Chapter 7

Vectors and transformations

01. 0580_m24_qp_42 Q: 7

(a) $\mathbf{p} = \begin{pmatrix} 8 \\ -5 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$

(i) Find $3\mathbf{q}$.

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

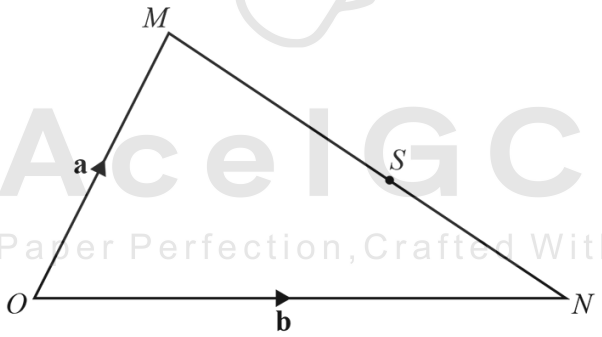
(ii) **(a)** Find $\mathbf{p} - \mathbf{q}$.

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

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

..... [2]

(b)



NOT TO SCALE

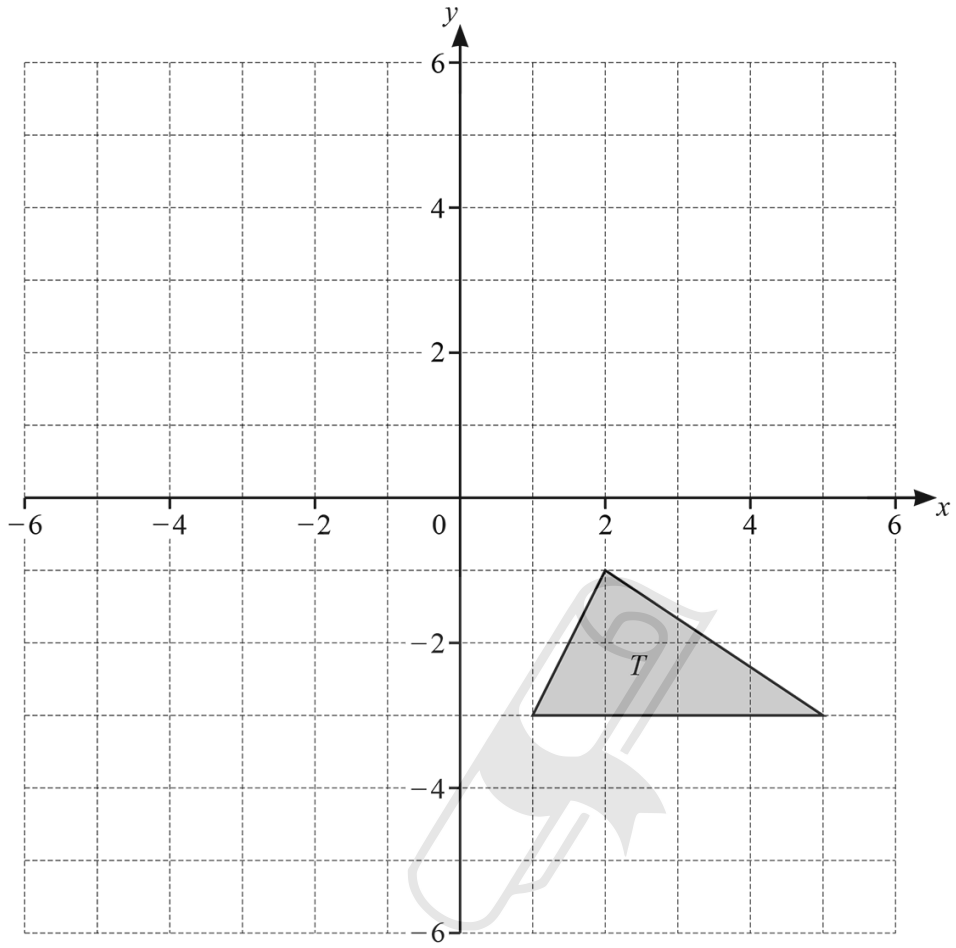
In triangle OMN, O is the origin, $\overrightarrow{OM} = \mathbf{a}$ and $\overrightarrow{ON} = \mathbf{b}$.
S is a point on MN such that $MS : SN = 5:3$.

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

..... [3]

02. 0580_s24_qp_41 Q: 2

(a)



On the grid, draw the image of

(i) triangle T after a reflection in the x-axis [1]

(ii) triangle T after a translation by the vector $\begin{pmatrix}-5\\-2\end{pmatrix}$ [2]

(iii) triangle T after an enlargement by scale factor $-\frac{1}{2}$ with centre $(-1, 1)$. [2]

(b) A shape P is enlarged by scale factor 3 to give shape Q.
Shape Q is then enlarged by scale factor $\frac{2}{5}$ to give shape R.

The area of shape P is $10\,\text{cm}^2$.

Calculate the area of shape R.

..... cm^2 [3]

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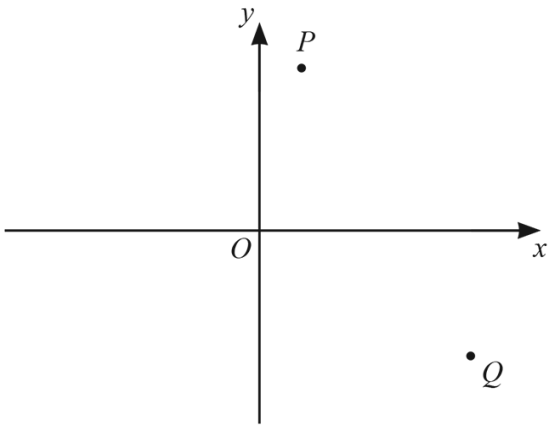
03. 0580_s24_qp_41 Q: 5

(a) P is the point (1, 7).
Q is the point (5, –5).



NOT TO SCALE

(i) Find $\overrightarrow{PQ}$.

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

(ii) Show that $|\overrightarrow{OP}| = |\overrightarrow{OQ}|$.

[3]

(iii) PQ is a chord of a circle with centre O.

Calculate the circumference of this circle.

..... [2]

(iv) PQ is the diameter of a different circle with centre R.

Find the coordinates of R.

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

(v) Find the equation of the perpendicular bisector of PQ.
Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

(b) The position vector of A is **a**.
The position vector of B is **b**.

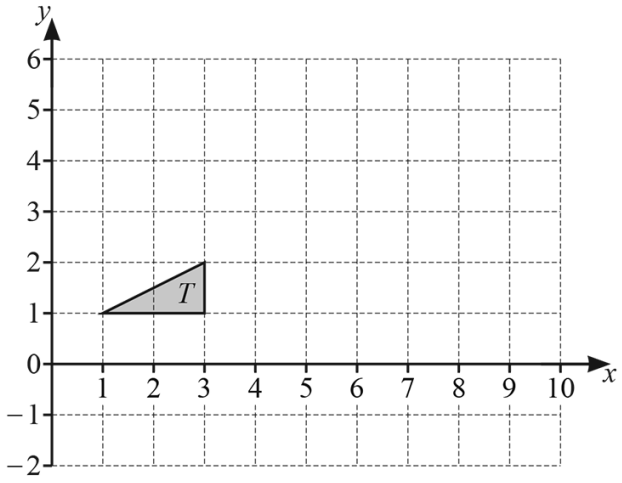
M is a point on AB such that $AM : MB = 2 : 3$.

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

..... [4]

04. 0580_m23_qp_42 Q: 4

(a)



(i) Enlarge triangle T by scale factor 3, centre (0, 2). [2]

(ii) **(a)** Rotate triangle T about (4, 2) by 90° clockwise.
Label the image P. [2]

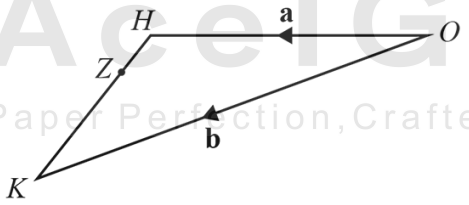
(b) Reflect triangle T in the line $x+y=6$.
Label the image Q. [3]

(c) Describe fully the **single** transformation that maps triangle P onto triangle Q.

.....

..... [2]

(b)

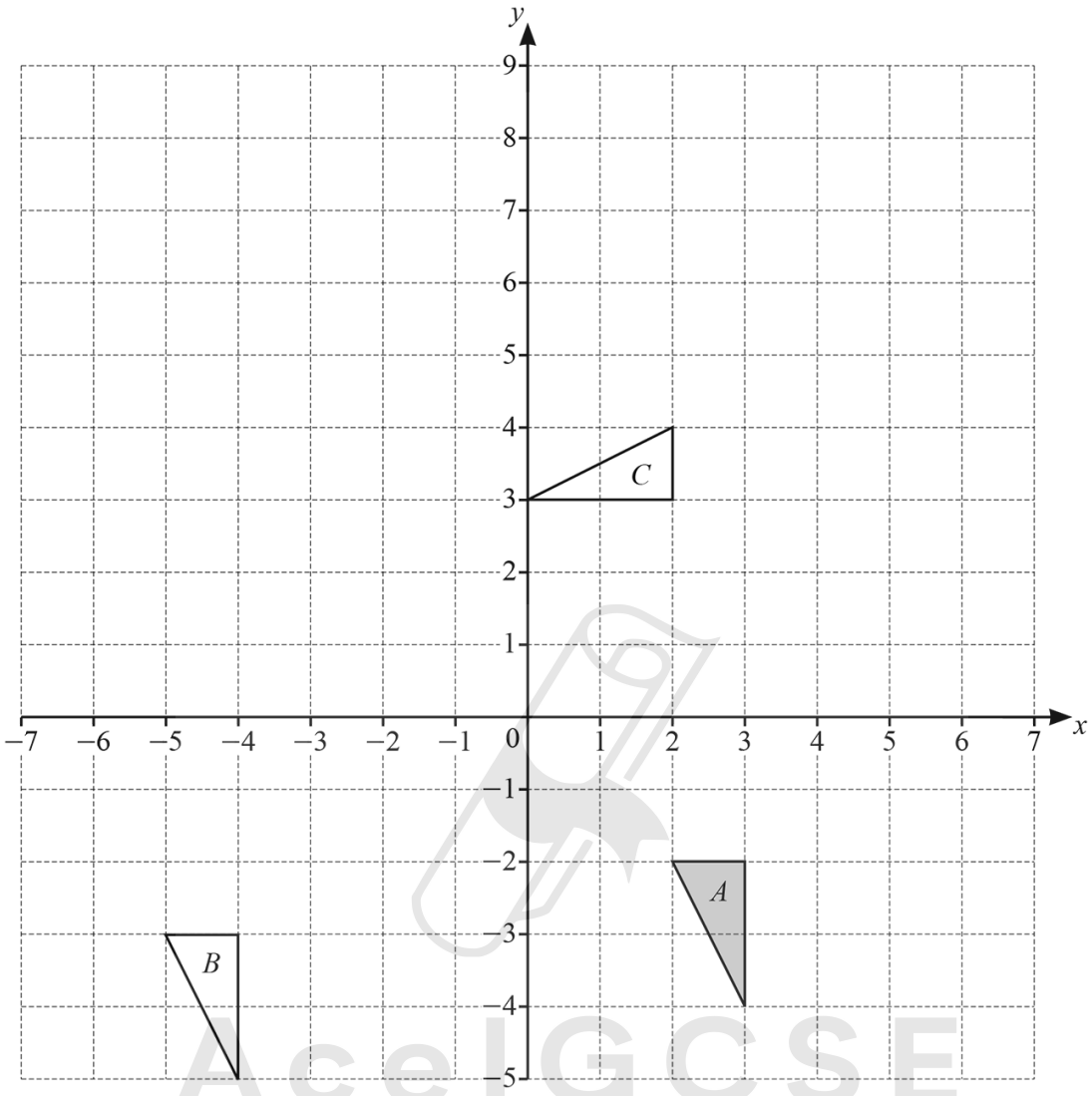


The diagram shows triangle OHK, where O is the origin.
The position vector of H is **a** and the position vector of K is **b**.
Z is the point on HK such that $HZ : ZK = 2 : 5$.

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

..... [3]

05. 0580_w23_qp_41 Q: 1



(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

(i) shape A after a reflection in the line $y = 2$ [2]

(ii) shape A after an enlargement, scale factor -2, centre (0, 0). [2]

06. 0580_w23_qp_41 Q: 10

(a) ABC is a triangle.

B is the point $(1, -10)$, A is the point $(4, 14)$ and $\overrightarrow{CA} = \begin{pmatrix} -11 \\ 8 \end{pmatrix}$.

(i) Find the coordinates of C.

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

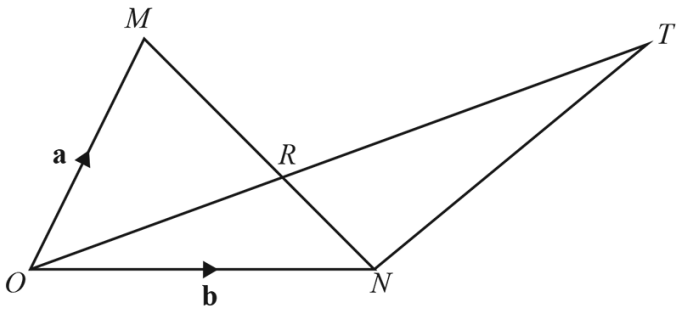
(ii) Find $\overrightarrow{BA}$.

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

(iii) Find $|\overrightarrow{CA}|$.

..... [2]

(b)



NOT TO SCALE

OMN is a triangle.
$\overrightarrow{OM} = \mathbf{a}$ and $\overrightarrow{ON} = \mathbf{b}$.
R is a point on MN such that $MR : RN = 3 : 2$.
ORT is a straight line.

(i) Show that $\overrightarrow{OR} = \frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$.

[3]

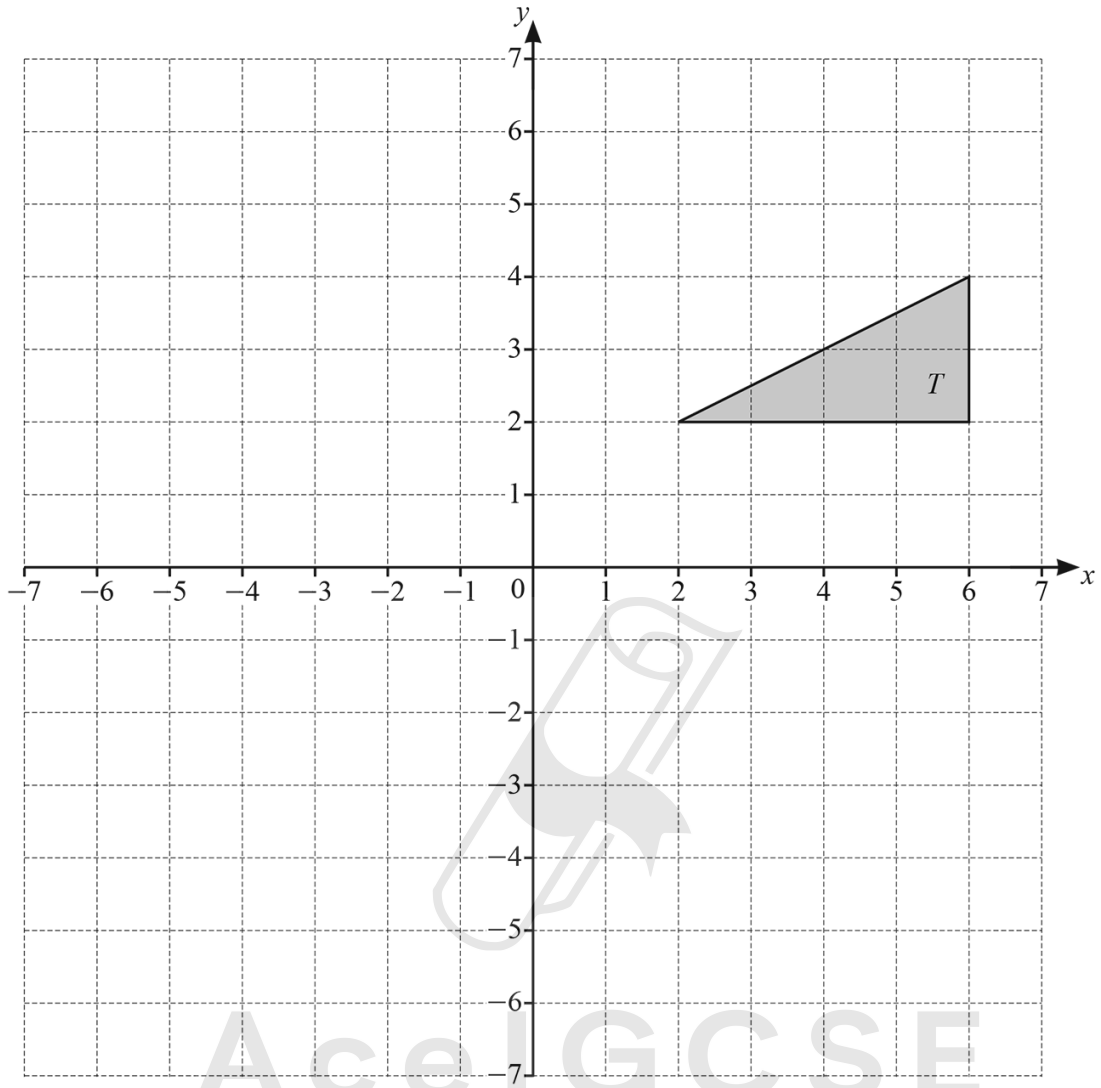
(ii) **(a)** $\overrightarrow{NT} = 4\mathbf{a} + k\mathbf{b}$ and $\overrightarrow{OT} = c\overrightarrow{OR}$.

Find the value of k and the value of c.

$k =$ ..... $c =$ ..... [4]

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

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



(a) **(i)** Translate triangle T by the vector $\begin{pmatrix} -7 \\ 1 \end{pmatrix}$. Label the image K. [2]

(ii) Describe fully the **single** transformation that maps triangle K onto triangle T.

.....

..... [1]

(b) Reflect triangle T in the line $y = 4$. [2]

(c) Rotate triangle T through 90° clockwise about (0, 0). [2]

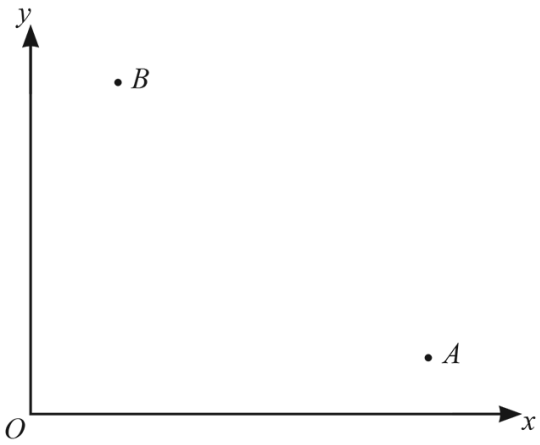
(d) **(i)** Enlarge triangle T by scale factor $-\frac{1}{2}$, centre (0, 0). Label the image P. [2]

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

.....

..... [2]

08. 0580_w23_qp_42 Q: 12



NOT TO SCALE

O is the origin (0, 0), A is the point (8, 1) and B is the point (2, 5).

(a) Write as column vectors.

(i) $\overrightarrow{OB}$

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

(ii) $\overrightarrow{AB}$

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

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

$y =$ ..... [3]

(c) Find the equation of the perpendicular bisector of AB.
Give your answer in the form $y = mx + c$.

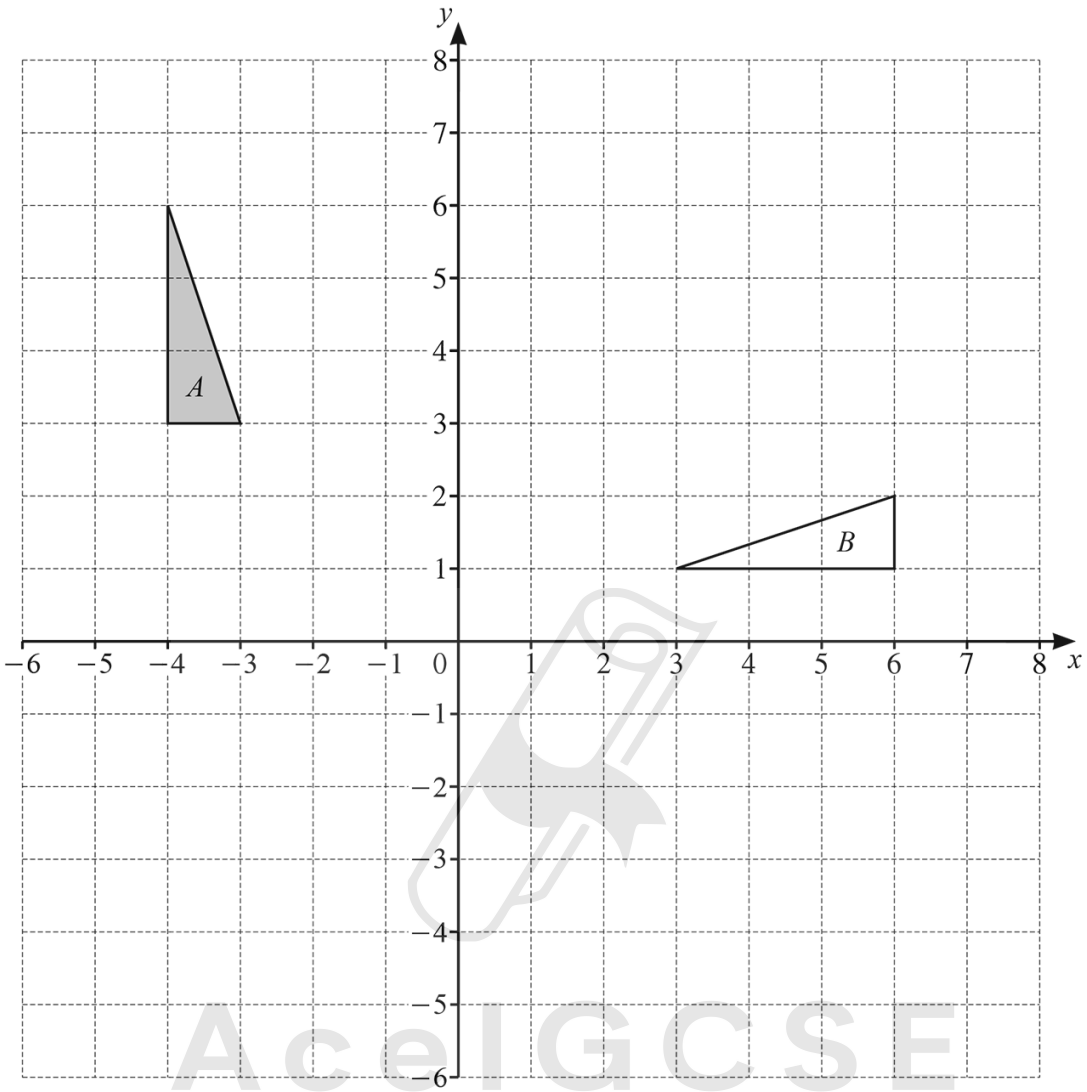
$y =$ ..... [4]

(d) The line AB meets the y-axis at P.
The perpendicular bisector of AB meets the y-axis at Q.

Find the length of PQ.

..... [2]

09. 0580_w23_qp_43 Q: 3



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

.....

..... [3]

(b) Draw the image of triangle A after

(i) a reflection in the line $y = 1$ [2]

(ii) a translation by the vector $\begin{pmatrix} 5 \\ -7 \end{pmatrix}$ [2]

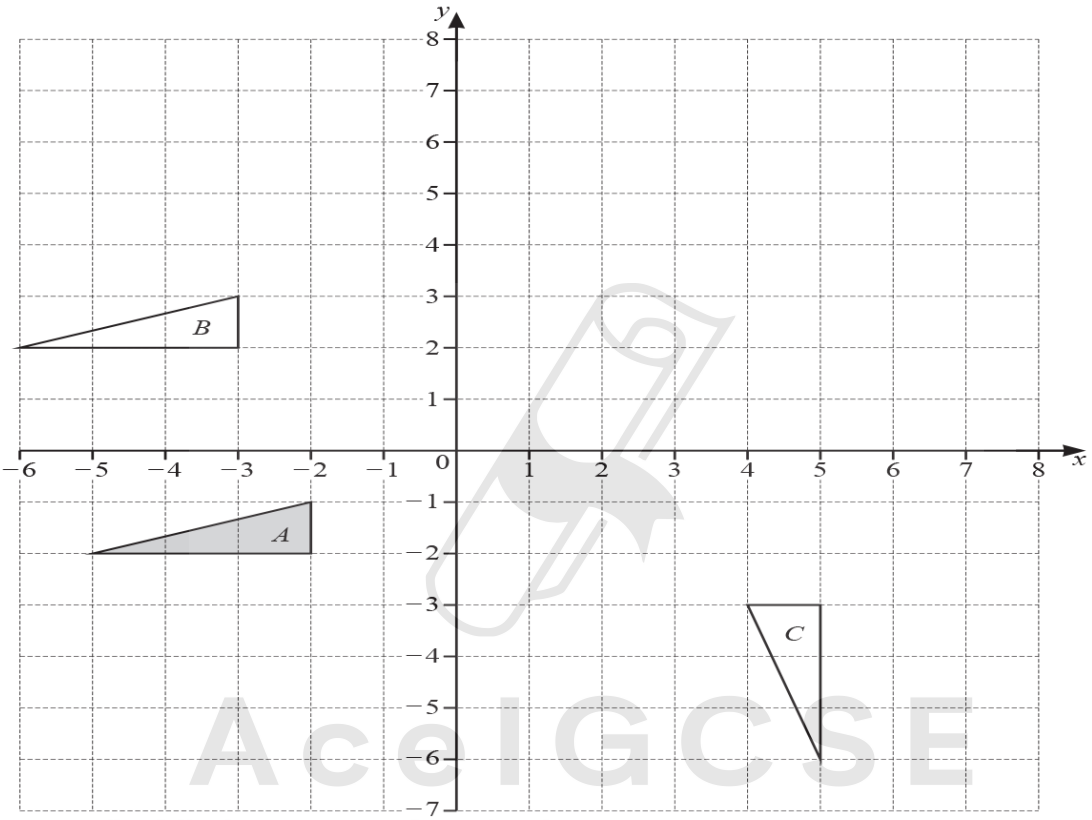
(iii) an enlargement, scale factor 2, centre $(-4,\ 5)$. [2]

10. 0580_s22_qp_42 Q: 5

(a) Draw the lines of symmetry of the rectangle.

[2]

(b)



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

(a) triangle A onto triangle B,

.....

..... [2]

(b) triangle A onto triangle C.

.....

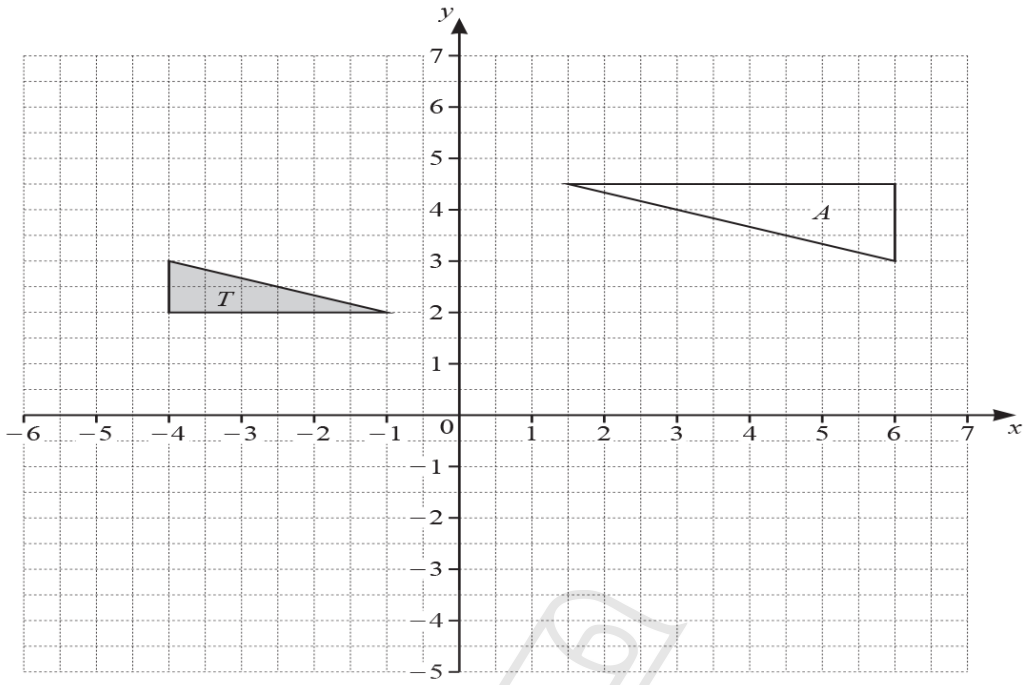
..... [3]

(ii) **(a)** Draw the image of triangle A after reflection in $y = 2$. [2]

(b) Draw the image of triangle A after enlargement by scale factor -2, centre $(-1, 1)$. [2]

11. 0580_s22_qp_43 Q: 2

(a)



(i) Draw the image of triangle T after a reflection in the line $y = x$. [2]

(ii) Draw the image of triangle T after a translation by the vector $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$. [2]

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

.....

..... [3]

(b) A quadrilateral P is enlarged by a scale factor of 1.2 to give quadrilateral Q.
The area of quadrilateral P is 20 cm^2.

Calculate the area of quadrilateral Q.

..... cm^2 [2]

12. 0580_w22_qp_41 Q: 6

(a) $\mathbf{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$

Find

(i) $3\mathbf{q}$,

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

(ii) $\mathbf{p} - \mathbf{q}$,

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

(iii) $|\mathbf{p}|$.

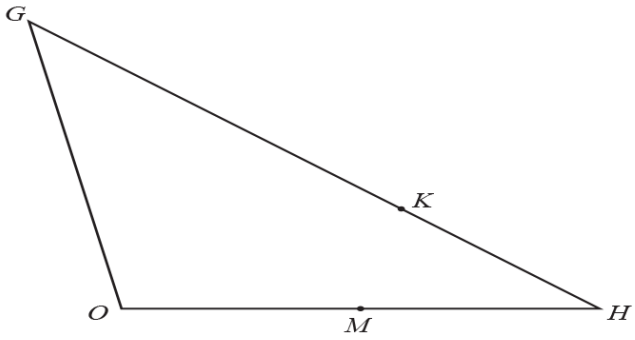
..... [2]

(b) B is the point (2, 7) and $\overrightarrow{AB} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$.

Find the coordinates of A.

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

(c)

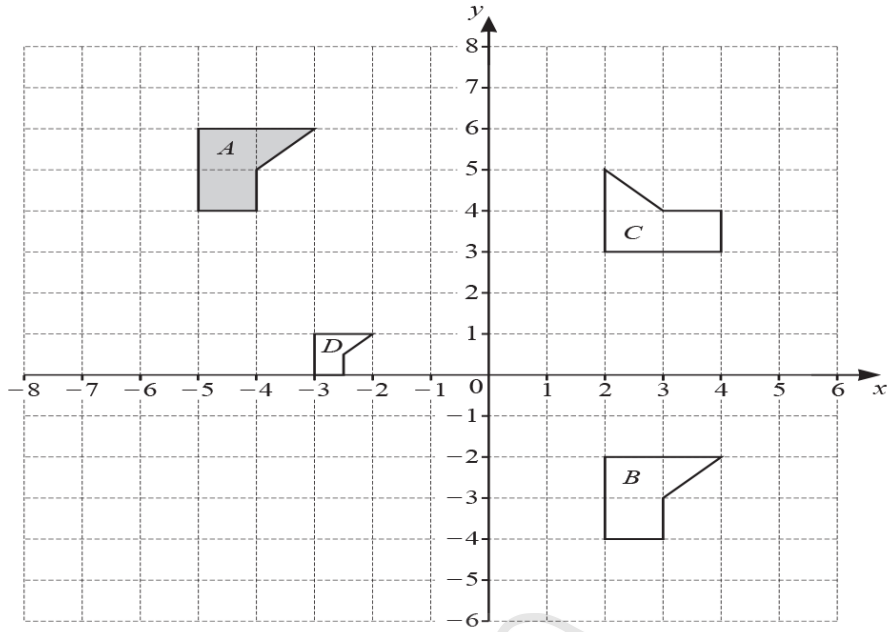


In triangle OGH, M is the midpoint of OH and K divides GH in the ratio 5 : 2.
$\overrightarrow{OG} = \mathbf{g}$ and $\overrightarrow{OH} = \mathbf{h}$.

Find $\overrightarrow{MK}$ in terms of $\mathbf{g}$ and $\mathbf{h}$.
Give your answer in its simplest form.

$\overrightarrow{MK} =$ ..... [4]

13. 0580_w22_qp_42 Q: 4



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

(i) shape A onto shape B,

.....

..... [2]

(ii) shape A onto shape C,

.....

..... [3]

(iii) shape A onto shape D.

.....

..... [3]

(b) On the grid, draw the image of shape A after a reflection in the line $y = x + 8$. [2]

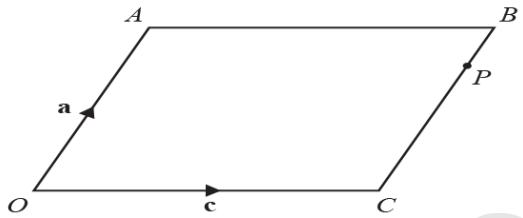
14. 0580_w22_qp_42 Q: 11

(a) $\left|\begin{pmatrix} 9m \\ 40m \end{pmatrix}\right| = \frac{205}{2}$

Find the two possible values of m.

$m =$ ..... or ..... [3]

(b)



$OABC$ is a parallelogram.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.
P is the point on CB such that $CP : PB = 3 : 1$.

(i) Find, in terms of **a** and/or **c**, in their simplest form,

(a) $\overrightarrow{AC}$,

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

(b) $\overrightarrow{CP}$,

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

(c) $\overrightarrow{OP}$.

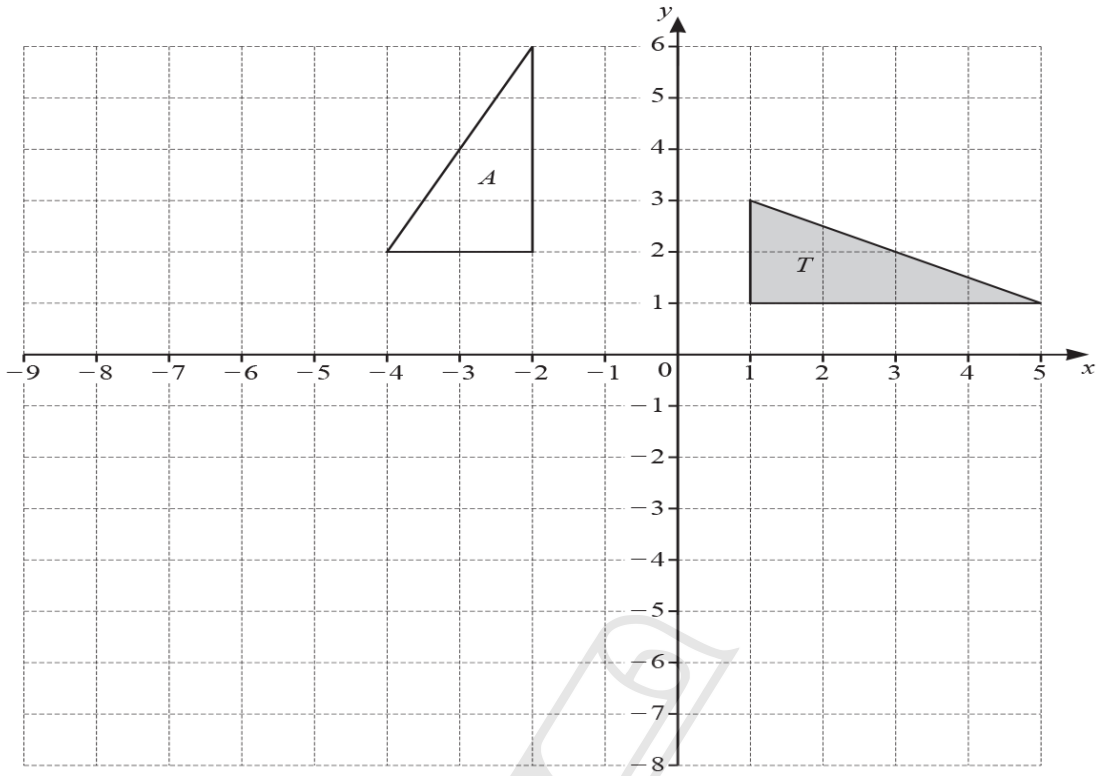
$\overrightarrow{OP} =$ ..... [1]

(ii) OP and AB are extended to meet at Q.

Find the position vector of Q.

..... [2]

15. 0580_w22_qp_43 Q: 4



(a) Draw the reflection of triangle T in the line $y = -2$. [2]

(b) Draw the enlargement of triangle T with scale factor $\frac{1}{2}$ and centre of enlargement $(-5, -3)$. [2]

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

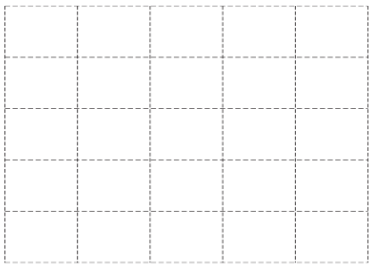
.....

..... [3]

16. 0580_w22_qp_43 Q: 10

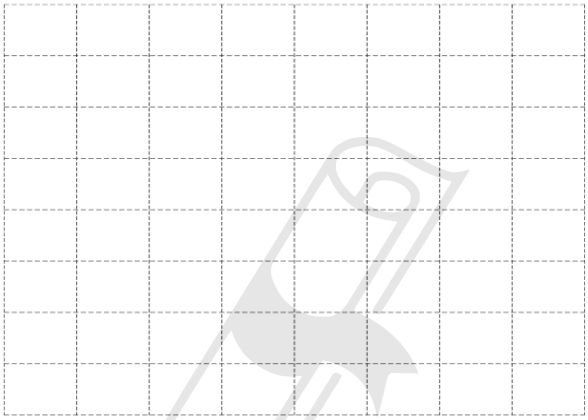
(a) $\mathbf{a} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$

(i) On the grid, draw and label vector $2\mathbf{a}$.



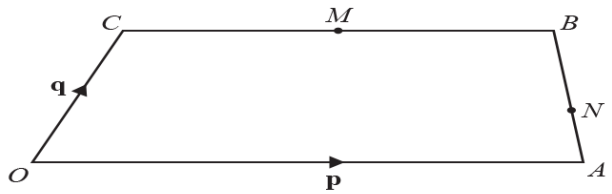
[1]

(ii) On the grid, draw and label vector $(\mathbf{a} - \mathbf{b})$.



[2]

(b)



$OABC$ is a trapezium with OA parallel to CB.
M is the midpoint of CB and N is the point on AB such that $AN : NB = 1 : 2$.
O is the origin, $\overrightarrow{OA} = \mathbf{p}$, $\overrightarrow{OC} = \mathbf{q}$ and $\overrightarrow{CB} = \frac{3}{4}\mathbf{p}$.

(i) Find, in terms of $\mathbf{p}$ and/or $\mathbf{q}$, in its simplest form

(a) $\overrightarrow{OB}$

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

(b) $\overrightarrow{AB}$

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

(c) $\overrightarrow{MN}$.

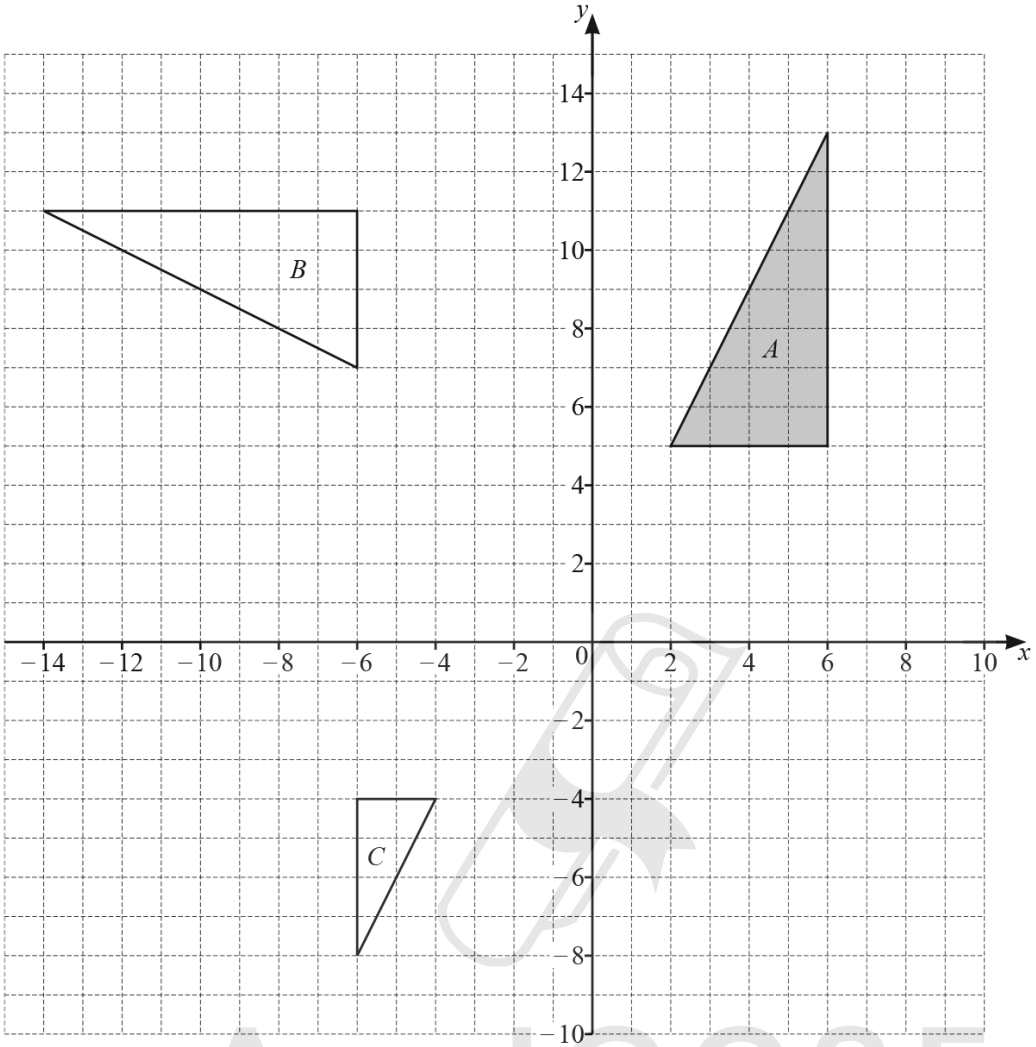
$\overrightarrow{MN} =$ ..... [3]

(ii) OA and MN are extended to meet at G.

Find the position vector of G in terms of $\mathbf{p}$.

..... [2]

17. 0580_m21_qp_42 Q: 2



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

(i) triangle A onto triangle B,

.....

..... [3]

(ii) triangle A onto triangle C.

.....

..... [3]

(b) Draw the image of triangle A after a translation by the vector $\begin{pmatrix} -5 \\ -10 \end{pmatrix}$. [2]

(c) Draw the image of triangle A after a reflection in the line $y = 4$. [2]

18. 0580_s21_qp_42 Q: 5

(a) $\mathbf{a} = \begin{pmatrix} -3 \\ 8 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 2 \\ -5 \end{pmatrix}$

(i) Find

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

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

(b) $2\mathbf{a} + \mathbf{b}$,

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

(c) $|\mathbf{b}|$.

..... [2]

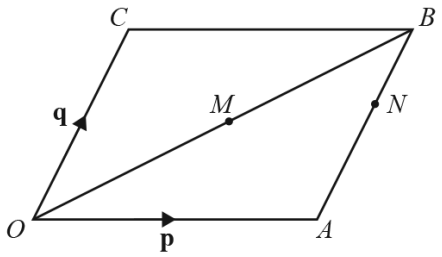
(ii) $\mathbf{a} + k\mathbf{b} = \begin{pmatrix} 13 \\ m \end{pmatrix}$, where k and m are integers.

Find the value of k and the value of m.

$k =$ .....

$m =$ ..... [3]

(b)



NOT TO SCALE

$OABC$ is a parallelogram and O is the origin.
M is the midpoint of OB.
N is the point on AB such that $AN : NB = 3 : 2$.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OC} = \mathbf{q}$.

(i) Find, in terms of **p** and **q**, in its simplest form.

(a) $\overrightarrow{OB}$

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

(b) $\overrightarrow{CM}$

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

(c) $\overrightarrow{MN}$

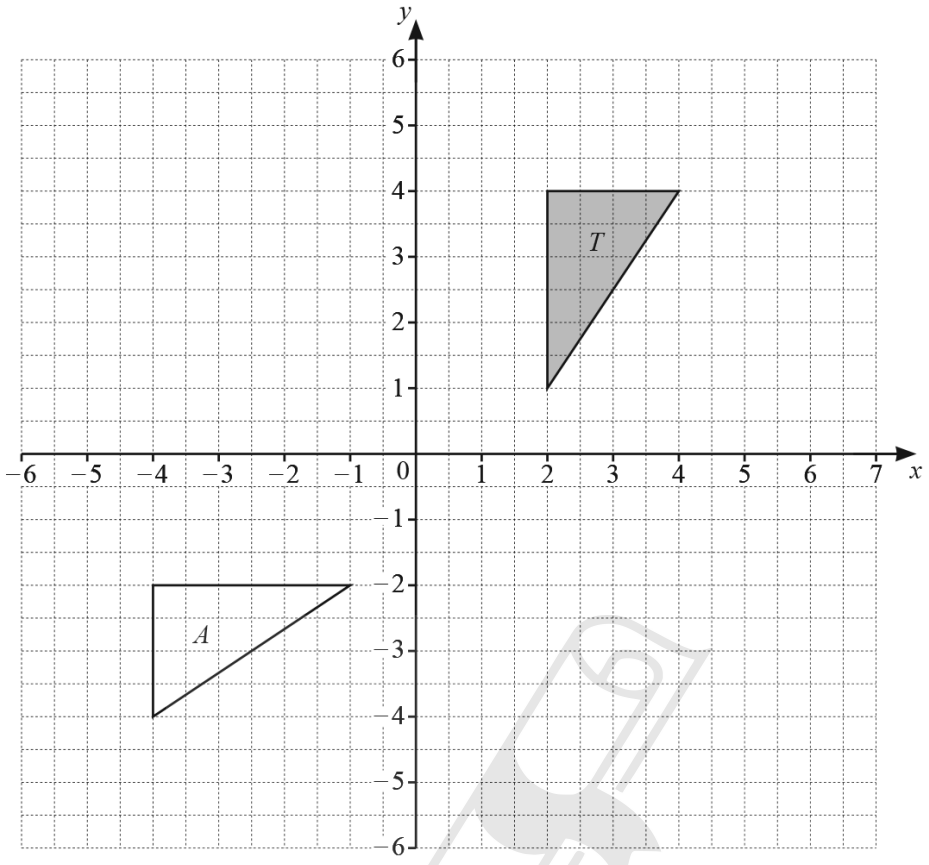
$\overrightarrow{MN} =$ ..... [2]

(ii) CB and ON are extended to meet at D.

Find the position vector of D in terms of **p** and **q**.
Give your answer in its simplest form.

..... [3]

19. 0580_s21_qp_42 Q: 7



(a) On the grid, draw the image of

(i) triangle T after a translation by the vector $\begin{pmatrix} 2 \\ -1 \end{pmatrix}$, [2]

(ii) triangle T after a rotation, 90° clockwise, about the origin, [2]

(iii) triangle T after an enlargement, scale factor $-\frac{1}{2}$, centre $(-2, 3)$. [2]

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

.....

..... [2]

20. 0580_s21_qp_43 Q: 4

(a) A is the point (1, 5) and B is the point (3, 9).
M is the midpoint of AB.

(i) Find the coordinates of M.

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

(ii) Find the equation of the line that is perpendicular to AB and passes through M.
Give your answer in the form $y = mx + c$.

$y =$ ..... [4]

(b) The position vector of P is $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and the position vector of Q is $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$.

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

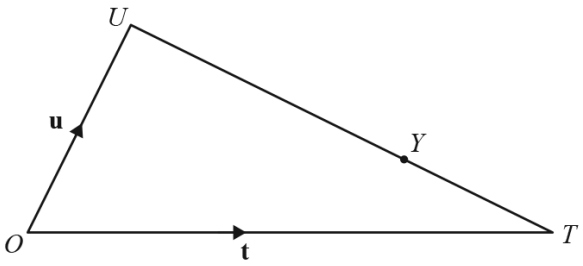
$\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [2]

(ii) R is the point such that $\overrightarrow{PR} = 3\overrightarrow{PQ}$.

Find the position vector of R.

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

(c)



NOT TO SCALE

$\overrightarrow{OT} = \mathbf{t}$, $\overrightarrow{OU} = \mathbf{u}$ and $UY = 2YT$.

(i) Find $\overrightarrow{OY}$ in terms of **t** and **u**.
Give your answer in its simplest form.

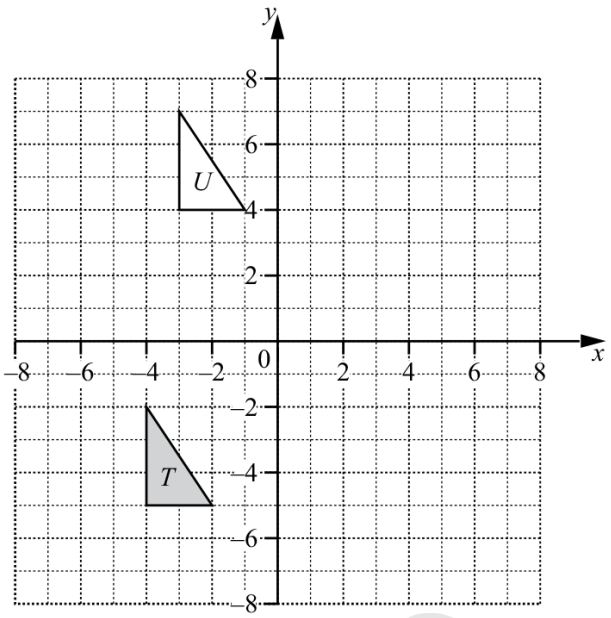
$\overrightarrow{OY}$ = ... [2]

(ii) Z is on OT and YZ is parallel to UO.

Find $\overrightarrow{OZ}$ in terms of **t** and/or **u**.
Give your answer in its simplest form.

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

21. 0580_p20_qp_40 Q: 4



(a) **(i)** Draw the reflection of triangle T in the line $x = 0$. [2]

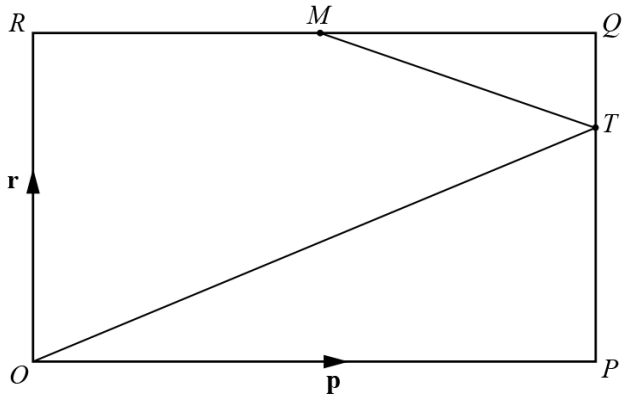
(ii) Draw the rotation of triangle T about $(-2, -1)$ through 90° clockwise. [2]

(b) Describe fully the **single** transformation that maps triangle T onto triangle U.

.....

..... [2]

22. 0580_p20_qp_40 Q: 6



NOT TO SCALE

$OPQR$ is a rectangle and O is the origin.
M is the midpoint of RQ and $PT : TQ = 2 : 1$.
$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OR} = \mathbf{r}$.

(a) Find, in terms of **p** and/or **r**, in its simplest form

(i) $\overrightarrow{MQ}$,

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

(ii) $\overrightarrow{MT}$,

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

(iii) $\overrightarrow{OT}$.

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

(b) RQ and OT are extended and meet at U.

Find the position vector of U in terms of **p** and **r**.
Give your answer in its simplest form.

..... [2]

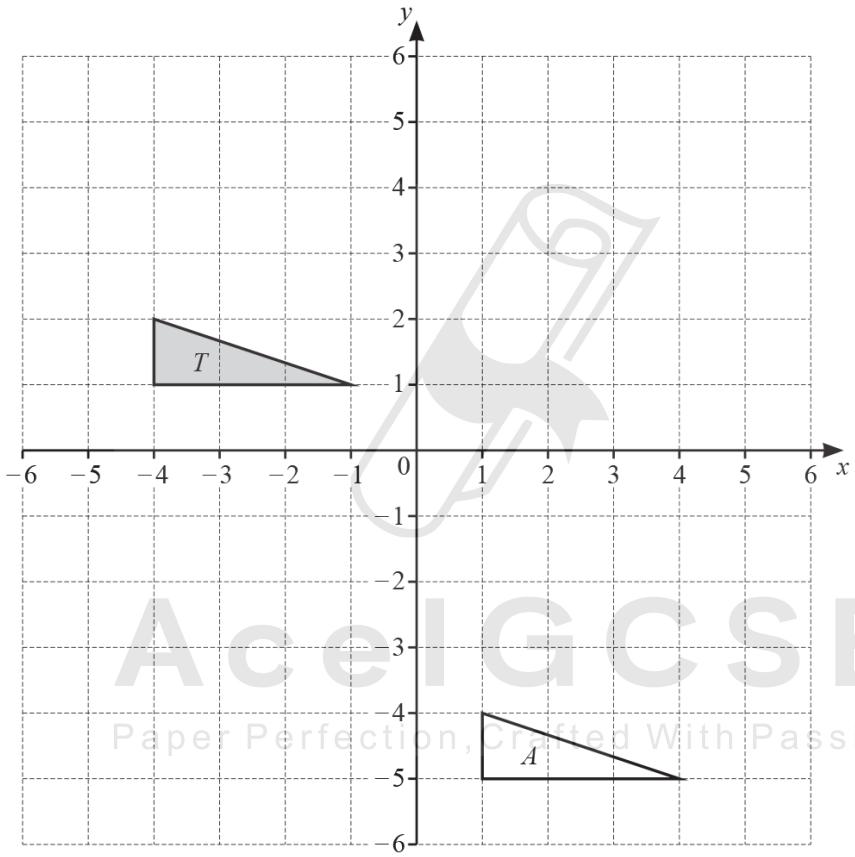
(c) $\overrightarrow{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$ and $|\overrightarrow{MT}| = \sqrt{180}$.

Find the positive value of k.

$k =$ ..... [3]

---

23. 0580_s20_qp_41 Q: 4



(a) Draw the image of triangle T after a reflection in the line $y = -1$. [2]

(b) Draw the image of triangle T after a rotation through 90° clockwise about (0, 0). [2]

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

.....

..... [2]

---

24. 0580_s20_qp_42 Q: 2

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

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

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

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

..... [2]

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

Find the coordinates of B.

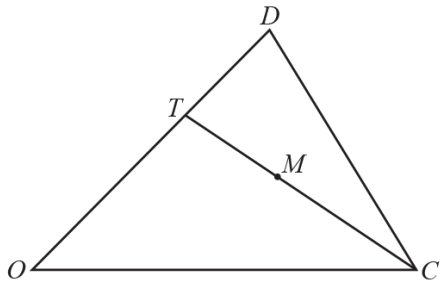
(..... , ...) [1]

(c) The line $y = 3x - 2$ crosses the y-axis at G.

Write down the coordinates of G.

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

(d)



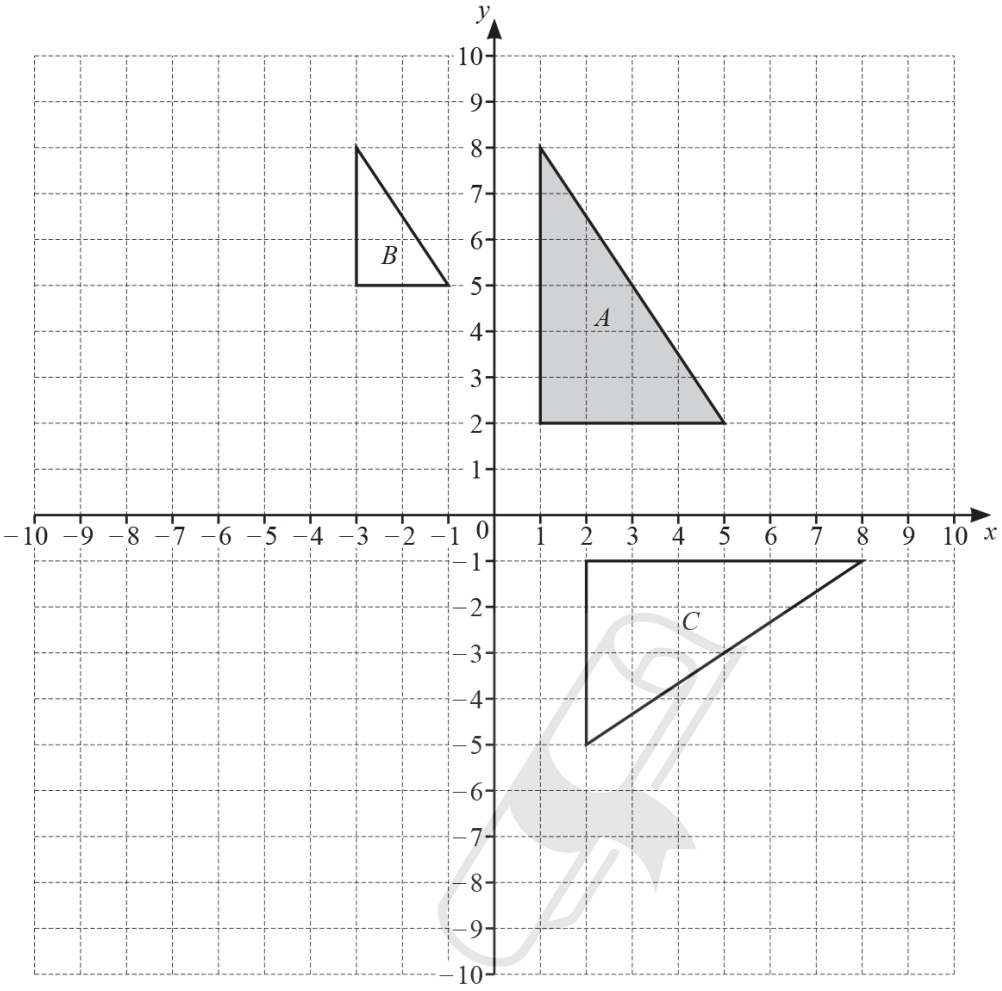
NOT TO SCALE

In the diagram, O is the origin, $OT = 2TD$ and M is the midpoint of TC.
$\overrightarrow{OC} = \mathbf{c}$ and $\overrightarrow{OD} = \mathbf{d}$.

Find the position vector of M.
Give your answer in terms of $\mathbf{c}$ and $\mathbf{d}$ in its simplest form.

..... [3]

25. 0580_s20_qp_43 Q: 2



(a) **(i)** Draw the image of triangle A after a reflection in the line $y = -x$. [2]

(ii) Draw the image of triangle A after a translation by the vector $\begin{pmatrix} -2 \\ -9 \end{pmatrix}$. [2]

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

(i) triangle A onto triangle B,

.....

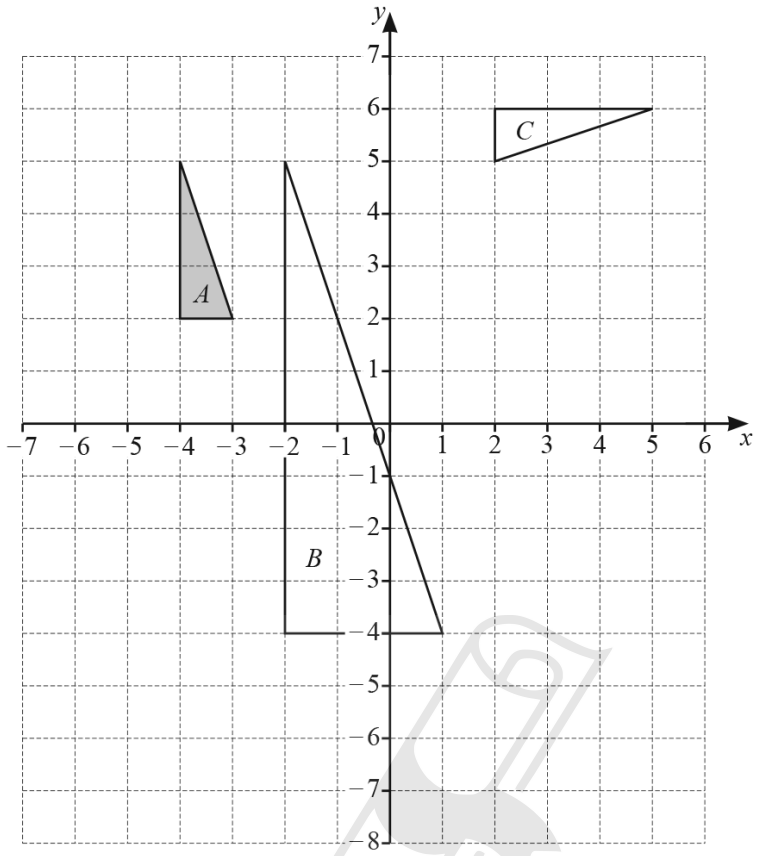
..... [3]

(ii) triangle A onto triangle C.

.....

..... [3]

26. 0580_w20_qp_41 Q: 1



(a) Draw the image of shape A after a translation by the vector $\begin{pmatrix} 8 \\ -6 \end{pmatrix}$. [2]

(b) Draw the image of shape A after a reflection in the line $y = -1$. [2]

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

.....

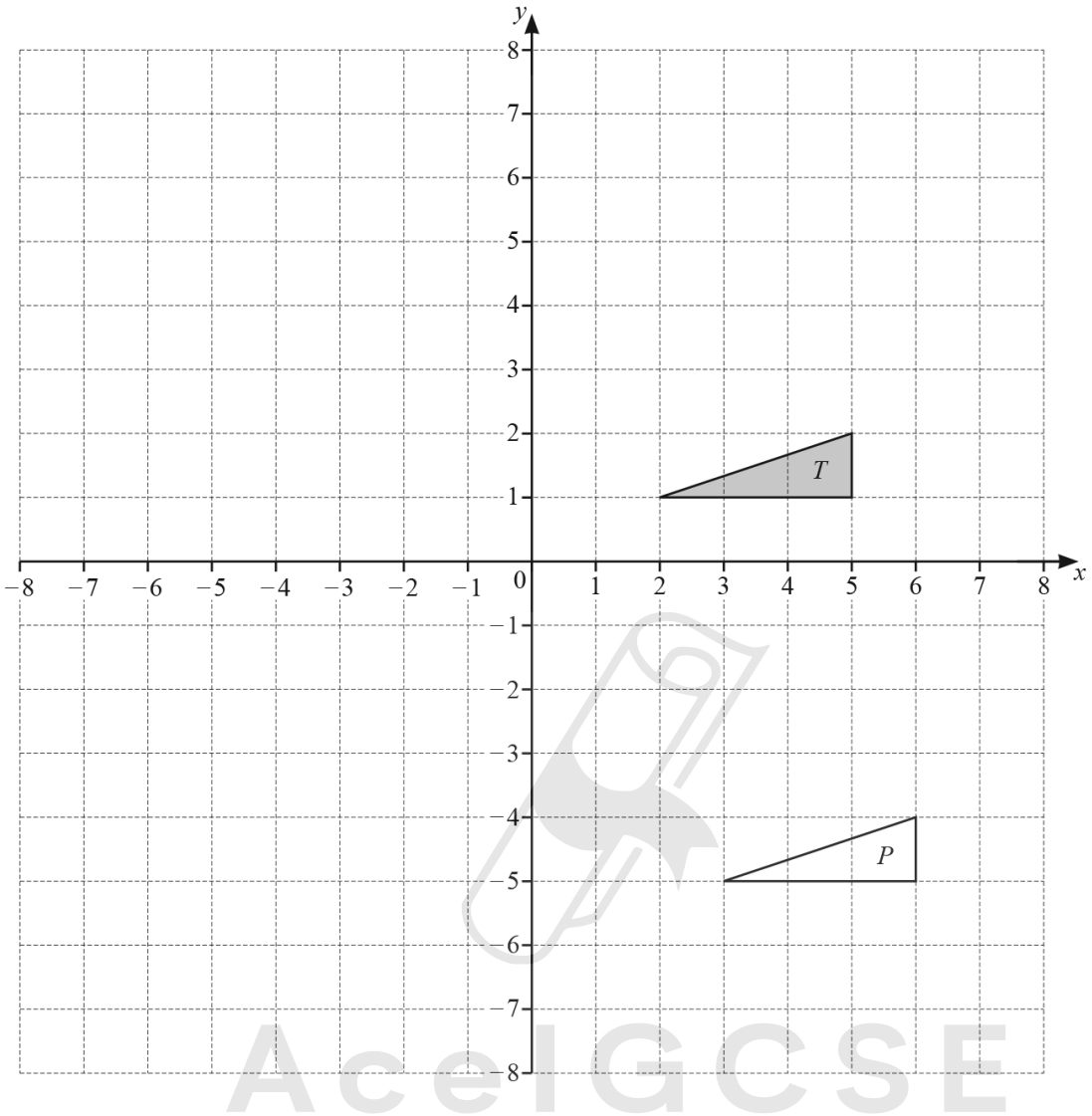
..... [3]

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

.....

..... [3]

27. 0580_w20_qp_42 Q: 2



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

.....

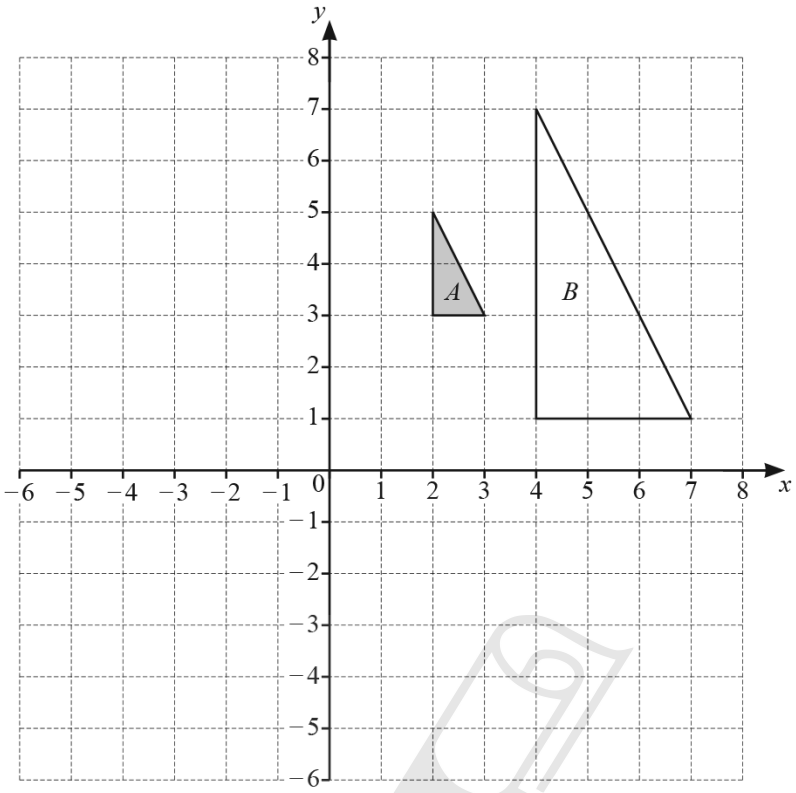
..... [2]

(b) **(i)** Reflect triangle T in the line $x = 1$. [2]

(ii) Rotate triangle T through 90° anticlockwise about (6, 0). [2]

(iii) Enlarge triangle T by a scale factor of −2, centre (1, 0). [2]

28. 0580_w20_qp_43 Q: 2



(a) On the grid, draw the image of

(i) triangle A after a rotation of 90° anticlockwise about (0, 0), [2]

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

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

.....

..... [3]

29. 0580_w20_qp_43 Q: 8

(a) $\overrightarrow{AB} = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

Find

(i) $\overrightarrow{AC}$,

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

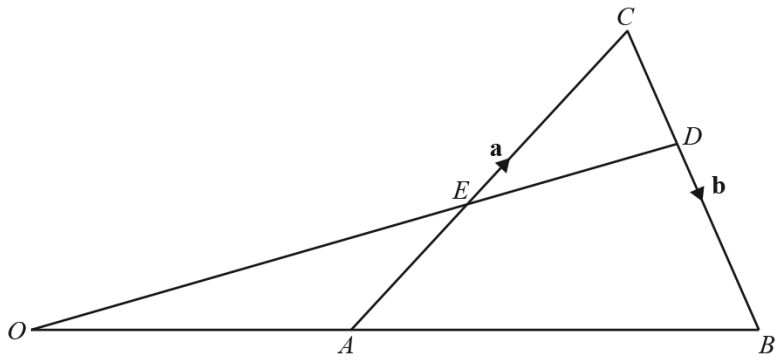
(ii) $\overrightarrow{BD}$,

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

(iii) $|\overrightarrow{BC}|$.

..... [2]

(b)



NOT TO SCALE

In the diagram, OAB and OED are straight lines.
O is the origin, A is the midpoint of OB and E is the midpoint of AC.
$\overrightarrow{AC} = \mathbf{a}$ and $\overrightarrow{CB} = \mathbf{b}$.

Find, in terms of **a** and **b**, in its simplest form

(i) $\overrightarrow{AB}$,

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

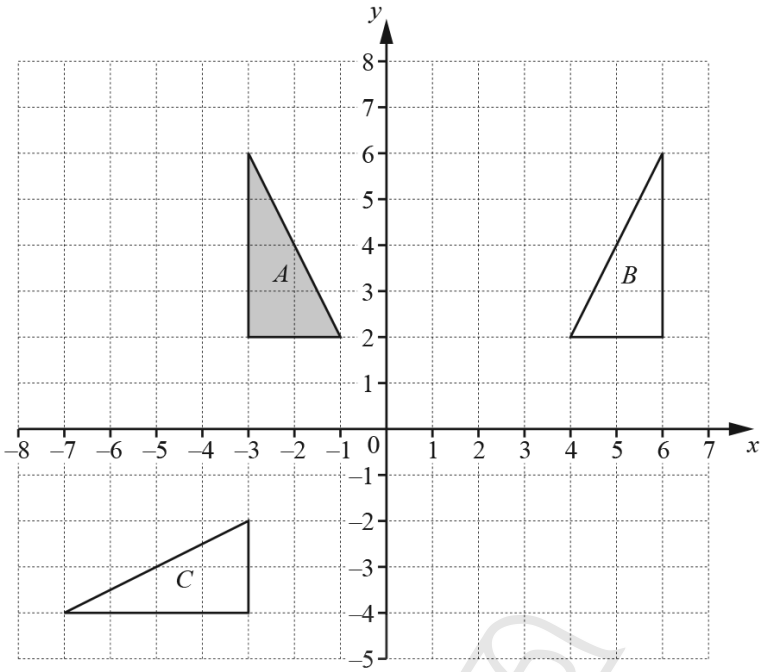
(ii) $\overrightarrow{OE}$,

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

(iii) the position vector of D.

..... [3]

30. 0580_m19_qp_42 Q: 2



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

(i) triangle A onto triangle B,

.....

..... [2]

(ii) triangle A onto triangle C.

.....

..... [3]

(b) On the grid, draw the image of

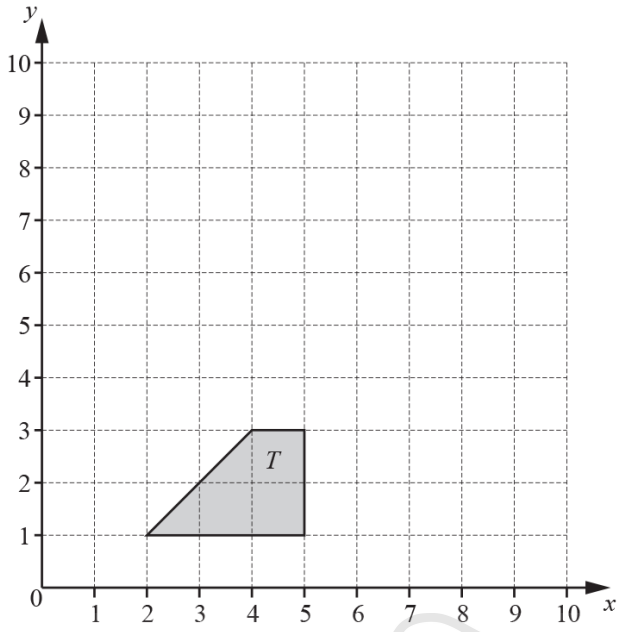
(i) triangle A after an enlargement, scale factor $-\frac{1}{2}$, centre (3, 0), [2]

(ii) triangle A after a translation by the vector $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$, [2]

(iii) triangle A after the transformation that is represented by the matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.

[3]

31. 0580_s19_qp_41 Q: 1



(a) **(i)** Translate shape T by the vector $\begin{pmatrix} -1 \\ 6 \end{pmatrix}$.

Label the image A. [2]

(ii) Rotate shape T about the point (5, 3) through 180°.
Label the image B. [2]

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

.....

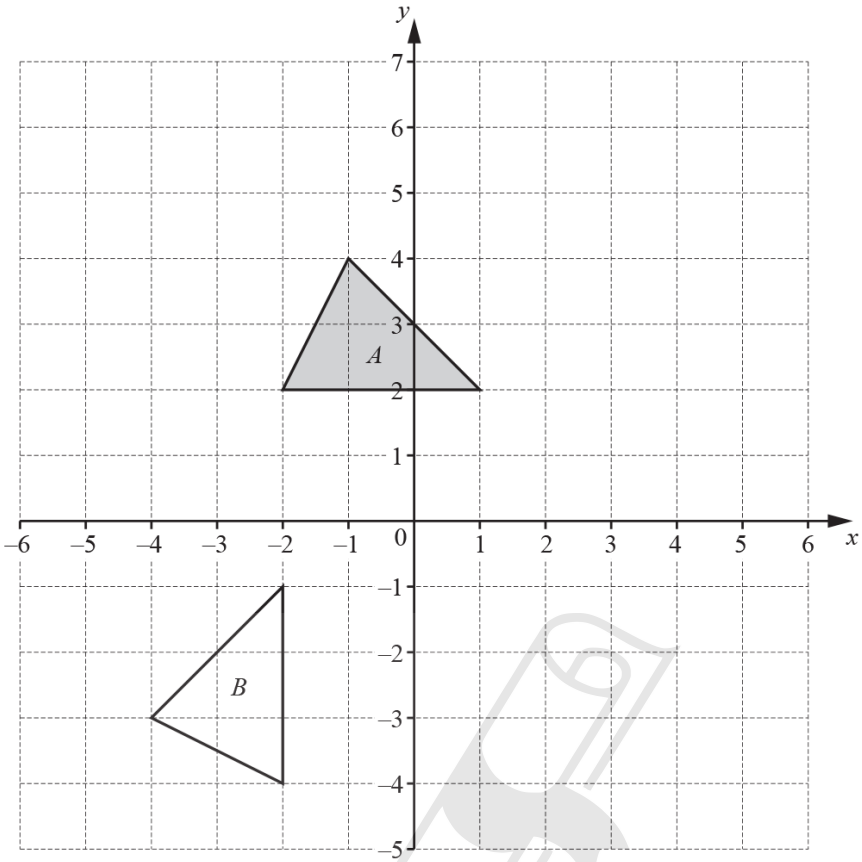
..... [3]

(b) **(i)** Reflect shape T in the line $y = x$. [2]

(ii) Find the matrix that represents the transformation in **part (b)(i)**.

( ) [2]

32. 0580_s19_qp_43 Q: 3



(a) On the grid, draw the image of

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

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

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

.....

..... [3]

(c) **(i)** Find the matrix that represents an enlargement, scale factor -2, centre (0, 0).

( ) [2]

(ii) Calculate the determinant of the matrix in **part (c)(i)**.

..... [1]

33. 0580_w19_qp_42 Q: 3

A line joins A (1, 3) to B (5, 8).

(a) **(i)** Find the midpoint of AB.

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

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

$y =$ ..... [3]

(b) The line AB is transformed to the line PQ.

Find the co-ordinates of P and the co-ordinates of Q after AB is transformed by

(i) a translation by the vector $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$,

P (..... , ...)

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

(ii) a rotation through 90° anticlockwise about the origin,

P (..... , ...)

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

(iii) a reflection in the line $x = 2$,

P (..... , ...)

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

(iv) a transformation by the matrix $\begin{pmatrix} -1 & 2 \\ 0 & -1 \end{pmatrix}$.

P (..... , ...)

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

(c) Describe fully the **single** transformation that maps the line AB onto the line PQ where P is the point $(-2, -6)$ and Q is the point $(-10, -16)$.

.....

..... [3]

34. 0580_w19_qp_42 Q: 8

(a) Make p the subject of

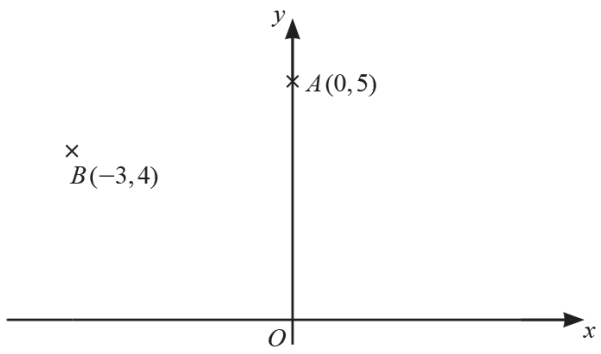
(i) $5p+7=m$,

$p =$ ..... [2]

(ii) $y^2-2p^2=h$.

$p =$ ..... [3]

(b)



NOT TO SCALE

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

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

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

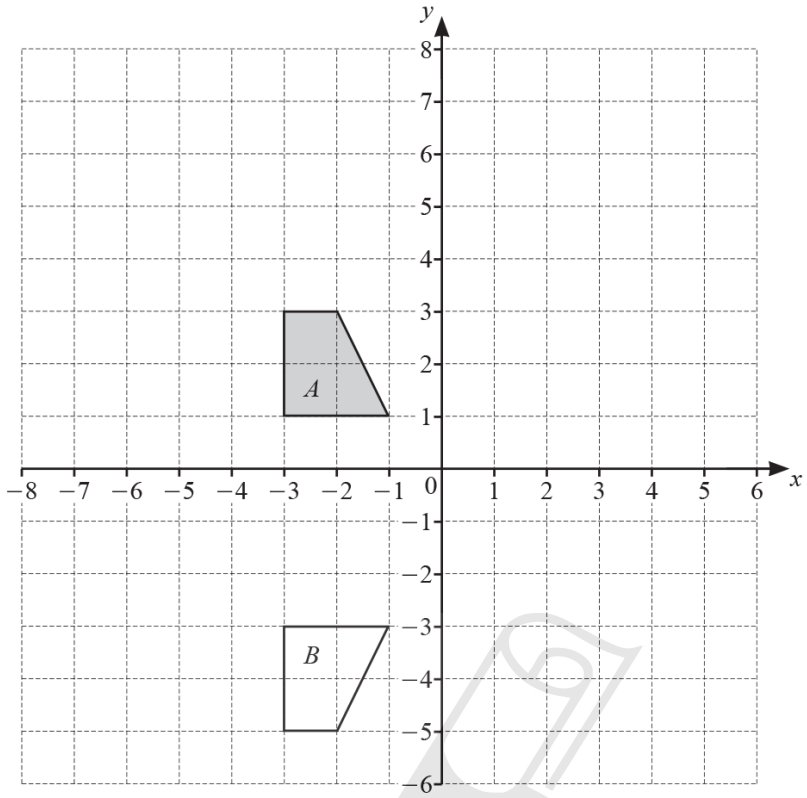
$\overrightarrow{AB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

(iii) A and B lie on a circle, centre O.

Calculate the length of the arc AB.

..... [6]

35. 0580_w19_qp_43 Q: 7



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

.....

..... [2]

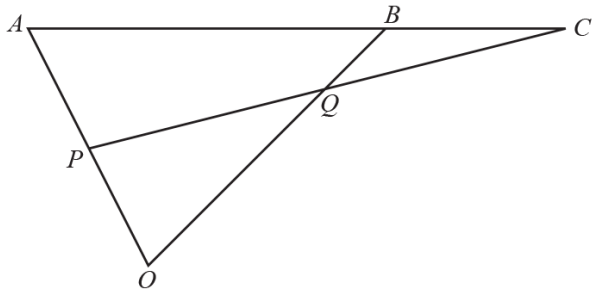
(b) On the grid, draw the image of

(i) shape A after a translation by the vector $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$, [2]

(ii) shape A after a rotation through 180° about (0, 0), [2]

(iii) shape A after an enlargement, scale factor 2, centre (−7, 0). [2]

36. 0580_w19_qp_43 Q: 11



NOT TO SCALE

OAB is a triangle and ABC and PQC are straight lines.
P is the midpoint of OA, Q is the midpoint of PC and $OQ : QB = 3 : 1$.
$\overrightarrow{OA} = 4\mathbf{a}$ and $\overrightarrow{OB} = 8\mathbf{b}$.

(a) Find, in terms of **a** and/or **b**, in its simplest form

(i) $\overrightarrow{AB}$,

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

(ii) $\overrightarrow{OQ}$,

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

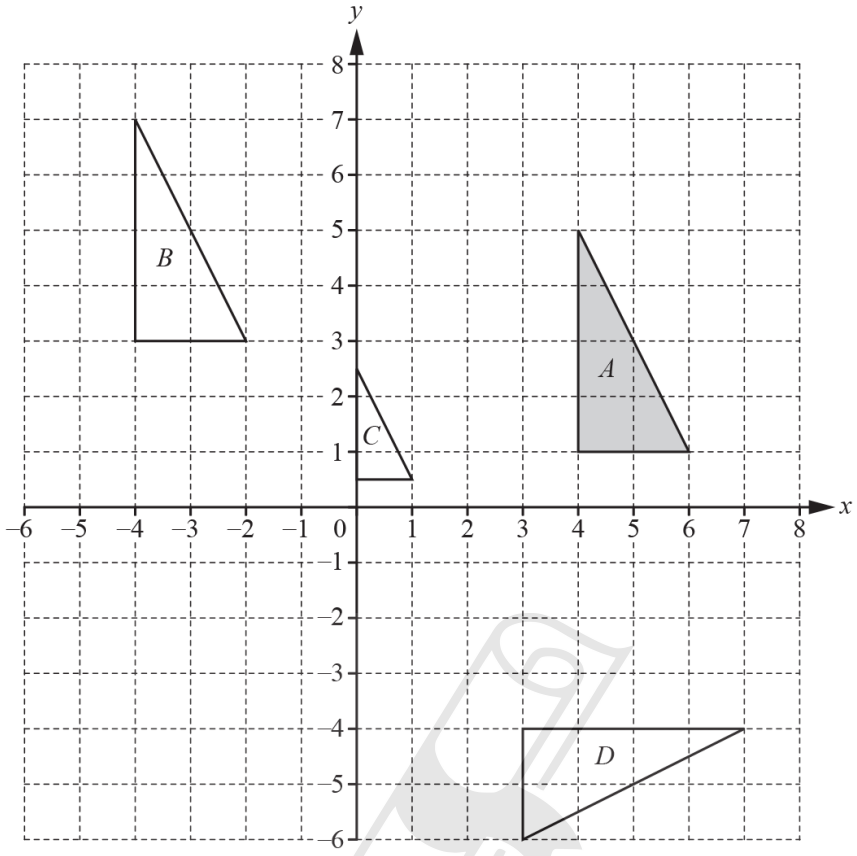
(iii) $\overrightarrow{PQ}$.

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

(b) By using vectors, find the ratio $AB : BC$.

..... : ..... [3]

37. 0580_s18_qp_41 Q: 4



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

(i) triangle A onto triangle B,

.....

..... [2]

(ii) triangle A onto triangle C,

.....

..... [3]

(iii) triangle A onto triangle D.

.....

..... [3]

(b) On the grid, draw the image of triangle A after an enlargement by scale factor 2, centre $(7, 3)$. [2]

38. 0580_s18_qp_41 Q: 11

(a) $\overrightarrow{OA} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ $\overrightarrow{AB} = \begin{pmatrix} 8 \\ -7 \end{pmatrix}$ $\overrightarrow{AC} = \begin{pmatrix} -3 \\ 6 \end{pmatrix}$

Find

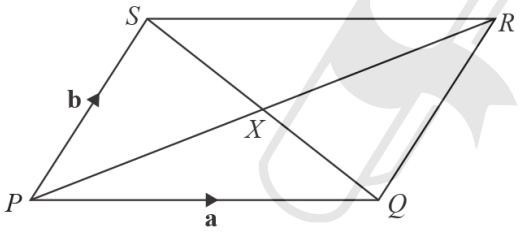
(i) $|\overrightarrow{OB}|$,

$|\overrightarrow{OB}| =$ ..... [3]

(ii) $\overrightarrow{BC}$.

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

(b)



NOT TO SCALE

$PQRS$ is a parallelogram with diagonals PR and SQ intersecting at X.
$\overrightarrow{PQ} = \mathbf{a}$ and $\overrightarrow{PS} = \mathbf{b}$.

Find $\overrightarrow{QX}$ in terms of **a** and **b**.
Give your answer in its simplest form.

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

(c) $\mathbf{M} = \begin{pmatrix} 2 & 5 \\ 1 & 8 \end{pmatrix}$

Calculate

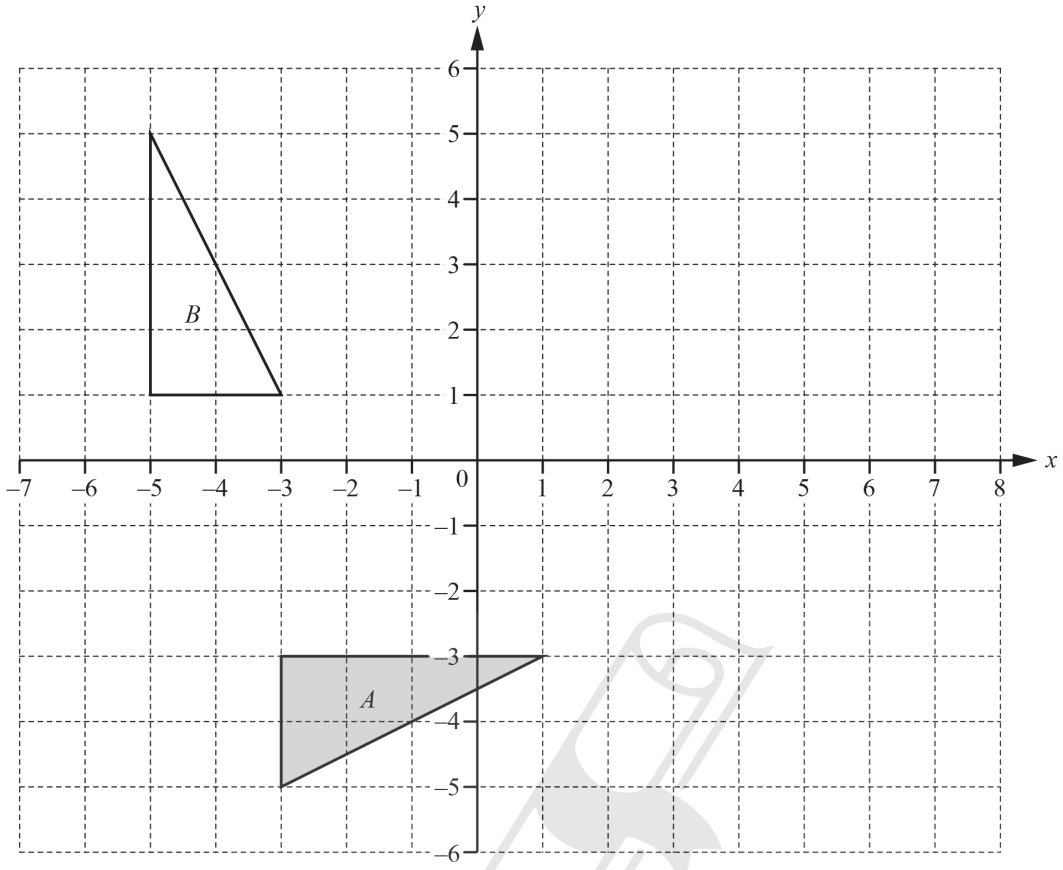
(i) $\mathbf{M}^2$,

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

(ii) $\mathbf{M}^{-1}$.

$\mathbf{M}^{-1} =$ $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

39. 0580_s18_qp_42 Q: 3



(a) **(i)** Draw the image of triangle A after a reflection in the line $x = 2$. [2]

(ii) Draw the image of triangle A after a translation by the vector $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$. [2]

(iii) Draw the image of triangle A after an enlargement by scale factor $-\frac{1}{2}$, centre (3, 1). [3]

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

.....

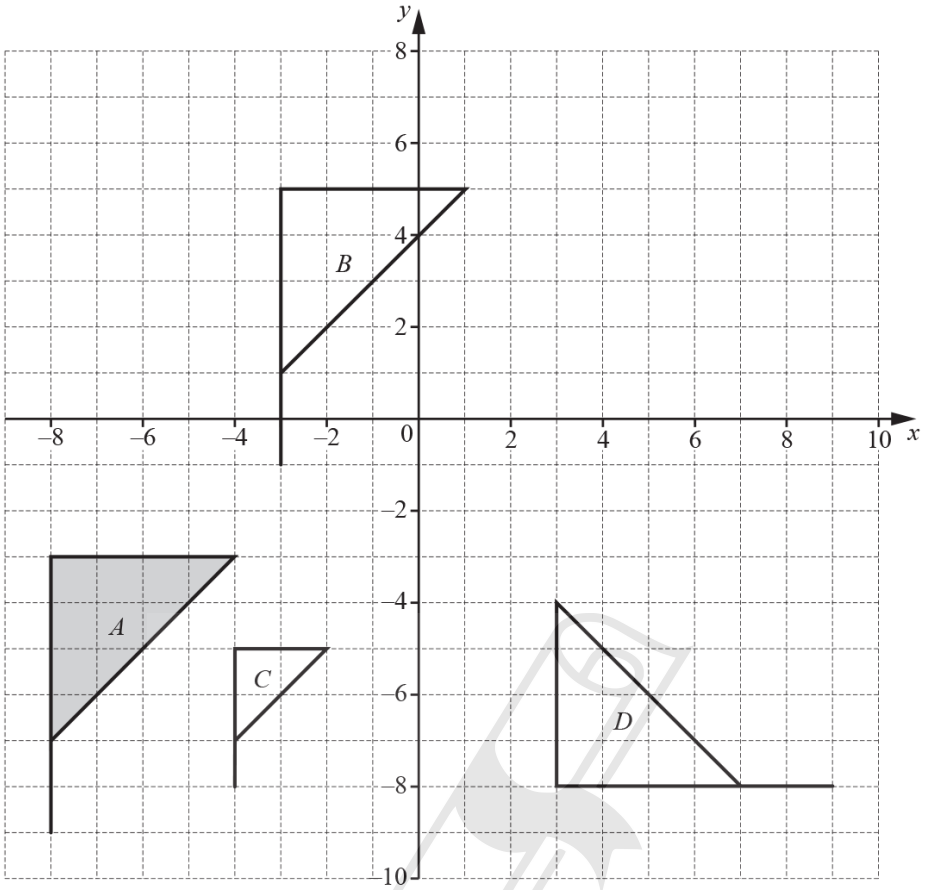
..... [3]

(c) Describe fully the **single** transformation represented by the matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$.

.....

..... [2]

40. 0580_w18_qp_41 Q: 2



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

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

.....

..... [2]

(ii) flag *A* onto flag *C*,

.....

..... [3]

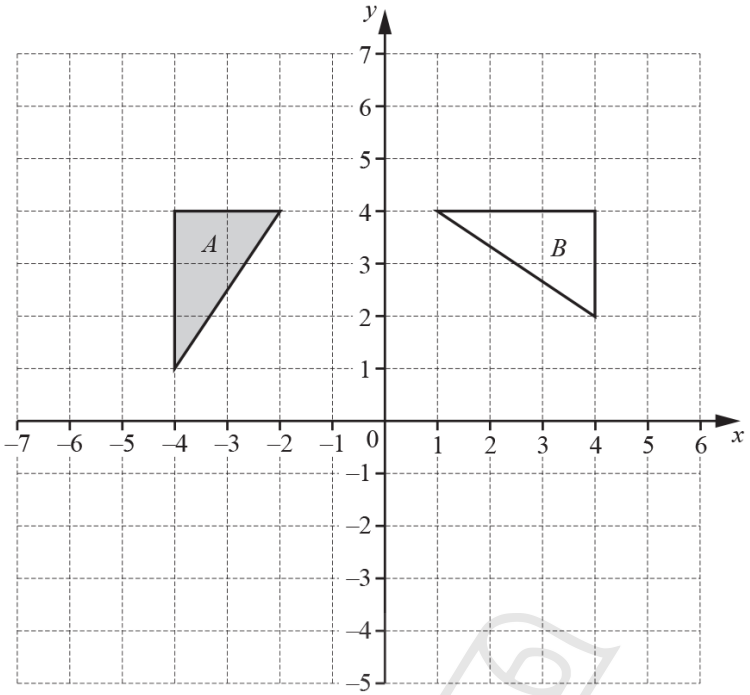
(iii) flag *A* onto flag *D*.

.....

..... [3]

(b) Draw the reflection of flag *A* in the line $y = -1$. [2]

41. 0580_w18_qp_42 Q: 3



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

.....

..... [3]

(b) On the grid, draw the image of

(i) triangle A after a reflection in the x-axis, [1]

(ii) triangle A after a translation by the vector $\begin{pmatrix} 7 \\ -5 \end{pmatrix}$, [2]

(iii) triangle A after the transformation represented by the matrix $\begin{pmatrix} 0.5 & 0 \\ 0 & 0.5 \end{pmatrix}$. [3]

42. 0580_w18_qp_42 Q: 11

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

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

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

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

..... [2]

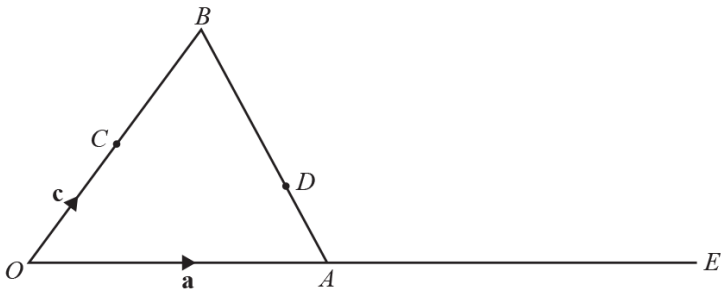
(iii) $m\mathbf{a} + n\mathbf{b} = \mathbf{c}$

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]

(b)



NOT TO SCALE

OAB is a triangle and C is the mid-point of OB.
D is on AB such that $AD : DB = 3 : 5$.
OAE is a straight line such that $OA : AE = 2 : 3$.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.

(i) Find, in terms of **a** and **c**, in its simplest form,

(a) $\overrightarrow{AB}$,

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

(b) $\overrightarrow{AD}$,

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

(c) $\overrightarrow{CE}$,

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

(d) $\overrightarrow{CD}$.

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

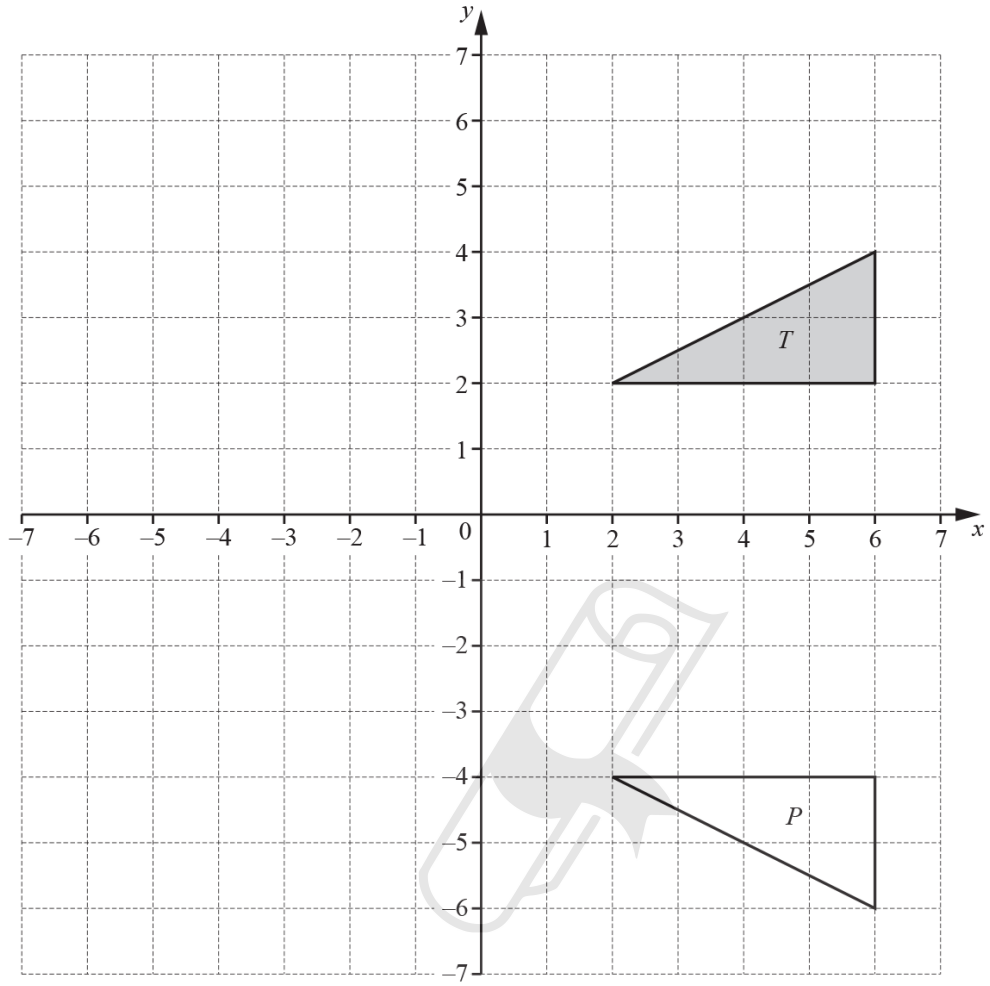
(ii) $\overrightarrow{CE} = k\overrightarrow{CD}$

Find the value of k.

$k =$ ..... [1]

43. 0580_w18_qp_43 Q: 1

(a)



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

.....

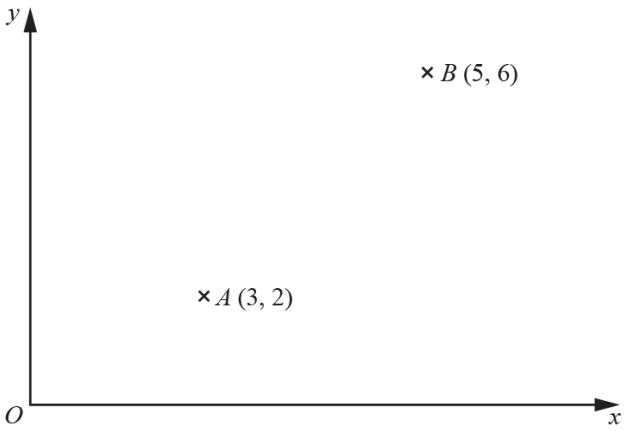
..... [2]

(ii) Translate triangle T by the vector $\begin{pmatrix}-2\\-5\end{pmatrix}$. [2]

(iii) Rotate triangle T through 90° anticlockwise about (0, 0). [2]

(iv) Enlarge triangle T by scale factor $-\frac{1}{2}$ with centre (0, 0). [2]

(b)



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

Find the co-ordinates of C.

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

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

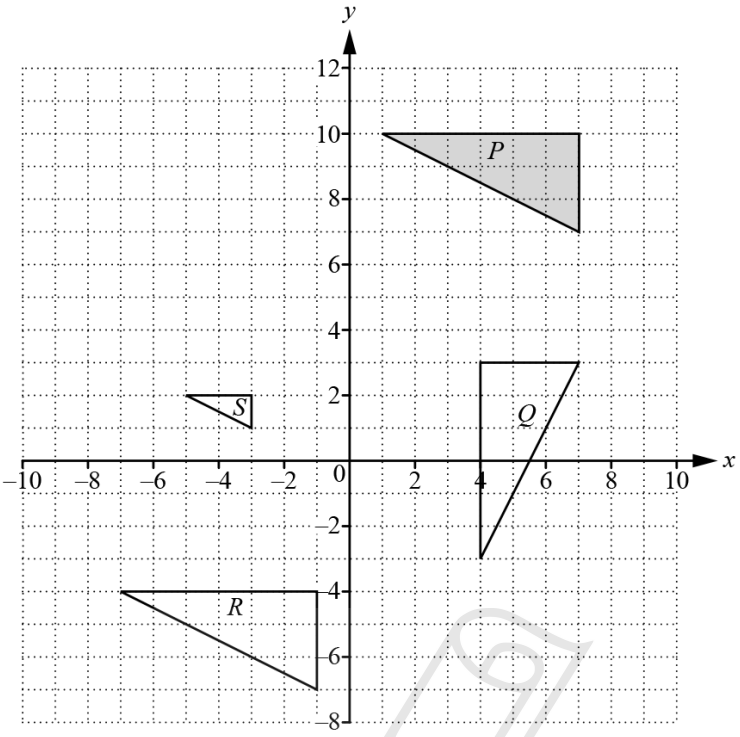
..... [3]

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

Write down the co-ordinates of D.

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

44 0580_m17_qp_42 Q: 2



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

(i) shape P onto shape Q,

.....

..... [3]

(ii) shape P onto shape R,

.....

..... [2]

(iii) shape P onto shape S.

.....

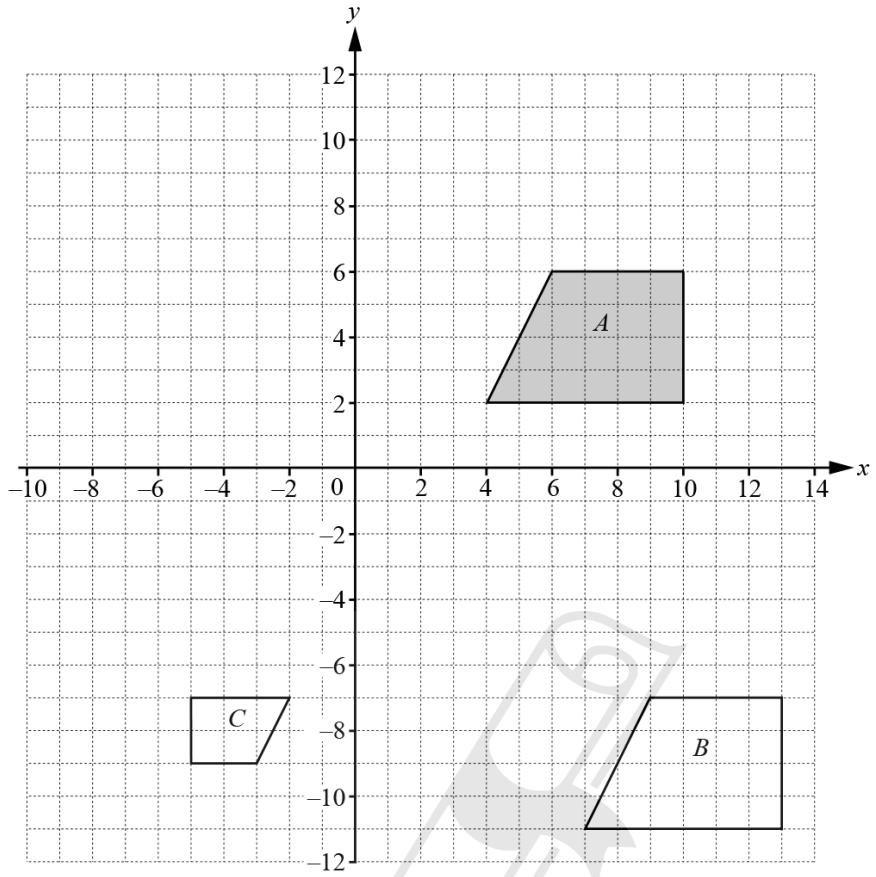
..... [3]

(b) **(i)** Draw the reflection of **shape S** in the line $y = x$. [2]

(ii) Write down the matrix that represents the transformation in **part (b)(i)**.

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

45. 0580_s17_qp_43 Q: 6



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

(i) shape *B*,

.....

..... [2]

(ii) shape *C*.

.....

..... [3]

(b) Draw the image of shape *A* after rotation through 90° anticlockwise about the point (3, −1). [2]

(c) Draw the image of shape *A* after reflection in $y = 1$. [2]

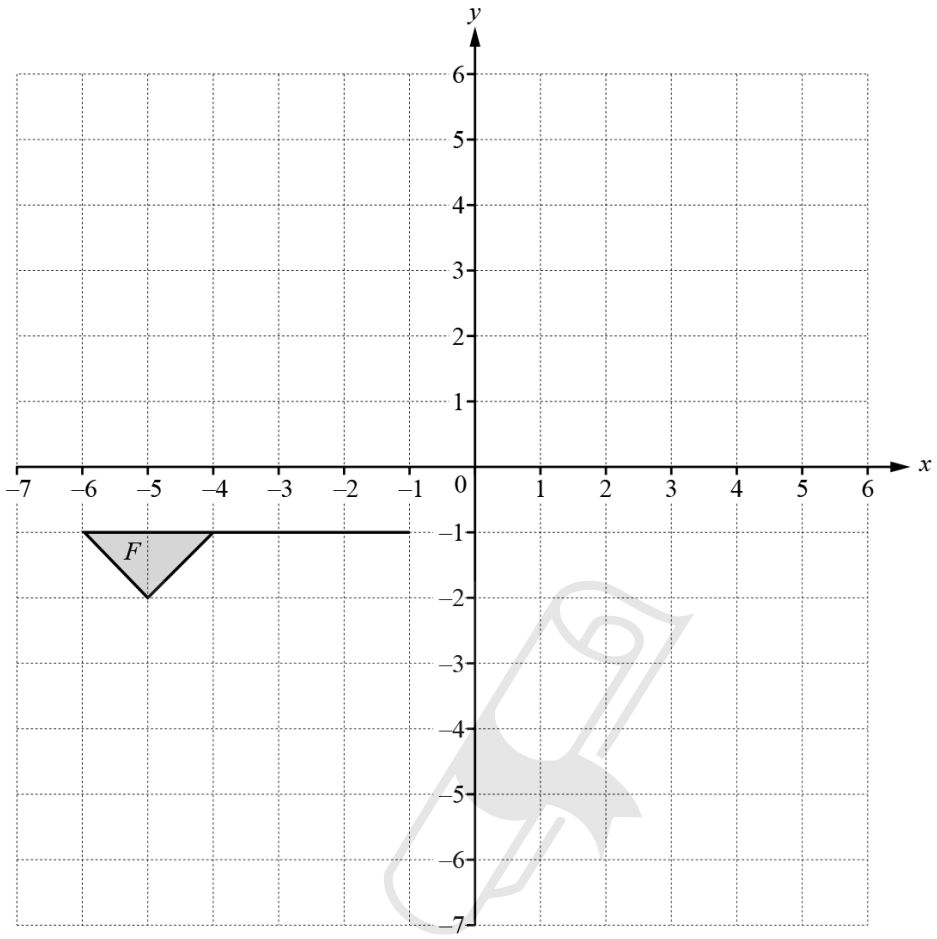
(d) Describe fully the **single** transformation represented by the matrix $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$.

.....

..... [3]

46. 0580_w17_qp_42 Q: 4

(a)



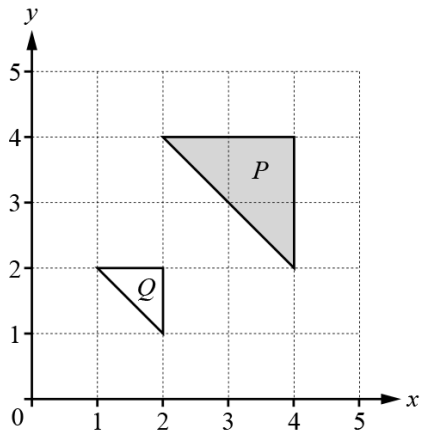
Draw the image of

(i) flag F after translation by the vector $\begin{pmatrix} 6 \\ -2 \end{pmatrix}$, [2]

(ii) flag F after rotation through 180° about $(-2, 0)$, [2]

(iii) flag F after reflection in the line $y = x$. [2]

(b)



(i) Describe fully the **single** transformation that maps triangle P onto triangle Q.

.....

..... [3]

(ii) Find the matrix that represents this transformation.

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

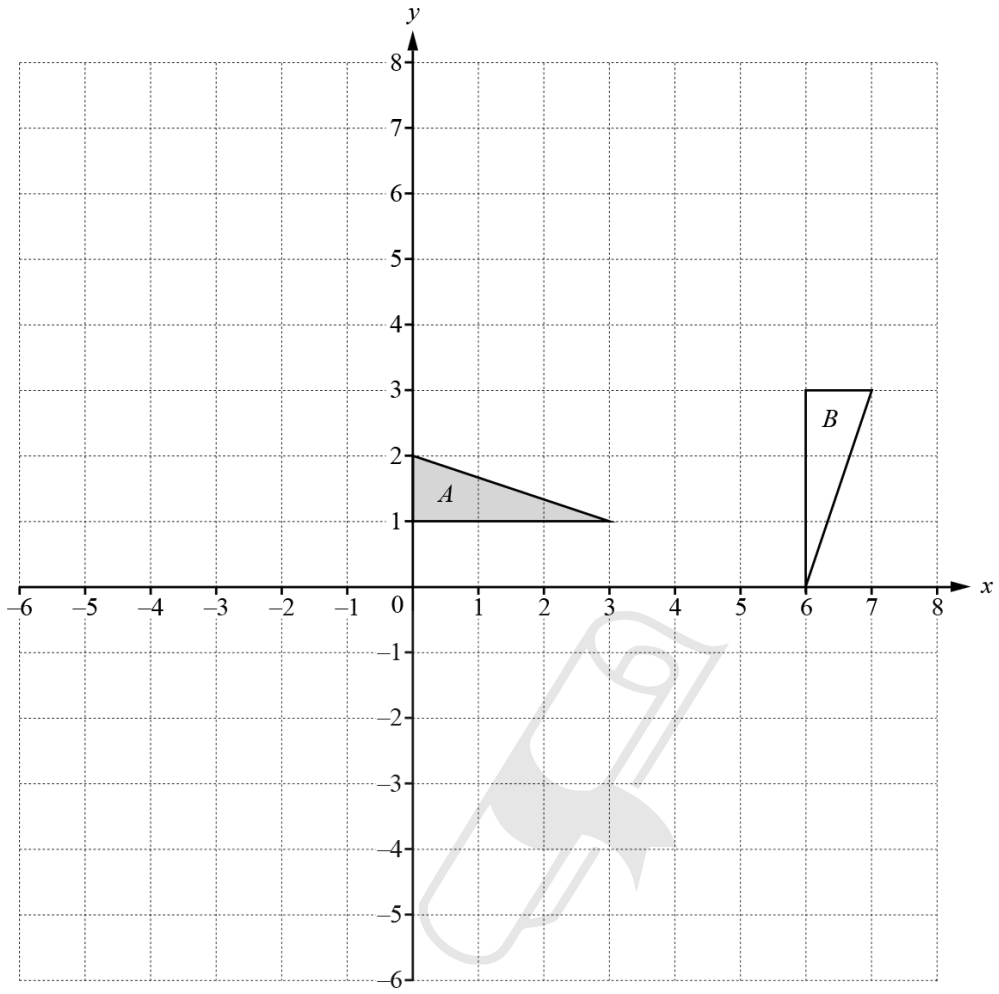
(c) The point A is translated to the point B by the vector $\begin{pmatrix} 4u \\ 3u \end{pmatrix}$.

$|\overrightarrow{AB}| = 12.5$

Find u.

$u =$ ..... [3]

47. 0580_w17_qp_43 Q: 5



(a) Draw the image of

(i) triangle A after a reflection in the line $x = 0$, [2]

(ii) triangle A after an enlargement, scale factor 2, centre (0, 4), [2]

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

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

.....

..... [3]

(c) $\mathbf{T} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ $\mathbf{U} = \begin{pmatrix} 3 & 1 \\ 0 & 2 \end{pmatrix}$

Point P has co-ordinates $(1, -4)$.

(i) Find $\mathbf{T}(P)$.

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

(ii) Find $\mathbf{TU}(P)$.

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

(iii) Describe the **single** transformation represented by the matrix **T**.

.....

..... [3]

01. 0580_m24_ms_42 Q: 7

Question	Answer	Marks	Partial Marks
(a)(i)	$\begin{pmatrix}-12\\15\end{pmatrix}$	1	
(a)(ii)(a)	$\begin{pmatrix}12\\-10\end{pmatrix}$	1	
(a)(ii)(b)	15.6 or 15.62…	2	**M1dep** for $their12^2+(their[-]10)^2$ oe, dep *their* $12 \neq 0$ and *their* $-10 \neq 0$
(b)	$\frac{3}{8}a+\frac{5}{8}b$ final answer	3	**B2** for an unsimplified correct answer or $MS=\frac{5}{8}(b-a)$ soi or $NS=\frac{3}{8}(-b+a)$ soi or **B1** for correct route for $\overrightarrow{OS}$ or for $MN = \mathbf{b} - \mathbf{a}$ or $NM = \mathbf{a} - \mathbf{b}$

02. 0580_s24_ms_41 Q: 2

Question	Answer	Marks	Partial Marks
(a)(i)	Triangle at (2, 1) (1, 3) (5, 3)	1	
(a)(ii)	Triangle at (–4, –5) (–3, –3) (0, –5)	2	**B1** for translation by $\begin{pmatrix}-5\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-2\end{pmatrix}$
(a)(iii)	Triangle at (–2.5, 2) (–4, 3) (–2, 3)	2	**B1** for enlargement by sf $-\frac{1}{2}$ with any centre
(b)	14.4	3	**M2** for [10 ×] $3^2 \times \left(\frac{2}{5}\right)^2$ oe or **M1** for 3^2 or $\left(\frac{2}{5}\right)^2$ soi

03. 0580_s24_ms_41 Q: 5

Question	Answer	Marks	Partial Marks
(a)(i)	$\begin{pmatrix} 4 \\ -12 \end{pmatrix}$	**2**	**B1** for each
(a)(ii)	$1^2 + 7^2$	**M1**	
	$5^2 + ([-]5)^2$	**M1**	
	Both $\sqrt{50}$ oe	**A1**	With no errors seen If M0M0A0 scored SC1 for $\sqrt{50}$ oe for each
(a)(iii)	44.4 or 44.42[8…] to 44.435	**2**	FT *their* **(a)(ii)** correct to 3sf or better **M1** for $2 \times \pi \times$ *their* $\sqrt{50}$ oe
(a)(iv)	(3, 1)	**2**	**B1** for each

Question	Answer	Marks	Partial Marks
(a)(v)	[$y =$] $\frac{1}{3}x$	4	**B3** for a correct equation in the wrong form as final answer Or **B2** for 1/3 stated or used as perpendicular gradient OR **M1** for [grad PQ] = $\frac{7--5}{1-5}$ oe **M1** for $\frac{-1}{their\ \text{grad}\ PQ}$ **M1dep** for substituting *their*(a)(iv) or (0,0) into y = *their* $mx + c$ oe dep on the 2nd M1 or B2
(b)	$\frac{3}{5}$ **a** + $\frac{2}{5}$ **b** final answer	4	**B3** for an unsimplified correct answer or **B2** for $AM = \frac{2}{5}(\boldsymbol{b} - \boldsymbol{a})$ soi or $BM = \frac{3}{5}(\boldsymbol{a} - \boldsymbol{b})$ soi or **B1** for AB = **b** – **a** or BA = **a** – **b** or for a correct route for OM or for correct diagram

04. 0580_m23_ms_42 Q: 4

Question	Answer	Marks	Partial Marks
(a)(i)	Triangle at (3, –1), (9, –1), (9, 2)	2	**B1** for correct shape, size and orientation or for correct plots but no triangle
(a)(ii)(a)	Triangle at (3, 3), (4, 3), (3, 5)	2	**B1** for correct shape size and orientation or for rotation about (4, 2) 90° anticlockwise or for correct plots but no triangle
(a)(ii)(b)	Triangle at (4, 3), (5, 3), (5, 5)	3	**B2** for correct shape size and orientation or for correct plots but no triangle or **M1** for $x + y = 6$ drawn
(a)(ii)(c)	Reflection $x = 4$	2	**B1** for each

Question	Answer	Marks	Partial Marks
(b)	$\frac{5}{7}\mathbf{a}+\frac{2}{7}\mathbf{b}$ final answer	3	**B2** for correct unsimplified answer OR **M2** for $\overrightarrow{HZ}=\frac{2}{7}(\mathbf{b}-\mathbf{a})$ or $\overrightarrow{KZ}=\frac{5}{7}(\mathbf{a}-\mathbf{b})$ oe or **M1** for $\overrightarrow{HK}=-\mathbf{a}+\mathbf{b}$ or $\overrightarrow{KH}=-\mathbf{b}+\mathbf{a}$ or for a correct route

05. 0580_w23_ms_41 Q: 1

Question	Answer	Marks	Partial Marks
(a)(i)	Translation $\begin{pmatrix}-7\\-1\end{pmatrix}$ oe	2	**B1** for each
(a)(ii)	Rotation 90° clockwise oe (5, 1)	3	**B1** for each
(b)(i)	Image at (2, 6) (3, 6) (3, 8)	2	**B1** for reflection in $y = k$, $k \neq 2$ or for reflection in $x = 2$
(b)(ii)	Image at (–4, 4) (–6, 4) (–6, 8)	2	**B1** for an enlargement, sf –2 in the wrong position

06. 0580_w23_ms_41 Q: 10

Question	Answer	Marks	Partial Marks
(a)(i)	(15, 6)	**2**	**B1** for each
(a)(ii)	$\begin{pmatrix} 3 \\ 24 \end{pmatrix}$	**1**	
(a)(iii)	13.6 or 13.60…	**2**	**M1** for $(-11)^2 + 8^2$ oe
(b)(i)	$\mathbf{a} + \frac{3}{5}(\mathbf{b} - \mathbf{a})$ or $\mathbf{b} + \frac{2}{5}(\mathbf{a} - \mathbf{b})$ leading to $\frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$ with no errors	**M3**	**M2** for $[\overrightarrow{MR} =] \frac{3}{5}(\mathbf{b} - \mathbf{a})$ oe or $[\overrightarrow{NR} =] \frac{2}{5}(\mathbf{a} - \mathbf{b})$ oe or **M1** for $\overrightarrow{MN} = \mathbf{b} - \mathbf{a}$ or $\overrightarrow{NM} = \mathbf{a} - \mathbf{b}$ or a correct route for $\overrightarrow{OR}$
(b)(ii)(a)	$k = 5$, $c = 10$	**4**	**B2** for $c = 10$ or **M1** for $c(\frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}) = \mathbf{b} + 4\mathbf{a} + k\mathbf{b}$ oe or for $\frac{2}{5}c = 4$ and **M1** for $\frac{3}{5} \times$ *their* $c = k + 1$
(b)(ii)(b)	$3\mathbf{a} + 6\mathbf{b}$ final answer	**1**	**FT** $3\boldsymbol{a} + (\textit{their } k + 1)\boldsymbol{b}$

07. 0580_w23_ms_42 Q: 1

Question	Answer	Marks	Partial Marks
(a)(i)	Image at (–5, 3), (–1, 3), (–1, 5)	2	**B1** for translation $\begin{pmatrix}-7\\k\end{pmatrix}$ or $\begin{pmatrix}k\\1\end{pmatrix}$
(a)(ii)	Translation $\begin{pmatrix}7\\-1\end{pmatrix}$ cao	1	
(b)	Image at (6, 4), (6, 6), (2, 6)	2	**B1** for reflection in line $x = 4$ or for reflection in line $y = k$
(c)	Image at (2, –2), (2, –6), (4, –6)	2	**B1** for correct size and orientation or for rotation 90° anticlockwise about (0, 0)
(d)(i)	Image at (–1, –1), (–3, –1), (–3, –2)	2	**B1** for correct size and orientation or for enlargement SF $\frac{1}{2}$, centre (0, 0)
(d)(ii)	Enlargement and [centre] (0, 0) [factor] –2	2	**B1** for Enlargement **and** [centre] (0, 0) **B1** for [factor] –2

08. 0580_w23_ms_42 Q: 12

Question	Answer	Marks	Partial Marks
(a)(i)	$\begin{pmatrix}2\\5\end{pmatrix}$	1	
(a)(ii)	$\begin{pmatrix}-6\\4\end{pmatrix}$	1	
(b)	$[y =] -\frac{2}{3}x + \frac{19}{3}$ oe	3	**M1** for gradient = $\frac{1-5}{8-2}$ oe **M1** for substituting (8, 1) or (2, 5) into $y = $ *their* $mx + c$
(c)	$[y =] \frac{3}{2}x - \frac{9}{2}$ oe	4	**B1** for (5, 3) oe **M1** for gradient = $-\frac{1}{\textit{their}\text{ gradient of }AB}$ **M1** substituting *their* midpoint into $y =$ *their* $mx + c$
(d)	$\frac{65}{6}$ oe	2	**M1** for *their* $\frac{19}{3}$ – *their* $-\frac{9}{2}$ oe

09. 0580_w23_ms_43 Q: 3

Question	Answer	Marks	Partial Marks
(a)	Rotation 90° [anticlockwise] oe (2, 7)	**3**	**B1** for each
(b)(i)	Image at (–4, –1), (–3, –1), (–4, –4)	**2**	**B1** for reflection in $y = k$ or $x = 1$
(b)(ii)	Image at (2, –4), (1, –4), (1, –1)	**2**	**B1** for translation by $\begin{pmatrix} 5 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -7 \end{pmatrix}$
(b)(iii)	Image at (–4, 7), (–4, 1), (–2, 1)	**2**	**B1** for enlargement, factor 2 with other centre

10. 0580_s22_ms_42 Q: 5

Question	Answer	Marks	Partial Marks
(a)	Correct lines drawn	**2**	**B1** for one correct with no incorrect lines
(b)(i)(a)	Translation or translate $\begin{pmatrix} -1 \\ 4 \end{pmatrix}$ oe	**2**	**B1** for each
(b)(i)(b)	Rotation or rotate 90 [anticlockwise] oe [centre] (2, 1)	**3**	**B1** for each
(b)(ii)(a)	Triangle at (– 5, 6) (– 2, 6) (– 2, 5)	**2**	**B1** for reflection in $y = k$

Question	Answer	Marks	Partial Marks
(b)(ii)(b)	Triangle at (1, 5) (1, 7) (7, 7)	**2**	**B1** for correct size and orientation, wrong position

11. 0580_s22_ms_43 Q: 2

Question	Answer	Marks	Partial Marks
(a)(i)	Triangle drawn at (2, – 1), (2, – 4), (3, – 4)	2	**B1** for two correct points If 0 scored, **SC1** for reflection of triangle T in $y = -x$
(a)(ii)	Triangle drawn at (– 5, 6), (– 2, 5), (– 5, 5)	2	**B1** for translation by $\begin{pmatrix}-1\\k\end{pmatrix}$ or by $\begin{pmatrix}k\\3\end{pmatrix}$ If 0 scored **SC1** for triangle drawn at (–4.5, 3.5), (–4.5, 4.5) and (–1.5, 3.5)
(a)(iii)	Enlargement [SF] – 1.5 oe [centre] (0, 3)	3	**B1** for each
(b)	$28.8, 28\frac{8}{10}, 28\frac{4}{5}$	2	**M1** for 1.2^2 oe

12. 0580_w22_ms_41 Q: 6

Question	Answer	Marks	Partial Marks
(a)(i)	$\begin{pmatrix}-3\\3\end{pmatrix}$	1	
(a)(ii)	$\begin{pmatrix}3\\2\end{pmatrix}$	1	
(a)(iii)	3.61 or 3.605 to 3.606	2	**M1** for $2^2 + 3^2$ oe
(b)	(6, 1)	2	**B1** for each

Question	Answer	Marks	Partial Marks
(c)	$\frac{2}{7}\mathbf{g} + \frac{3}{14}\mathbf{h}$	4	**B3** for correct unsimplified expression for $\overrightarrow{MK}$ or **B2** for $[\overrightarrow{MK} =] \frac{2}{7}\mathbf{g} + k\mathbf{h}$ or $[\overrightarrow{MK} =] k\mathbf{g} + \frac{3}{14}\mathbf{h}$ or $\overrightarrow{HK} = \frac{2}{7}(\mathbf{g} - \mathbf{h})$ oe or $\overrightarrow{GK} = \frac{5}{7}(\mathbf{h} - \mathbf{g})$ oe or **M1** for correct route for $\overrightarrow{MK}$

13. 0580_w22_ms_42 Q: 4

Question	Answer	Marks	Partial Marks
(a)(i)	Translation $\begin{pmatrix} 7 \\ -8 \end{pmatrix}$ oe	2	**B1** for each
(a)(ii)	Rotation 90° [anticlockwise] oe (0, 8)	3	**B1** for each
(a)(iii)	Enlargement [sf] $\frac{1}{2}$ oe [centre] (–1, –4)	3	**B1** for each
(b)	Image at (–4, 4) (–3, 4) (–2, 5) (–2, 3) (–4, 3)	2	**B1** for the line $y = x + 8$ drawn soi long enough to be fit for purpose or correct size and orientation but wrong position

14. 0580_w22_ms_42 Q: 11

Question	Answer	Marks	Partial Marks
(a)	2.5 and – 2.5 oe	3	**M2** for $1681m^2 = \frac{42025}{4}$ oe or **M1** for $(9m)^2 + (40m)^2$ oe
(b)(i)(a)	**c** – **a** final answer	1	
(b)(i)(b)	$\frac{3}{4}$ **a** final answer	1	
(b)(i)(c)	**c** + $\frac{3}{4}$ **a** final answer	1	**FT c** + *their* **(b)(i)(b)**, must be a vector in terms of **a** and/or **c** in its simplest form
(b)(ii)	**a** + $\frac{4}{3}$ **c** oe	2	**B1** for $[\overrightarrow{BQ} =]\ \frac{1}{3}$ **c** or $[\overrightarrow{AQ} =]\ \frac{4}{3}$ **c** or **M1** for a correct route or for answer **a** + k**c** oe, where $k > 1$

15. 0580_w22_ms_43 Q: 4

Question	Answer	Marks	Partial Marks
(a)	Triangle drawn at (1, – 5), (1, – 7), (5, – 5)	2	**B1** for reflection in any horizontal line If 0 scored, **SC1** for reflection in $x = -2$
(b)	Triangle drawn at (– 2, 0), (– 2, – 1), (0, – 1)	2	**B1** for correct size and orientation but wrong position
(c)	Rotation 90 [anticlockwise] oe [centre] (– 1, 0)	3	**B1** for each

16. 0580_w22_ms_43 Q: 10

Question	Answer	Marks	Partial Marks
(a)(i)	2**a** drawn correctly with direction arrow	1	
(a)(ii)	**a** – **b** drawn correctly with direction arrow	2	**B1** for $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ seen or implied or **M1** for correctly drawing *their* **a** – **b** with an arrow
(b)(i)(a)	$\mathbf{q} + \frac{3}{4}\mathbf{p}$ final answer	1	
(b)(i)(b)	$\mathbf{q} - \frac{1}{4}\mathbf{p}$ final answer	2	**M1** for a correct route
(b)(i)(c)	$\frac{13}{24}\mathbf{p} - \frac{2}{3}\mathbf{q}$ final answer	3	**M2** for $\frac{3}{8}\mathbf{p} - \frac{2}{3}$ (*their* **(b)(i)(b)**) oe or for $-\frac{3}{8}\mathbf{p} - \mathbf{q} + \mathbf{p} + \frac{1}{3}$ (*their* **(b)(i)(b)**) oe or **M1** for a correct route or for $[\overrightarrow{BN} =] -\frac{2}{3}$ (*their* **(b)(i)(b)**) or $[\overrightarrow{AN} =] \frac{1}{3}$ (*their* **(b)(i)(b)**) or final answer $k\mathbf{p} - \frac{2}{3}\mathbf{q}$ oe or $\frac{13}{24}\mathbf{p} - k\mathbf{q}$ oe
(b)(ii)	$\frac{19}{16}\mathbf{p}$ oe final answer	2	**M1** for $\overrightarrow{AG} = \frac{3}{8}\mathbf{p} \div 2$ soi or for answer $k\mathbf{p}$ oe

17. 0580_m21_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	rotation 90 anticlockwise oe (–3, 2)	**3**	**B1** for each
(a)(ii)	enlargement $-\frac{1}{2}$ $(-2,-1)$	**3**	**B1** for each
(b)	Image at (– 3, – 5) (1, – 5) (1, 3)	**2**	**B1** for translation by $\begin{pmatrix}-5\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-10\end{pmatrix}$
(c)	Image at (2, 3) (6, 3) (6, – 5)	**2**	**B1** for reflection in $y = k$ or $x = 4$

18. 0580_s21_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)(i)(a)	$\begin{pmatrix} 5 \\ -13 \end{pmatrix}$ final answer	1	
(a)(i)(b)	$\begin{pmatrix} -4 \\ 11 \end{pmatrix}$ final answer	2	**B1** for answer $\begin{pmatrix} -4 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 11 \end{pmatrix}$ or $\begin{pmatrix} -6 \\ 16 \end{pmatrix}$ seen
(a)(i)(c)	5.39 or 5.385…	2	**M1** for $2^2 + ([-]5)^2$
(a)(ii)	$[k =] 8$ $[m =] -32$	3	**B2** for $k = 8$ or $m = -32$ or **M1** for $-3 + 2k = 13$ oe or for $m = -5 \times$ *their* $k + 8$ correctly evaluated
(b)(i)(a)	$\mathbf{p} + \mathbf{q}$ final answer	1	
(b)(i)(b)	$\frac{1}{2}\mathbf{p} - \frac{1}{2}\mathbf{q}$ **or** $\frac{1}{2}(\mathbf{p} - \mathbf{q})$ or $\frac{\mathbf{p} - \mathbf{q}}{2}$ final answer	2	**M1** for unsimplified answer or any correct vector route for $\overrightarrow{CM}$, e.g. $-\mathbf{q} + \frac{1}{2}$ *their* **(b)(i)(a)**
(b)(i)(c)	$\frac{1}{2}\mathbf{p} + \frac{1}{10}\mathbf{q}$ or $\frac{5\mathbf{p} + \mathbf{q}}{10}$ final answer	2	**M1** for unsimplified answer or any correct vector route for $\overrightarrow{MN}$
(b)(ii)	$\frac{5}{3}\mathbf{p} + \mathbf{q}$ or $\frac{5\mathbf{p} + 3\mathbf{q}}{3}$ final answer	3	**B2** for unsimplified correct answer OR **M1** for $\mathbf{p} + \frac{3}{5}\mathbf{q}$ seen **B1** for final answer of form $k\mathbf{p} + \mathbf{q}$ $(k > 1)$ or final answer $\frac{5}{3}\mathbf{p} + j\mathbf{q}$ oe (any j)

19. 0580_s21_ms_42 Q: 7

	Answer	Mark	Partial Marks
(a)(i)	Triangle at (4, 0) (4, 3) (6, 3)	2	**B1** for translation by $\begin{pmatrix}2\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-1\end{pmatrix}$ If 0 scored **SC1** for triangle at (3, 0.5) (3, 3.5) (5, 3.5)
(a)(ii)	Triangle at (1, –2) (4, –4) (4, –2)	2	**B1** for rotation 90 clockwise wrong centre or for rotation 90 anticlockwise about the origin
(a)(iii)	Triangle at (–4, 4) (–4, 2.5) (–5, 2.5)	2	**B1** for enlargement SF $-\frac{1}{2}$ with wrong centre or for enlargement SF $\frac{1}{2}$ with centre (–2, 3)
(b)	Reflection $y = -x$ oe	2	**B1** for each

20. 0580_s21_ms_43 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	(2, 7)	2	**B1** for each coordinate

	Answer	Mark	Partial Marks
(a)(ii)	$-\frac{1}{2}x+8$ oe	4	Correct equivalent in different form scores 3 marks. **M1** for gradient of $AB = \frac{9-5}{3-1}$ or $\frac{4}{2}$ or 2 **M1 dep** for gradient $p = -\frac{1}{\text{their grad of } AB}$ **M1 (dep** on previous M1) for substitution of *their* midpoint into $y = (\text{their } p)x + c$ oe where *their* $p \neq 0$
(b)(i)	$\begin{pmatrix}0\\2\end{pmatrix}$	2	**B1** for $\begin{pmatrix}0\\k\end{pmatrix}$ or $\begin{pmatrix}k\\2\end{pmatrix}$
(b)(ii)	$\begin{pmatrix}-2\\9\end{pmatrix}$	2	**FT** *their* $\overrightarrow{PQ}$ **B1FT** for $\begin{pmatrix}0\\6\end{pmatrix}$
(c)(i)	$\frac{2}{3}\mathbf{t}+\frac{1}{3}\mathbf{u}$ or $\frac{1}{3}(2\mathbf{t}+\mathbf{u})$ final answer	2	**M1** for $\overrightarrow{UY} = \frac{2}{3}(\mathbf{t}-\mathbf{u})$ oe or $\overrightarrow{TY} = \frac{1}{3}(\mathbf{u}-\mathbf{t})$ oe or correct route soi
(c)(ii)	$\frac{2}{3}\mathbf{t}$ cao	1	

21. 0580_p20_ms_40 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	Correct image (2, –5) (4, –5) (4, –2)	2	**SC1** for reflection in $y = 0$ or 3 correct points not joined
(a)(ii)	Correct image (–3, 1) (–6, 1) (–6, –1)	2	**SC1** for rotation 90° clockwise any centre or 3 correct points not joined
(b)	Translation by $\begin{pmatrix}1\\9\end{pmatrix}$	2	**B1** for each

22. 0580_p20_ms_40 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	$\frac{1}{2}\mathbf{p}$	1	
(a)(ii)	$\frac{1}{2}\mathbf{p} - \frac{1}{3}\mathbf{r}$	1	
(a)(iii)	$\mathbf{p} + \frac{2}{3}\mathbf{r}$	1	
(b)	$\mathbf{r} + \frac{3}{2}\mathbf{p}$	2	**M1** for correct unsimplified answer or for correct route or for recognising $\overrightarrow{OU}$ as position vector
(c)	6 nfww	3	**B2** for $(2k)^2 + ([-]k)^2 = 180$ oe or **M1** for $(2k)^2 + ([-]k)^2$ oe

23. 0580_s20_ms_41 Q: 4

	Answer	Mark	Partial Marks
(a)	Triangle at (–4, –4) (–1, –3) (–4, –3)	2	**B1** for correct points not joined or for reflection in any $y = k$ or for reflection in $x = -1$
(b)	Triangle at (1, 1) (1, 4) (2, 4)	2	**B1** for correct points not joined or rotation 90 clockwise around any point or rotation 90 anticlockwise around (0, 0)
(c)	Translation $\begin{pmatrix} 5 \\ -6 \end{pmatrix}$	2	**B1** for translation or correct vector oe

24. 0580_s20_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	$\begin{pmatrix} 6 \\ 17 \end{pmatrix}$	2	**B1** for each
(a)(ii)	6.4[0] or 6.403...	2	**M1** for $4^2 + 5^2$
(b)	(1, 2)	1	
(c)	(0, –2)	1	

	Answer	Mark	Partial Marks
(d)	$\frac{1}{2}\mathbf{c} + \frac{1}{3}\mathbf{d}$	3	**B2** for correct unsimplified answer or **M1** for $\overrightarrow{CT} = -\mathbf{c} + \frac{2}{3}\mathbf{d}$ oe or $\overrightarrow{TC} = \mathbf{c} - \frac{2}{3}\mathbf{d}$ oe or for correct route

25. 0580_s20_ms_43 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	triangle with vertices at (–2, –1) (–8, –1) (–2, –5)	**2**	**B1** for correct reflection in $y = x$
(a)(ii)	triangle with vertices at (–1, –1) (–1, –7) (3, –7)	**2**	**B1** for translation by $\begin{pmatrix} k \\ -9 \end{pmatrix}$ or $\begin{pmatrix} -2 \\ k \end{pmatrix}$
(b)(i)	Enlargement [centre] (–7, 8) [sf] ½	**3**	**B1** for each
(b)(ii)	Rotation [centre] (0, 0) 90° clockwise oe	**3**	**B1** for each

26. 0580_w20_ms_41 Q: 1

	Answer	Mark	Partial Marks
(a)	Image at (4, –1) (4, –4) (5, –4)	**2**	**B1** for translation by $\begin{pmatrix} 8 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -6 \end{pmatrix}$ or for correct vertices not joined
(b)	Image at (–4, –4) (–4, –7) (–3, –4)	**2**	**B1** for reflection in $x = -1$ or $y = k$ or for correct vertices not joined
(c)	Enlargement 3 (–5, 5)	**3**	**B1** for each
(d)	Rotation 90° clockwise oe (1, 1)	**3**	**B1** for each

27. 0580_w20_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)	Translation $\begin{pmatrix} 1 \\ -6 \end{pmatrix}$	2	**B1** for each
(b)(i)	Image at (0, 1), (–3, 1), (–3, 2)	2	**B1** for reflection in $x = k$ or $y = 1$
(b)(ii)	Image at (5, –4), (5, –1), (4, –1)	2	**B1** for rotation 90° anticlockwise with other centre or for rotation 90° clockwise about (6, 0)
(b)(iii)	Image at (–1, –2), (–7, –2), (–7, –4)	2	**B1** for enlargement, factor –2 with other centre

28. 0580_w20_ms_43 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	Triangle at (–3, 2) (–3, 3) (–5, 2)	2	**B1** for correct rotation about incorrect point or for rotation 90 clockwise around (0, 0)
(a)(ii)	Triangle at (5, –2) (6, –2) (5, 0)	2	**B1** for translation by $\begin{pmatrix} 3 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -5 \end{pmatrix}$
(b)	Enlargement [SF] 3 [Centre] (1, 4)	3	**B1** for each

29. 0580_w20_ms_43 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	$\begin{pmatrix}4\\4\end{pmatrix}$	2	**B1** for $\begin{pmatrix}4\\k\end{pmatrix}$ or $\begin{pmatrix}k\\4\end{pmatrix}$
(a)(ii)	$\begin{pmatrix}-4\\8\end{pmatrix}$	2	**B1** for $\begin{pmatrix}-4\\k\end{pmatrix}$ or $\begin{pmatrix}k\\8\end{pmatrix}$
(a)(iii)	5.39 or 5.385..	2	**M1** for $(-2)^2 + 5^2$ oe
(b)(i)	$\mathbf{a} + \mathbf{b}$	1	
(b)(ii)	$\frac{3}{2}\mathbf{a} + \mathbf{b}$	2	**M1** for a correct route, e.g. $\overrightarrow{OA} + \overrightarrow{AE}$
(b)(iii)	$2\mathbf{a} + \frac{4}{3}\mathbf{b}$	3	**M2** for unsimplified $\overrightarrow{OD}$ or for $\frac{4}{3}\mathbf{b}$ or **M1** for $\overrightarrow{OD}$ attempted in terms of **a** and **b** or for $\overrightarrow{CD} = \frac{1}{3}\mathbf{b}$ or $\overrightarrow{DB} = \frac{2}{3}\mathbf{b}$ seen

30. 0580_m19_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	Reflection $x = 1.5$	2	**B1** for each
(a)(ii)	Rotation (0, –1) 90° [anticlockwise] oe	3	**B1** for each
(b)(i)	Image at (5, –1) (6, –1) (6, –3)	2	**B1** for correct size and orientation but wrong position If 0 scored, **SC1** for enlargement SF $\frac{1}{2}$ with centre (3, 0)
(b)(ii)	Image at (–6, 3) (–4, 3) (–6, 7)	2	**B1** for translation $\begin{pmatrix}-3\\k\end{pmatrix}$ or $\begin{pmatrix}k\\1\end{pmatrix}$
(b)(iii)	Image at (2, –1) (2, –3) (6, –3)	3	**M2** for 3 correct coordinates soi or **M1** for $\begin{pmatrix}0&1\\1&0\end{pmatrix}\begin{pmatrix}-1&-3&-3\\2&2&6\end{pmatrix}$ or **B1** for stating reflection in $y = x$

31. 0580_s19_ms_41 Q: 1

	Answer	Mark	Partial Marks
(a)(i)	Image at (1, 7), (4, 7), (4, 9), (3, 9)	2	**B1** for translation by $\begin{pmatrix}-1\\k\end{pmatrix}$ or $\begin{pmatrix}k\\6\end{pmatrix}$
(a)(ii)	Image at (5, 3), (6, 3), (8, 5), (5, 5)	2	**B1** for 180° rotation with wrong centre
(a)(iii)	Rotation 180° (4.5, 6) OR Enlargement, [factor] – 1 (4.5, 6)	3	**B1** for rotation **B1** for 180° **B1FT** for centre from *their* (a)(i) **B1** for enlargement **B1** for – 1 **B1FT** for centre from *their* **(a)(i)**
(b)(i)	Image at (1, 2), (1, 5), (3, 5), (3, 4)	2	**B1** for $y = x$ drawn or for 3 correct points
(b)(ii)	$\begin{pmatrix}0&1\\1&0\end{pmatrix}$	2	**B1** for one correct row or one column within a 2 by 2 matrix

32. 0580_s19_ms_43 Q: 3

	Answer	Mark	Partial Marks
(a)(i)	Image at (–5, 4), (–2, 4), (–4, 6)	2	**B1** for translation by $\begin{pmatrix}-3\\k\end{pmatrix}$ or $\begin{pmatrix}k\\2\end{pmatrix}$
(a)(ii)	Image at (2, 1), (4, –1), (2, –2)	2	**B1** for reflection in $y = -x$ or $y = x$ drawn
(b)	Rotation 90°[anticlockwise] oe (1, –1)	3	**B1** for each
(c)(i)	$\begin{pmatrix}-2 & 0\\0 & -2\end{pmatrix}$	2	**B1** for 2 by 2 matrix with one correct row or column
(c)(ii)	Strict **FT** *their* **(c)(i)**	1	Answer not equal to zero **FT** *their* **(c)(i)** only if 2 by 2

33. 0580_w19_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)(i)	(3, 5.5)	2	**B1** for either value correct
(a)(ii)	$\frac{5}{4}x + \frac{7}{4}$ final answer	3	**B2** for answer $\frac{5}{4}x + c$ oe or for correct equation in different form or **M1** for $\frac{8-3}{5-1}$ oe **and M1** for correct substitution shown of (1, 3) or (5, 8) or *their* (a)(i) into $y = (\textit{their } m)x + c$ oe
(b)(i)	(6, 1) (10, 6)	2	**B1** for 2 or 3 values correct
(b)(ii)	(–3, 1) (–8, 5)	2	**B1** for 2 or 3 values correct If 0 scored, **SC1** for (3, –1) and (8, –5)
(b)(iii)	(3, 3) (–1, 8)	2	**B1** for 2 or 3 values correct but not for (1, 3) and (5, 8)

	Answer	Mark	Partial Marks
(b)(iv)	(5, –3) (11, –8)	**2**	**B1** for either or **M1** for $\begin{pmatrix}-1 & 2\\ 0 & -1\end{pmatrix}\begin{pmatrix}1\\3\end{pmatrix}$ or $\begin{pmatrix}-1 & 2\\ 0 & -1\end{pmatrix}\begin{pmatrix}5\\8\end{pmatrix}$
(c)	Enlargement –2 Origin oe	**3**	**B1** for each

34. 0580_w19_ms_42 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	$\frac{m-7}{5}$ oe final answer	**2**	**M1** for $5p = m - 7$ or $p + \frac{7}{5} = \frac{m}{5}$
(a)(ii)	$[\pm]\sqrt{\frac{y^2-h}{2}}$ or $[\pm]\sqrt{\frac{h-y^2}{-2}}$ oe final answer	**3**	**M1** for first correct step isolate term in p or divide by ±2 **M1** for second correct step FT *their* first step
(b)(i)	$\begin{pmatrix}0\\5\end{pmatrix}$	**1**	
(b)(ii)	$\begin{pmatrix}-3\\-1\end{pmatrix}$	**1**	

	Answer	Mark	Partial Marks
(b)(iii)	3.22 or 3.216... to 3.220...	**6**	**B3** for [angle AOB =] 36.8 or 36.9 or 36.84 to 36.87 or **M2** for tan[AOB] = $\frac{3}{4}$ oe or for [AOB =]2 × $\sin^{-1}\left(\frac{\sqrt{(5-4)^2+(0--3)^2}}{10}\right)$ oe or for cos [AOB =] $\frac{5^2+5^2-\left(\sqrt{(5-4)^2+(0--3)^2}\right)^2}{2\times5\times5}$ oe or **M1** for recognition of right-angle with perpendicular from B to OA or x-axis or for [AB^2 =] $(5-4)^2+(0--3)^2$ or better oe or (*their* AB)$^2 = 5^2 + 5^2 - 2 \times 5 \times 5 \times \cos OAB$ oe **M2** for $\frac{\textit{their}\ \text{angle}\ AOB}{360} \times 2 \times \pi \times 5$ oe or **M1** for radius = 5 soi

35. 0580_w19_ms_43 Q: 7

	Answer	Mark	Partial Marks
(a)	Reflection $y = -1$	2	**B1** for each
(b)(i)	Image at (–6, 5) (–6, 7) (–5, 7) (–4, 5)	2	**B1** for translation by $\begin{pmatrix}-3\\k\end{pmatrix}$ or $\begin{pmatrix}k\\4\end{pmatrix}$

	Answer	Mark	Partial Marks
(b)(ii)	Image at (1, –1) (3, –1) (3, –3) (2, –3)	2	**B1** for shape correct size and orientation but wrong position
(b)(iii)	Image at (1, 2) (1, 6) (3, 6) (5, 2)	2	**B1** for shape correct size and orientation, wrong position

36. 0580_w19_ms_43 Q: 11

	Answer	Mark	Partial Marks
(a)(i)	8**b** – 4**a** oe	1	
(a)(ii)	6**b**	1	
(a)(iii)	6**b** – 2**a** or 2(3**b** – **a**)	1	**FT** –2**a** + *their* (a)(ii)
(b)	2 : 1 oe final answer	3	Dep on correct $\overrightarrow{BC}$ or correct $\overrightarrow{AC}$ seen **B2** for $\overrightarrow{BC}$ = 4**b**–2**a** or **M1** for a correct route for $\overrightarrow{BC}$ in terms of **a** and **b** or for a correct route for $\overrightarrow{AC}$ in terms of **a** and **b** If no/incorrect working seen then **SC1** for final answer of 2 : 1 (oe)

37. 0580_s18_ms_41 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	Translation $\begin{pmatrix}-8\\2\end{pmatrix}$ oe	**2**	**B1** for each
(a)(ii)	Enlargement [sf =] $\frac{1}{2}$ oe $(-4, 0)$	**3**	**B1** for each
(a)(iii)	Rotation 90° clockwise oe $(1, -1)$	**3**	**B1** for each
(b)	Triangle with (1, –1), (5, –1), (1,7)	**2**	**B1** for correct size and orientation in wrong position or for 3 correct points not joined

38. 0580_s18_ms_41 Q: 11

	Answer	Mark	Partial Marks
(a)(i)	12.6 or 12.64 to 12.65	3	**M2** for $12^2 + (-4)^2$ OR **B1** for $\begin{pmatrix}12\\-4\end{pmatrix}$ **M1** for $(their 12)^2 + (their - 4)^2$
(a)(ii)	$\begin{pmatrix}-11\\13\end{pmatrix}$	2	**B1** for $\begin{pmatrix}-11\\k\end{pmatrix}$ or $\begin{pmatrix}k\\13\end{pmatrix}$ or for $[\overrightarrow{BA} =]\begin{pmatrix}-8\\7\end{pmatrix}$
(b)	$\frac{1}{2}$**(b – a)** oe	2	**M1** for correct route or correct unsimplified answer or **B1** for $\overrightarrow{QS}$ = **b – a** oe
(c)(i)	$\begin{pmatrix}9 & 50\\10 & 69\end{pmatrix}$	2	**B1** for 2 correct elements
(c)(ii)	$\frac{1}{11}\begin{pmatrix}8 & -5\\-1 & 2\end{pmatrix}$ oe isw	2	**B1** for $k\begin{pmatrix}8 & -5\\-1 & 2\end{pmatrix}$ or $\frac{1}{11}\begin{pmatrix}a & b\\c & d\end{pmatrix}$ or det = 11 soi

39. 0580_s18_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)(i)	Image at (3, – 3), (7, – 3), (7, – 5)	2	**B1** for reflection in any $x = k$ or if 3 correct points not joined
(a)(ii)	Image at (– 5, 1), (– 1, 1), (– 5, – 1)	2	**B1** for translation by $\begin{pmatrix}-2\\k\end{pmatrix}$ or $\begin{pmatrix}k\\4\end{pmatrix}$ or if 3 correct points not joined

	Answer	Mark	Partial Marks
(a)(iii)	Image at (6, 3), (6, 4), (4, 3)	**3**	**B2** for correct size and orientation but wrong position or if 3 correct points not joined **B1** for enlargement SF ½ with centre (3, 1)
(b)	Rotation 90° [anticlockwise]oe (– 6, – 2)	**3**	**B1** for each
(c)	Reflection $y = -x$ oe	**2**	**B1** for each

40. 0580_w18_ms_41 Q: 2

	Answer	Mark	Partial Marks
(a)(i)	Translation $\begin{pmatrix} 5 \\ 8 \end{pmatrix}$	**2**	**B1** for each Accept 5 right and 8 up
(a)(ii)	Enlargement [sf] 0.5 oe [centre] (0, –7)	**3**	**B1** for each
(a)(iii)	Rotation 90 [anticlockwise] oe Origin oe	**3**	**B1** for each
(b)	Image at (–8, 1) (–8, 5) (–8, 7) (–4, 1)	**2**	**B1** for reflection of flag A in the line $x = -1$ or $y = k$ or for vertices of triangle in correct place but not joined

41. 0580_w18_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)	Rotation 90[o] clockwise oe Origin oe	**3**	**B1** for each
(b)(i)	Image at (–4, –1) (–4, –4) (–2, –4)	**1**	
(b)(ii)	Image at (3, –1) (5, –1) (3, –4)	**2**	**B1** for translation by $\begin{pmatrix}7\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-5\end{pmatrix}$ or for 3 correct points not joined
(b)(iii)	Image at (–2, ½) (–2, 2) (–1, 2)	**3**	**B2** for 3 correct co-ordinates soi in working or correct size and orientation in wrong position or **M1** for $\begin{pmatrix}0.5 & 0\\0 & 0.5\end{pmatrix}\begin{pmatrix}-4 & -4 & -2\\1 & 4 & 4\end{pmatrix}$ shown or for statement: enlargement, sf 0.5, (0, 0)

42. 0580_w18_ms_42 Q: 11

	Answer	Mark	Partial Marks
(a)(i)	$\begin{pmatrix}-19\\-2\end{pmatrix}$	**2**	**B1** for answer $\begin{pmatrix}-19\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-2\end{pmatrix}$ or for $\begin{pmatrix}-9\\6\end{pmatrix}$ or $\pm\begin{pmatrix}10\\8\end{pmatrix}$ seen
(a)(ii)	3.61 or 3.605 to 3.606	**2**	**M1** for $\sqrt{([-]3)^2+2^2}$ oe
(a)(iii)	$-3m + 5n = 14$ and $2m + 4n = 9$	**B1**	Accept equivalents
	$[m =] -\frac{1}{2}$ or -0.5 and $[n =] 2\frac{1}{2}$ or 2.5 or $\frac{5}{2}$ with evidence of a correct algebraic method	**4**	**M1** for correctly equating one set of coefficients of *their* equations or rearranges one of *their* equations to make *m* or *n* the subject e.g. $[m =] \frac{1}{2}(9 - 4n)$ oe **M1** for correct method to eliminate one variable for *their* equations or correctly substitutes *their m* or *their n* into the other equation e.g. $-\frac{3(9-4n)}{2} + 5n = 14$ oe **B1** for one correct answer
(b)(i)(a)	$-\mathbf{a} + 2\mathbf{c}$	**1**	
(b)(i)(b)	$\frac{3}{8}(-\mathbf{a} + 2\mathbf{c})$ or $-\frac{3}{8}\mathbf{a} + \frac{3}{4}\mathbf{c}$ oe	**1**	**FT** $\frac{3}{8}$ (*their* **(b)(i)(a)**) in simplest form

	Answer	Mark	Partial Marks
(b)(i)(c)	$\frac{1}{2}(5\mathbf{a} - 2\mathbf{c})$ or $\frac{5}{2}\mathbf{a} - \mathbf{c}$ oe	**1**	
(b)(i)(d)	$\frac{1}{8}(5\mathbf{a} - 2\mathbf{c})$ or $\frac{5}{8}\mathbf{a} - \frac{1}{4}\mathbf{c}$ oe	**2**	**M1** for a correct unsimplified route
(b)(ii)	4	**1**	

43. 0580_w18_ms_43 Q: 1

	Answer	Mark	Partial Marks
(a)(i)	Reflection $y = -1$	2	**B1** for each
(a)(ii)	Triangle at (0, –3), (4, –1), (4, –3)	2	**B1** for translation $\begin{pmatrix} -2 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -5 \end{pmatrix}$ or for three correct vertices
(a)(iii)	Triangle at (–2, 2), (–2, 6), (–4, 6)	2	**B1** for rotation about (0, 0) 90° clockwise or 90° anticlockwise with wrong centre or for three correct vertices
(a)(iv)	Triangle at (–3, –1), (–3, –2), (–1, –1)	2	**B1** for scale factor $-\frac{1}{2}$ with wrong centre or scale factor $\frac{1}{2}$ with centre (0, 0) or for three correct vertices
(b)(i)	$\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ cao	1	
(b)(ii)	4.47 or 4.472…	2	**M1** for $(their\ 2)^2 + (their\ 4)^2$
(b)(iii)	(7, 10)	2	**B1** for each
(b)(iv)	$y = 2x - 4$ oe	3	**M1** for gradient = $\frac{6-2}{5-3}$ oe or answer $y = mx - 4$ **M1** for substituting (3, 2) or (5, 6) into $y = their\ mx + c$ or into $y - k = their\ m(x - h)$ or into $their\ y = mx - 4$
(b)(v)	(0, –4)	1	**FT** *their* **(b)(iv)**

44. 0580_m17_ms_42 Q: 2

	ANSWER	MARK	PARTIAL MARKS
(a) (i)	Rotation	**1**	
	90° [anticlockwise] oe	**1**	
	(9, 5)	**1**	
(ii)	Translation	**1**	
	$\begin{pmatrix} -8 \\ -14 \end{pmatrix}$ oe	**1**	
(iii)	Enlargement	**1**	
	[sf] $\frac{1}{3}$	**1**	
	(– 8, – 2)	**1**	
(b) (i)	Image at (1, – 3) (2, – 3) (2, – 5)	**2**	**M1** for triangle correct size and orientation, wrong position or **SC1** for correct reflection in $y = -x$
(ii)	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	**2**	**B1** for 1 correct column or row

45. 0580_s17_ms_43 Q: 6

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	Translation	**1**	
	$\begin{pmatrix} 3 \\ -13 \end{pmatrix}$ oe	**1**	
(a)(ii)	Enlargement	**1**	
	[sf] $-\frac{1}{2}$ oe	**1**	
	(0, –4)	**1**	
(b)	Image at (0, 0) (0, 6) (–4, 6) (–4, 2)	**2**	**B1** for rotation of 90° anticlockwise about the wrong centre or 90° clockwise about (3, –1) or 4 points correct but not joined.
(c)	Image at (4, 0) (10, 0) (10, –4) (6, –4)	**2**	**B1** for reflection in $y = k$ or in $x = 1$ or 4 points correct but not joined
(d)	Enlargement	**1**	
	[sf] 3	**1**	
	Origin oe	**1**	

46. 0580_w17_ms_42 Q: 4

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	Correct translation	**2**	**B1** for translation $\begin{pmatrix}6\\k\end{pmatrix}$ or $\begin{pmatrix}k\\-2\end{pmatrix}$
(a)(ii)	Correct rotation	**2**	**B1** for rotation 180° but other centre
(a)(iii)	Correct reflection	**2**	**B1** for reflection in $y=-x$
(b)(i)	Enlargement [factor] $\frac{1}{2}$ or 0.5 [centre] (0, 0) oe	**3**	**B1** for each
(b)(ii)	$\begin{pmatrix}\frac{1}{2} & 0\\0 & \frac{1}{2}\end{pmatrix}$ oe	**2**	**B1** for matrix of form $\begin{pmatrix}k & 0\\0 & k\end{pmatrix}$ oe, $k \neq 0$ or 1
(c)	± 2.5	**3**	**B2** for $25u^2 = 156.25$ or $5u = [\pm]12.5$ or **M1** for $(4u)^2 + (3u)^2$

47. 0580_w17_ms_43 Q: 5

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	Image at (0, 1), (0, 2), (–3, 1)	**2**	**B1** for reflection in $y = 0$ or $x = k$
(a)(ii)	Image at (0, 0), (0, –2), (6, –2)	**2**	**B1** for correct size and correct orientation wrong position or for 2 correct vertices plotted
(a)(iii)	Image at (–5, 4), (–5, 5), (–2, 4)	**2**	**B1** for translation by $\begin{pmatrix} -5 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 3 \end{pmatrix}$
(b)	Rotation 90° clockwise oe (4, –1)	**3**	**B1** for each
(c)(i)	(4, 1)	**2**	**M1** for $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 1 \\ -4 \end{pmatrix}$
(c)(ii)	(8, –1)	**2**	**M1** for $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 3 & 1 \\ 0 & 2 \end{pmatrix}\begin{pmatrix} 1 \\ -4 \end{pmatrix}$ or $\begin{pmatrix} 0 & -2 \\ 3 & 1 \end{pmatrix}\begin{pmatrix} 1 \\ -4 \end{pmatrix}$ or $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} -1 \\ -8 \end{pmatrix}$
(c)(iii)	Rotation 90° anti-clockwise oe Origin oe	**3**	**B1** for each