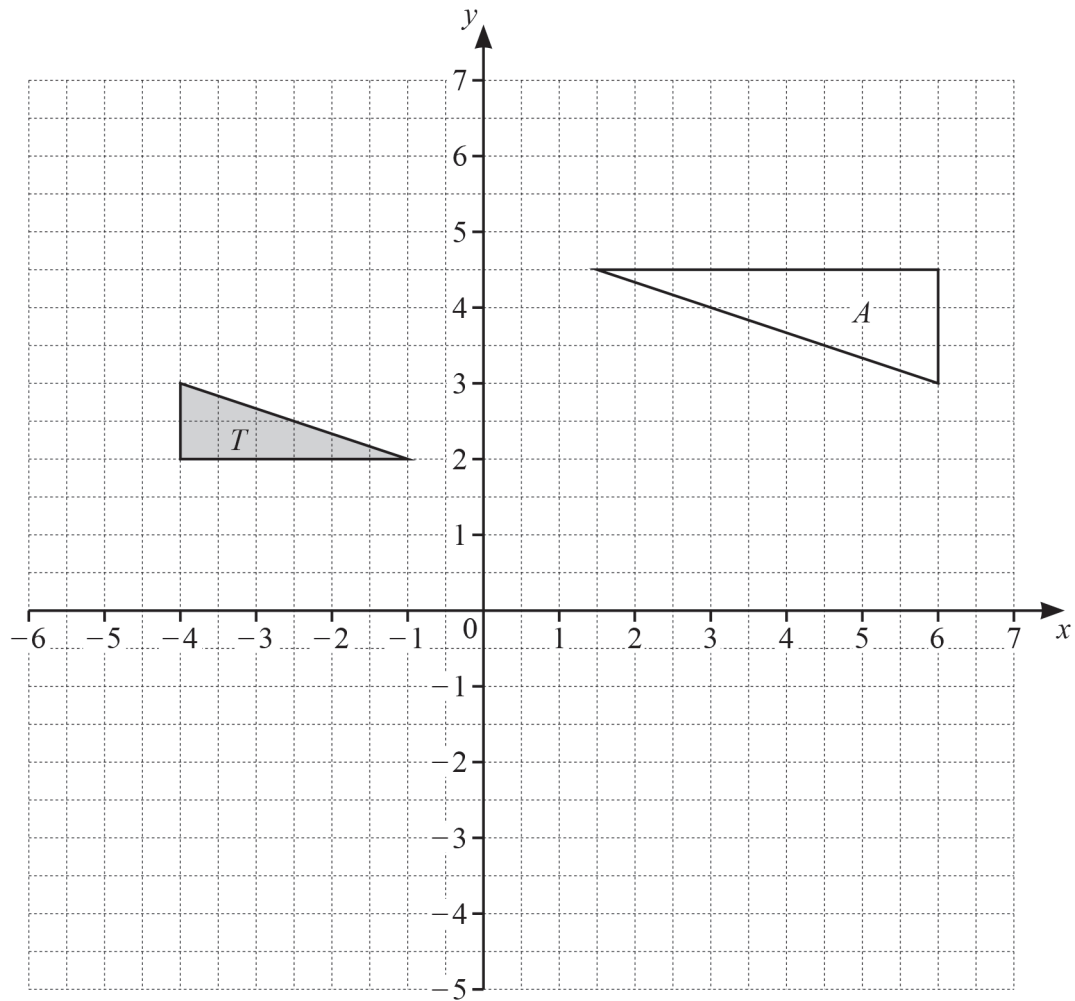
    (i) quadrilateral *B*,

    ....

    .... [3]

    (ii) quadrilateral *C*.

    ....

    .... [2]

(d) On the grid, draw the image of

    (i) quadrilateral *C* after a 90° anticlockwise rotation about the origin, [2]

    (ii) quadrilateral *C* after a reflection in the line *x* = 1. [2]

[Total: 11]

24

(a) Draw the image of triangle *T* after a reflection in the line *y* = *x*. [2]
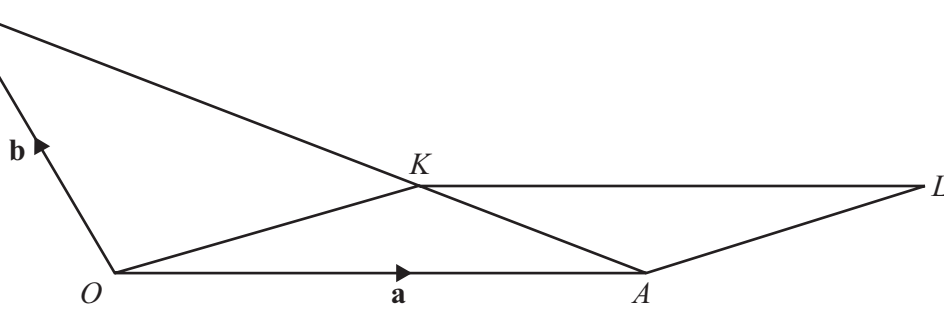
(b) Draw the image of triangle *T* after a translation by the vector $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$. [2]

(c) Describe fully the **single** transformation that maps triangle *T* onto triangle *A*.

....

.... [3]

[Total: 7]

25

NOT TO SCALE

The diagram shows a triangle *OAB* and a parallelogram *OALK*.
The position vector of *A* is **a** and the position vector of *B* is **b**.
K is a point on *AB* so that *AK* : *KB* = 1 : 2.

Find the position vector of *L*, in terms of **a** and **b**.
Give your answer in its simplest form.

.... [4]

[Total: 4]

26
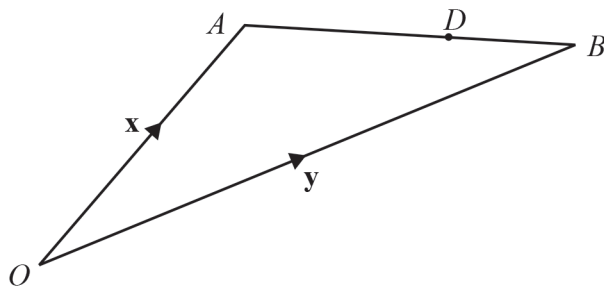
NOT TO
SCALE

$\overrightarrow{OA} = \mathbf{x}$, $\overrightarrow{OB} = \mathbf{y}$ and $\overrightarrow{OD} = \dfrac{3}{7}\,\mathbf{x} + \dfrac{4}{7}\,\mathbf{y}$.

Calculate the ratio $AD : DB$.

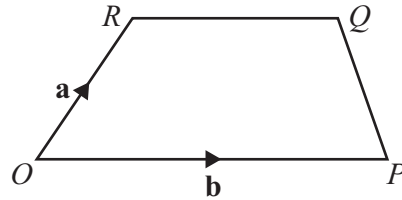.............................. : ....   [2]

[Total: 2]

27 $\mathbf{p} = \begin{pmatrix} 2 \\ 8 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$

Find $|\mathbf{p} - \mathbf{q}|$.

....   [2]

[Total: 2]

28

NOT TO
SCALE

The diagram shows a trapezium *OPQR*.

O is the origin, $\overrightarrow{OR} = \mathbf{a}$ and $\overrightarrow{OP} = \mathbf{b}$.

$$\left|\overrightarrow{RQ}\right| = \frac{3}{5}\left|\overrightarrow{OP}\right|$$

(a) Find $\overrightarrow{PQ}$ in terms of **a** and **b** in its simplest form.

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

(b) When *PQ* and *OR* are extended, they intersect at *W*.

Find the position vector of *W*.

.... [2]

[Total: 4]

29 The magnitude of the vector $\begin{pmatrix} 20 \\ k \end{pmatrix}$ is 29.

Find the value of k.

$k =$ .... [3]

[Total: 3]

30
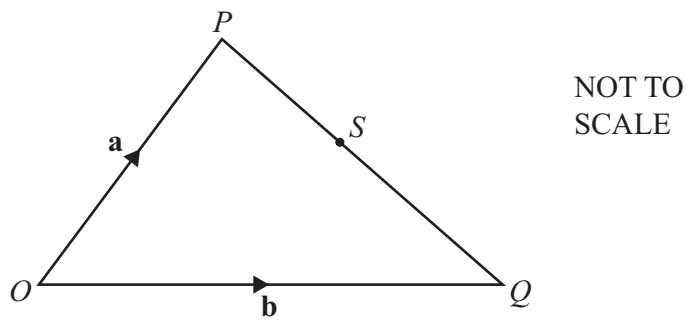
S is a point on PQ such that $PS : SQ = 4 : 5$.

Find $\overrightarrow{OS}$, in terms of **a** and **b**, in its simplest form.

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

[Total: 2]