IG-Maths 0580

Vectors, Matrices and Transformations

Exercise-Paper-4

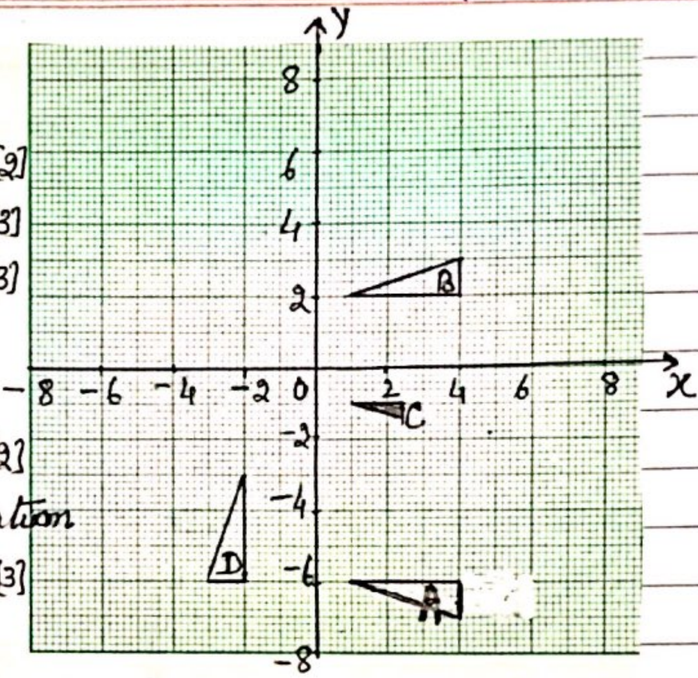
IG- Maths- 580. Matrices and Transformation. Vector, Exercise (Paper4)

Q1 (a) describe fully the single transformation which maps,

(i) triangle A onto triangle B, ---- [2]

(ii) triangle A onto triangle C, --- [3]

(iii) triangle A onto triangle D, ---- [3]



(b) Draw the image of

(i) triangle B after a translation of $\begin{pmatrix}-5\\2\end{pmatrix}$. ---- [2]

(ii) triangle B after a transformation by the matrix, $\begin{pmatrix}2 & 0\\0 & 2\end{pmatrix}$ --- [3]

(c) describe fully the single transformation represented by the matrix $\begin{pmatrix}-1 & 0\\0 & -1\end{pmatrix}$ --- [3]

SP-15/04/Q7

Q2 (a) Describe fully the single transformation that maps:

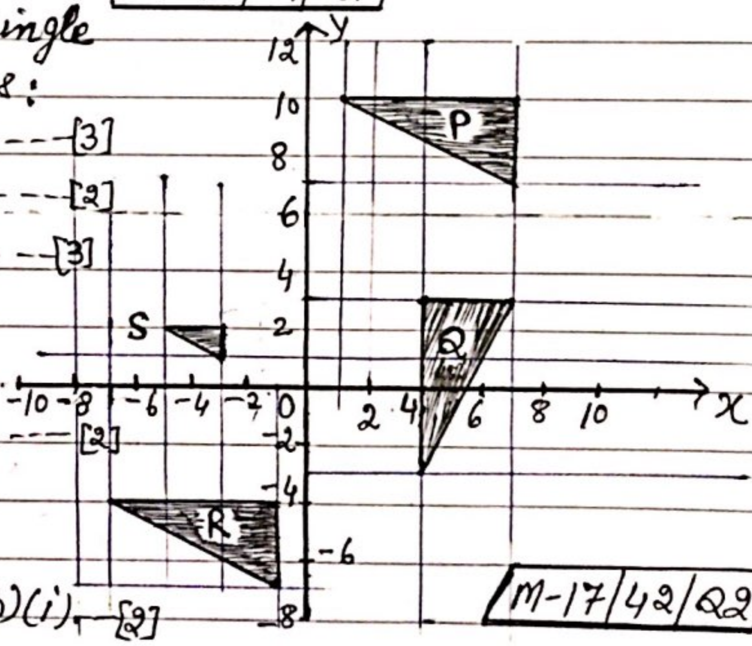
(i) Shape P onto shape Q. ---- [3]

(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). --- [2]



M-17/42/Q2

Q3 (a) (i) draw the image of triangle A after reflection in the line $x=4$ --- [2]

(ii) draw the image of triangle A after rotation of 90° anticlockwise about (0,0) -- [2]

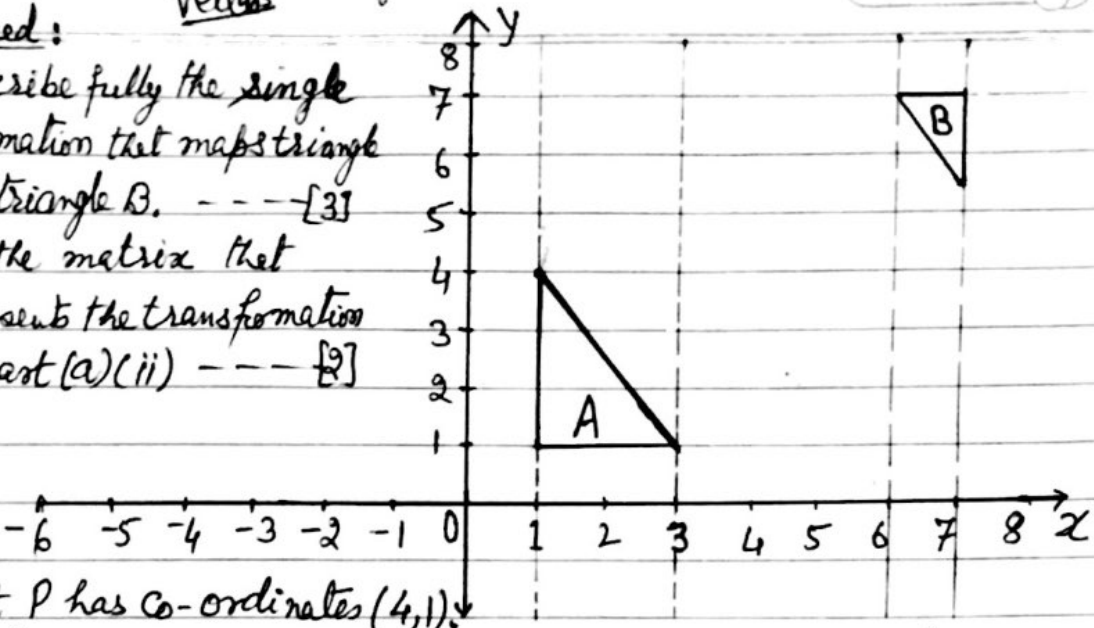
(iii) draw the image of triangle A after translation by the vector $\begin{pmatrix}1\\-5\end{pmatrix}$. -- [2]

(Continued →)

Continued:

Q3 (b) Describe fully the single transformation that maps triangle A onto triangle B. ---[3]

(c) Find the matrix that represent the transformation in part (a)(ii) ---[2]



(d) Point P has co-ordinates (4,1).
$F = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ and $G = \begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ represents transformations.

(i) Find G(P), the image of P after the transformation represented by G. ---[2]

(ii) Find GF(P) ---[3]

S-17/41/Q3

(iii) Find the matrix Q such that GQ(P) = P ---[3]

Q4 On the grid, draw

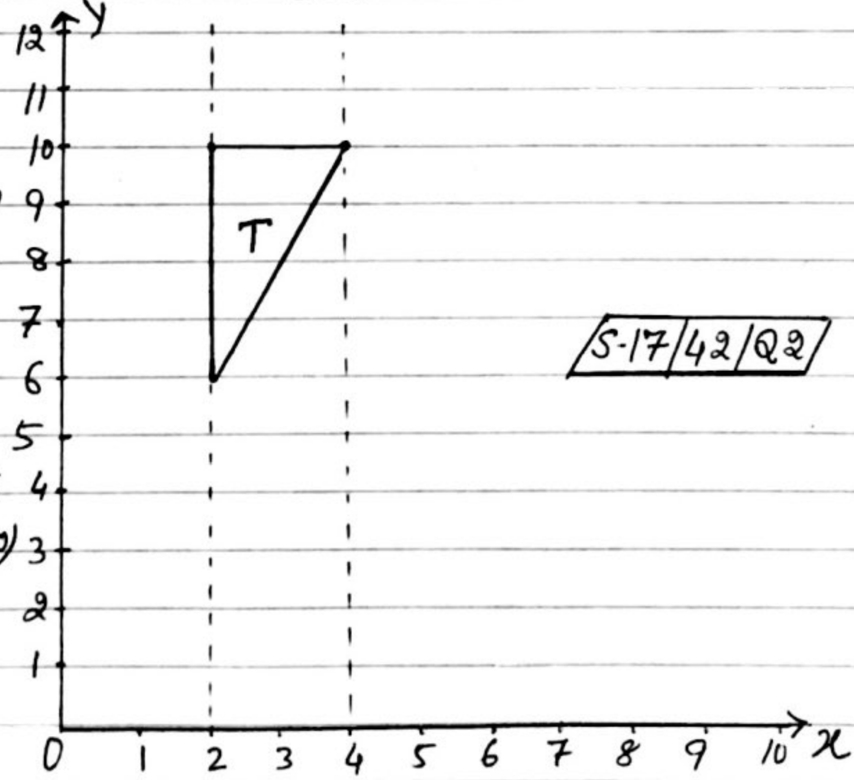
(a) the image of:

(i) Triangle T after translation by the vector $\begin{pmatrix} 6 \\ -5 \end{pmatrix}$ ---[2]

(ii) triangle T after rotation through 90° anticlockwise with centre (4,10). ---[2]

(iii) triangle T after enlargement with scale factor $\frac{1}{2}$, centre (10,0) --[2]

(b) Describe fully the single transformation that is represented by the matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ ---[2]



S-17/42/Q2

(c) $M = \begin{pmatrix} 2 & 3 \\ 2 & 4 \end{pmatrix}$ $N = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ $P = (1, 5)$

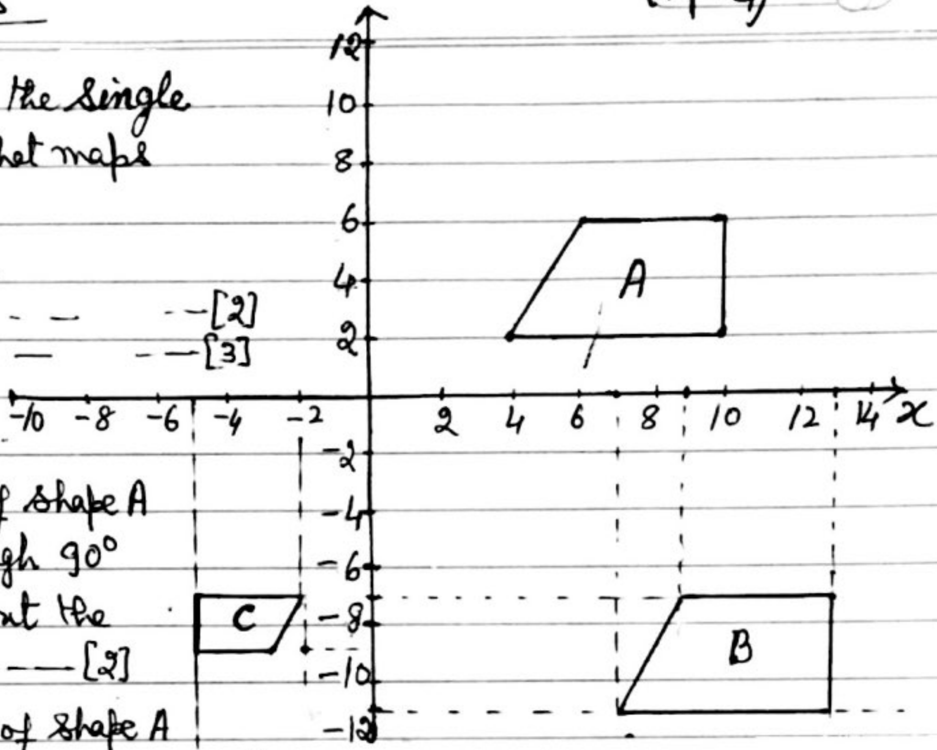
(i) Find (a) MN (b) NP (c) M^{-1} ---[2]+[2]+[2]

(ii) Write down a product of two of M, N and P, which is not possible to work out. ---[1]

Q5 (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]

S-17/43/Q6

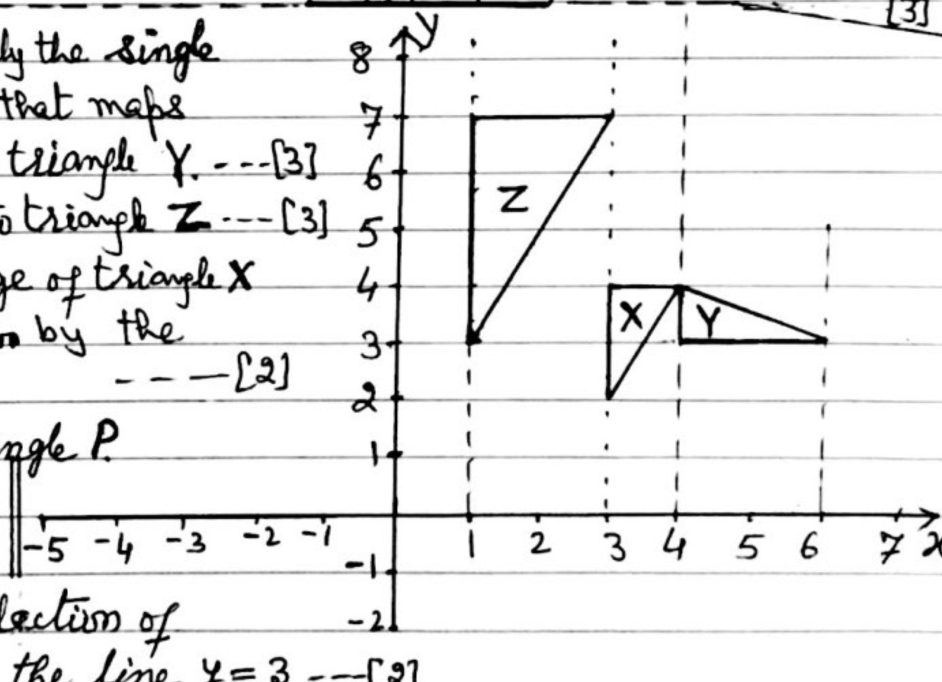
Q6 (a) Describe fully the single transformation that maps

(i) triangle X onto triangle Y. ---[3]

(ii) triangle X onto triangle Z ---[3]

(b)(i) Draw the image of triangle X after a translation by the vector $\begin{pmatrix}-5\\ 3\end{pmatrix}$. ---[2]

Label this triangle P.



(ii) Draw the reflection of triangle P in the line $y=3$. --[2]

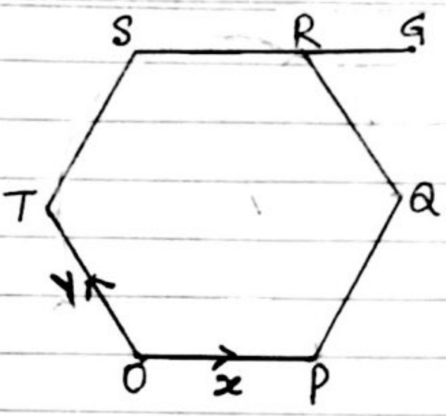
(c) Draw the image of triangle X after the transformation represented by the matrix $\begin{pmatrix}0 & -1\\ 1 & 0\end{pmatrix}$. --[3]

M-16/42/Q6

IG-Maths 0580 — **Matrices and transformation & Vectors** — Exercise (Paper 4) P-4

Q7 O is the origin and OPQRST is a regular hexagon.

$\vec{OP} = \mathbf{x}$ and $\vec{OT} = \mathbf{y}$



(a) Write down in terms of $\mathbf{x}$ and/or $\mathbf{y}$, in its simplest form,

(i) $\vec{QR}$ --- [1]

(ii) $\vec{PQ}$ -- [1]

(iii) the position vector of S. -- [2]

(b) The line SR is extended to G so that SR : RG = 2 : 1

Find $\vec{GQ}$, in terms of $\mathbf{x}$ and $\mathbf{y}$, in its simplest form. - [2]

(c) M is the mid point of OP.

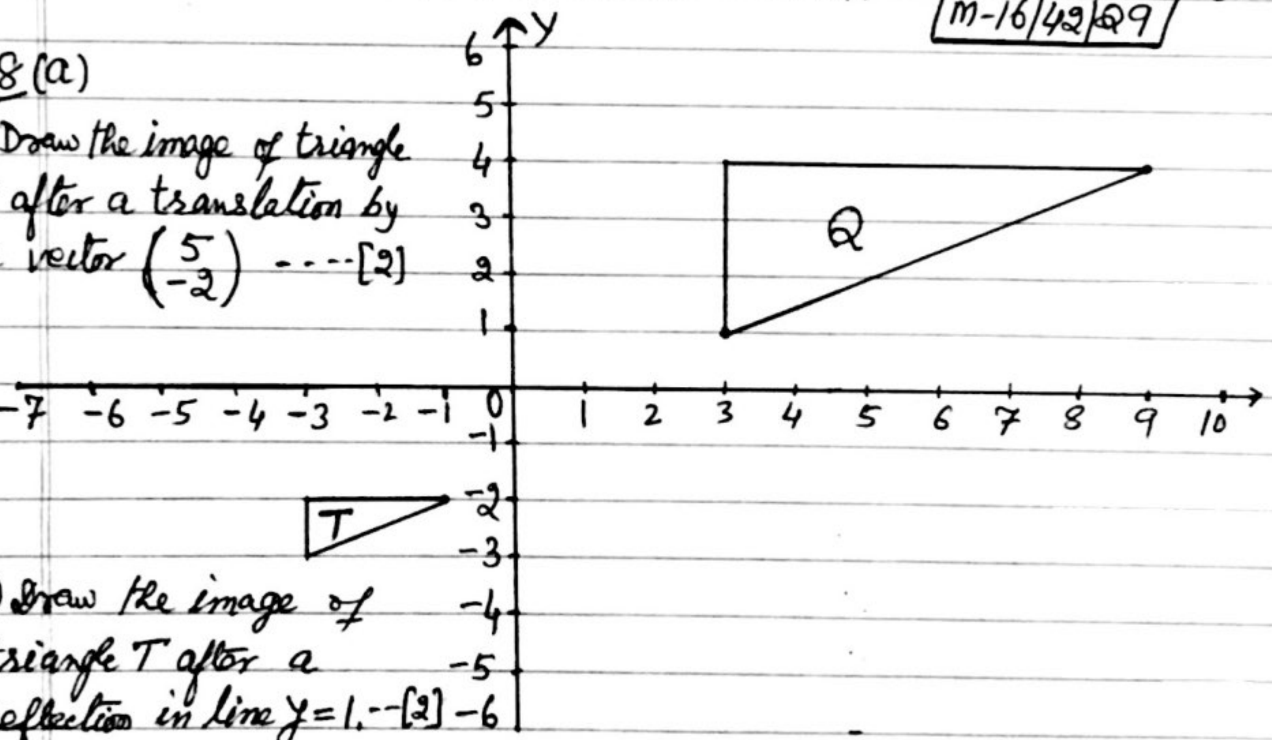
(i) Find $\vec{MG}$, in terms of $\mathbf{x}$ and $\mathbf{y}$, in its simplest form. -- [2]

(ii) H is a point on TQ such that TH : HQ = 3 : 1

Use vectors to show that H lies on MG. -- [2]

M-16/42/Q9

Q8 (a)



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

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

(iii) describe fully the single transformation that maps triangle T onto triangle Q. --- [3]

(continued →)

(continued →)

Q 8(b). $M = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ $N = \begin{pmatrix} 4 & 3 \\ 1 & k \end{pmatrix}$ $P = \begin{pmatrix} 1 & 3 \\ 0 & 6 \end{pmatrix}$

(i) Work out $M+P$ ---[1]

(ii) Work out PM ---[1]

(iii) $|M| = |N|$ find the value of k. ---[3]

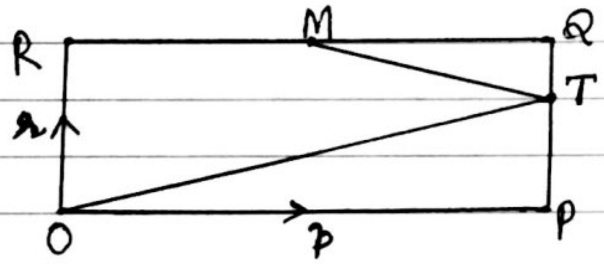
(C)(i) Describe fully the single transformation represented by the matrix, $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ ---[3]

(ii) Find the matrix represented by a reflection in the line $y=x$ ---[2]

S-16/41/Q2

Q9 OPQR is a rectangle and M is the midpoint of RQ and PT : TQ = 2 : 1

$\vec{OP} = \mathbf{p}$ and $\vec{OR} = \mathbf{r}$



(a) Find in terms of $\vec{p}$ and/or $\vec{r}$, in its simplest form:

(i) $\vec{MQ}$ [1]

(ii) $\vec{MT}$ [1]

(iii) $\vec{OT}$ [1]

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

Find the position vector of U in terms of $\vec{p}$ and $\vec{r}$.

Give your answer in its simplest form. [2]

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

Find the positive value of k. ---[3]

S-16/41/Q7

Q10 $A = \begin{pmatrix} 2 & 0 \\ -1 & 5 \\ 3 & -5 \end{pmatrix}$ $B = \begin{pmatrix} 1 & 3 \\ -1 & 5 \end{pmatrix}$ $C = \begin{pmatrix} 7 \\ -4 \end{pmatrix}$ $D = \begin{pmatrix} 2 & 5 \end{pmatrix}$

(a) Workout each of the following if answers is possible.

(i) BA (ii) 2A ---[1]+[1]

(iii) CD (iv) DC ---[2]+[2]

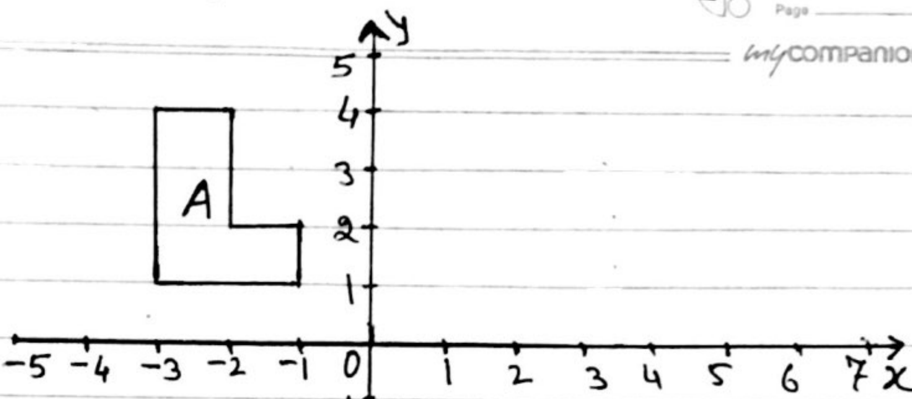
(v) B^2 ---[2]

(b) Find B^{-1}, the inverse of B. ---[2]

S-16/43/Q8

IG-Maths 0580 — Matrices and Transformation — Exercise

Q11



(a) On the grid, draw the image of,

(i) Shape A after a reflection in the line $x = 1$ --- [2]

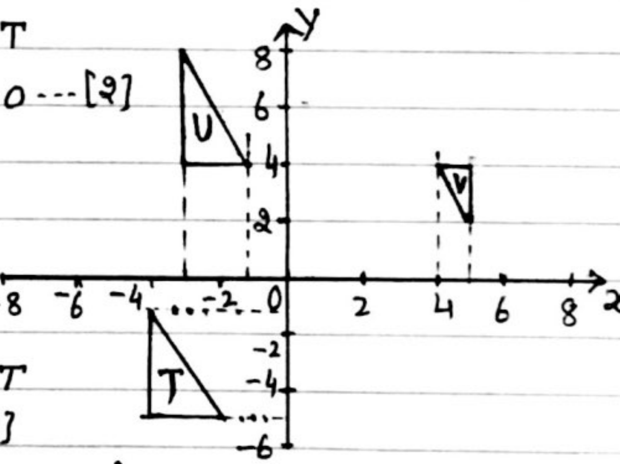
(ii) Shape A after an enlargement with scale factor -2, centre $(0, 1)$. --- [2]

(iii) Shape A after the transformation represented by the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ --- [3]

(b) Describe fully the single transformation representation by the matrix. $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$ -- [3]

S-16/42/Q3

Q12 (a) (i) Draw the image of triangle T after a reflection in the line $x = 0$ --- [2]



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

(iii) Describe fully the single transformation that maps triangle T onto triangle U. ------ [2]

(iv) Describe fully the single transformation that maps triangle T onto triangle V. -- [3]

(b) (i) Find the matrix that represents the transformation in part (a)(i) -- [2]

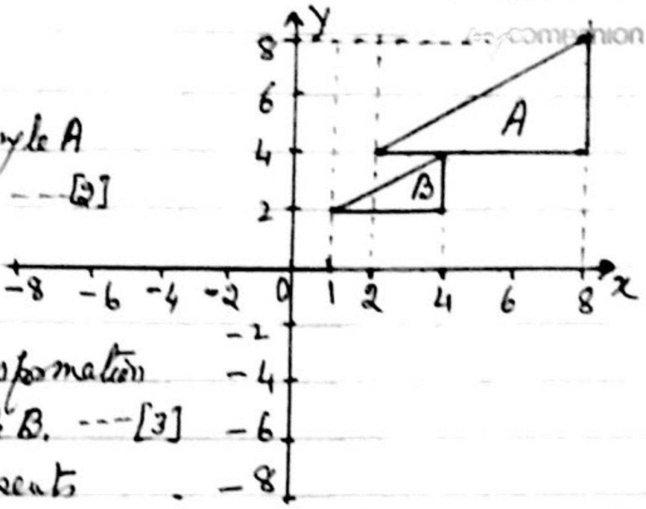
(ii) Describe fully the single transformation represented by the inverse of the matrix in part (b)(i) --- [2]

S-16/43/Q6

Q13 (a) $\vec{v} = \begin{pmatrix} -4 \\ -8 \end{pmatrix}$

(i) Draw the image of triangle A after the translation by vector $\vec{v}$ ---[2]

(ii) Calculate $|\vec{v}|$ ---[2]



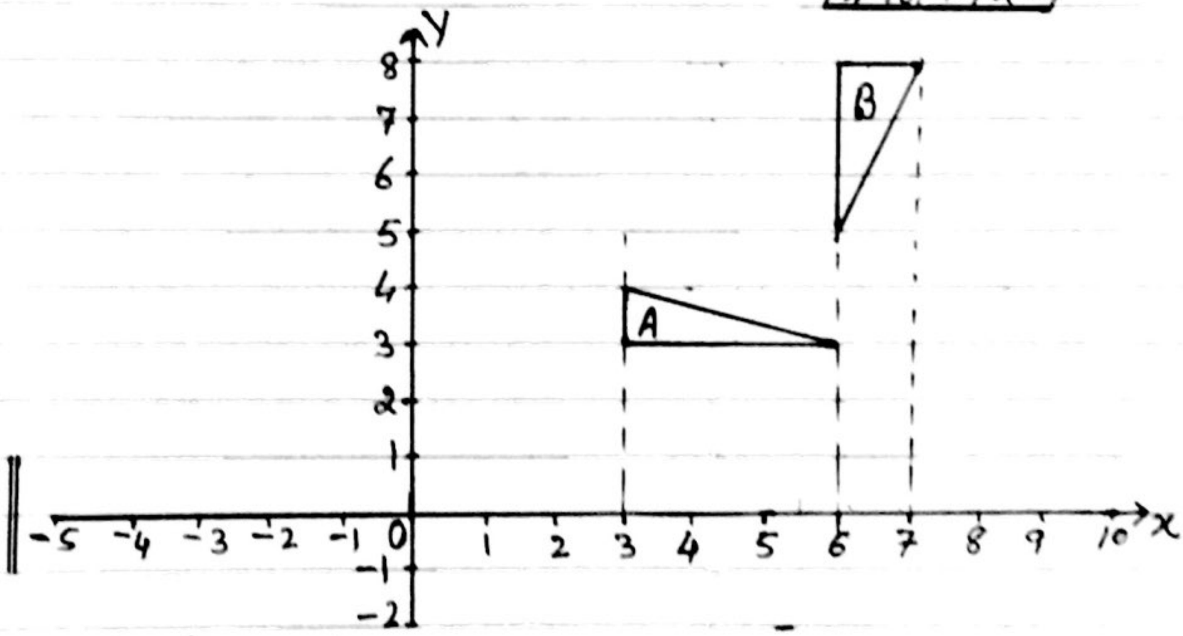
(b)(i) describe fully the single transformation that maps triangle A onto triangle B. ---[3]

(ii) Find the matrix that represents the transformation that maps triangle A onto triangle B. ---[2]

(iii) Calculate the determinant of the matrix in part (b)(ii) ---[1]

W-16/41/Q5

Q14



(a) Draw the image when triangle A is reflected in the line $x=1$ ---[2]

(b) Draw the image when triangle A is translated by the vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ ---[2]

(c) Draw the image when triangle A is enlarged by scale factor 2 with centre (4,5) ---[2]

(d) Describe fully the single transformation that maps triangle A onto triangle B. ---[3]

W-16/43/Q4

Q15 (a) $m = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $n = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

(i) Work out $2m - 3n$ ---[2]

(ii) Calculate $|2m - 3n|$ ---[2]

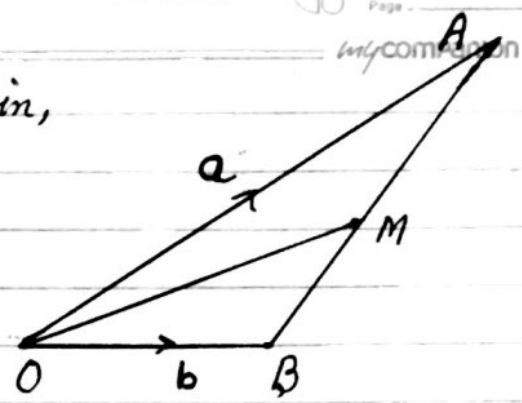
(continued→)

(continued →)

Q15 (b) (i) In the diagram, O is the origin, $\vec{OA} = \vec{a}$ and $\vec{OB} = \vec{b}$

The point M lies on AB, such that AM : MB = 3 : 2

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



(a) $\vec{AB}$ --- [1]

(b) $\vec{AM}$ --- [1]

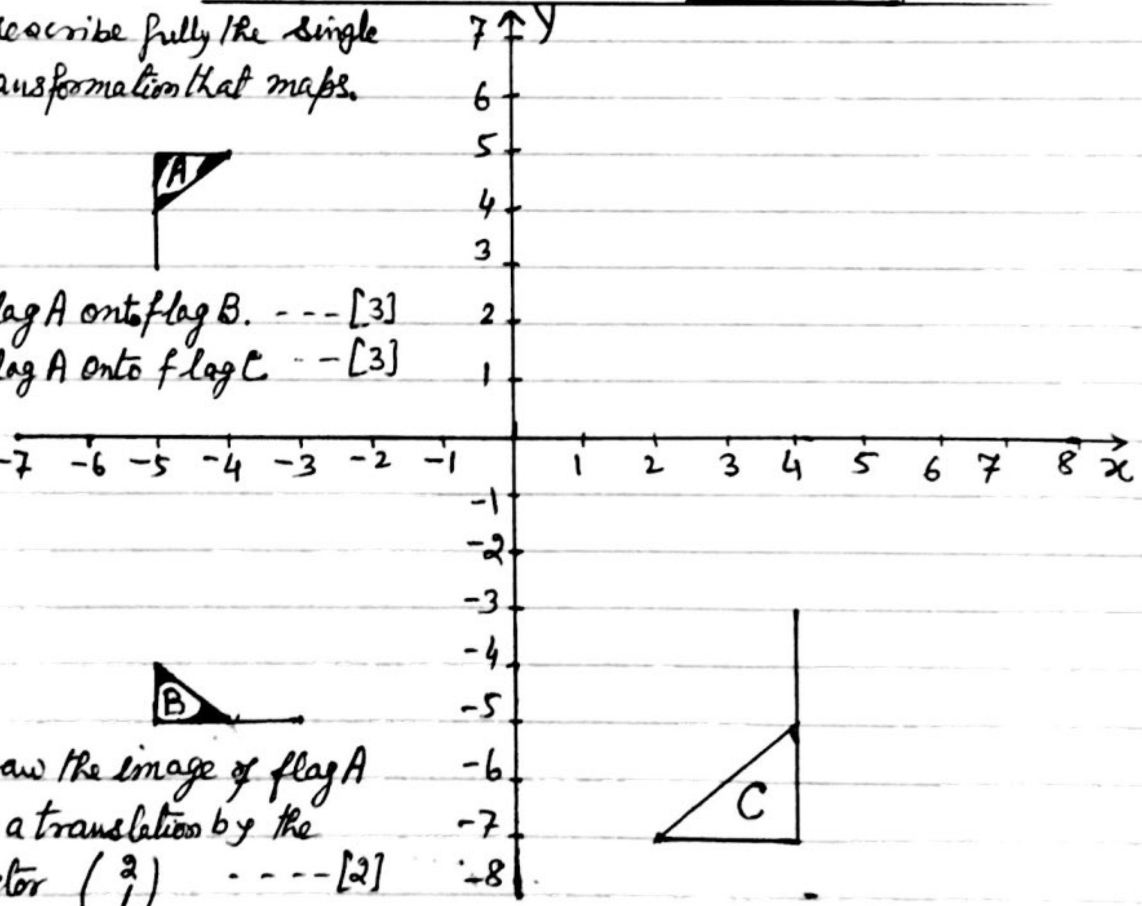
(c) the position vector of M --- [2]

(ii) OM is extended to the point C. The position vector of C is $\mathbf{a} + k\mathbf{b}$. Find the value of k. [W-16/43/Q9] --- [1]

Q16 (a) describe fully the single transformation that maps.

(i) Flag A onto flag B. --- [3]

(ii) Flag A onto flag C --- [3]



(b) draw the image of flag A after a translation by the vector $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ ---- [2]

(c) draw the image of flag A after a reflection in line $x = 1$ --- [2]

(d) discribe fully the single transformation represented by the matrix $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$. --- [2]

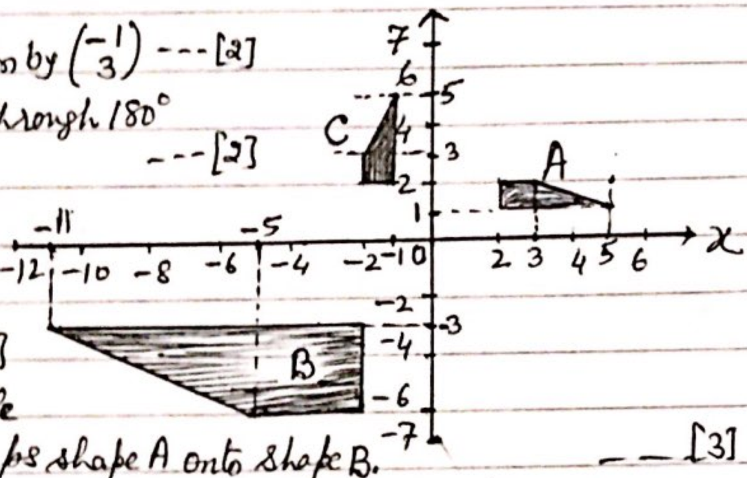
[M-15/42/Q7]

Q17 (a) Draw the image of,

(i) Shape A after a translation by $\begin{pmatrix}-1\\3\end{pmatrix}$ ---[2]

(ii) Shape A after a rotation through 180° about the point (0,0). ---[2]

(iii) Shape A after the transformation represented by the matrix $\begin{pmatrix}1&0\\0&-1\end{pmatrix}$ ---[3]



(b) Describe fully the single transformation that maps shape A onto shape B. ---[3]

(c) Find the matrix which represents the transformation that maps shape A onto shape C. ---[2]

$\boxed{\text{S-15/41/Q3}}$

Q18 (a) $A = \begin{pmatrix}2&-3\\1&4\end{pmatrix}$

Find:

(i) A^2 ---[2]

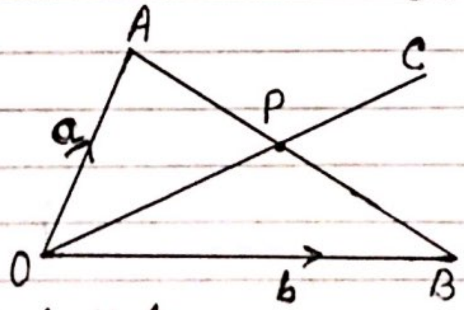
(ii) A^{-1}, the inverse of A. ---[2]

(b) Describe fully the single transformation represented by the matrix. $\begin{pmatrix}-1&0\\0&1\end{pmatrix}$ ---[2]

(c) Find the matrix that represents a clockwise rotation of 90° about the origin. ---[2]

(d) In the diagram, O is the origin and P lies on AB such that AP : PB = 3 : 4

$\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$



(i) Find $\vec{OP}$, in terms of $\mathbf{a}$ and $\mathbf{b}$, in its simplest form. ----[3]

(ii) The line OP is extended to C such that $\vec{OC} = m\vec{OP}$ and $\vec{BC} = k\mathbf{a}$

Find the value of m and the value of k. ---[2]

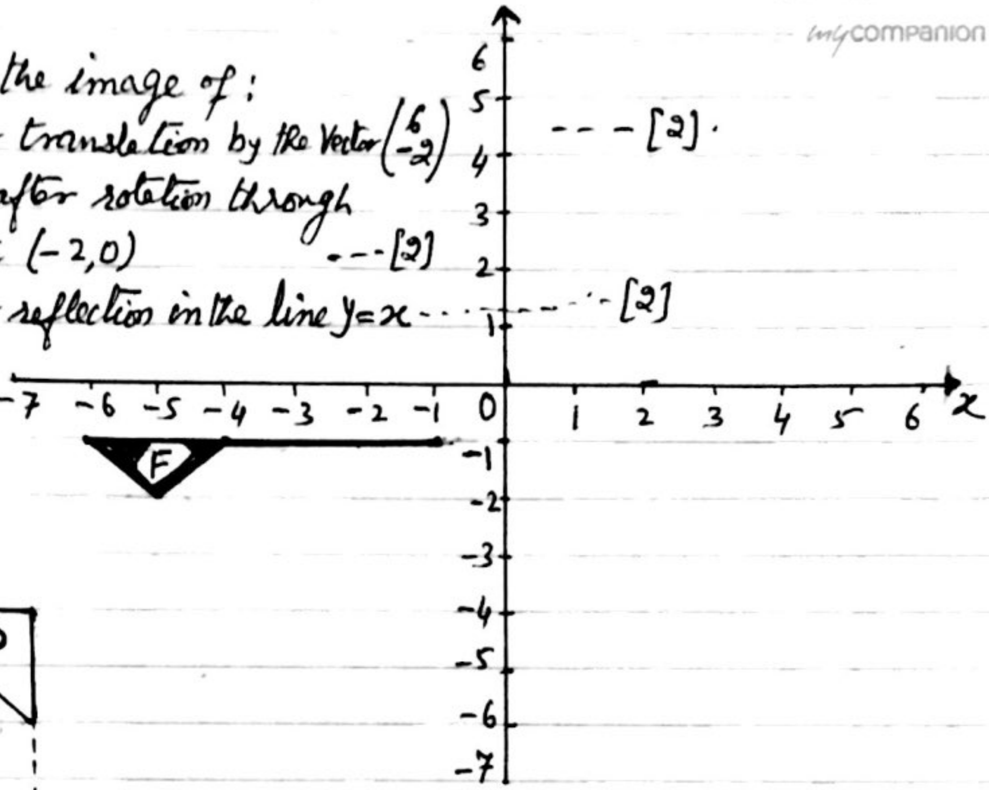
$\boxed{\text{W-17/41/Q11}}$

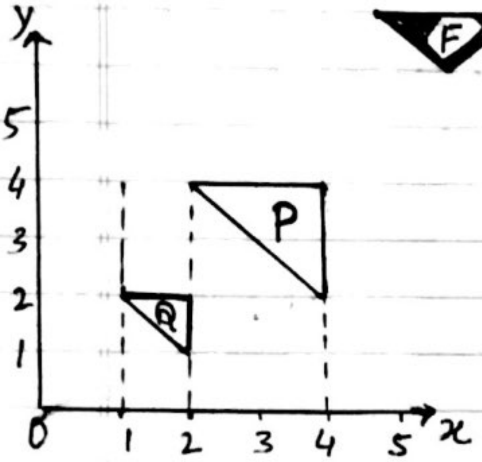
Q19 (a) Draw the image of:

(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 --- [2]

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

$|\overrightarrow{AB}| = 12.5$, find u. --- [3]

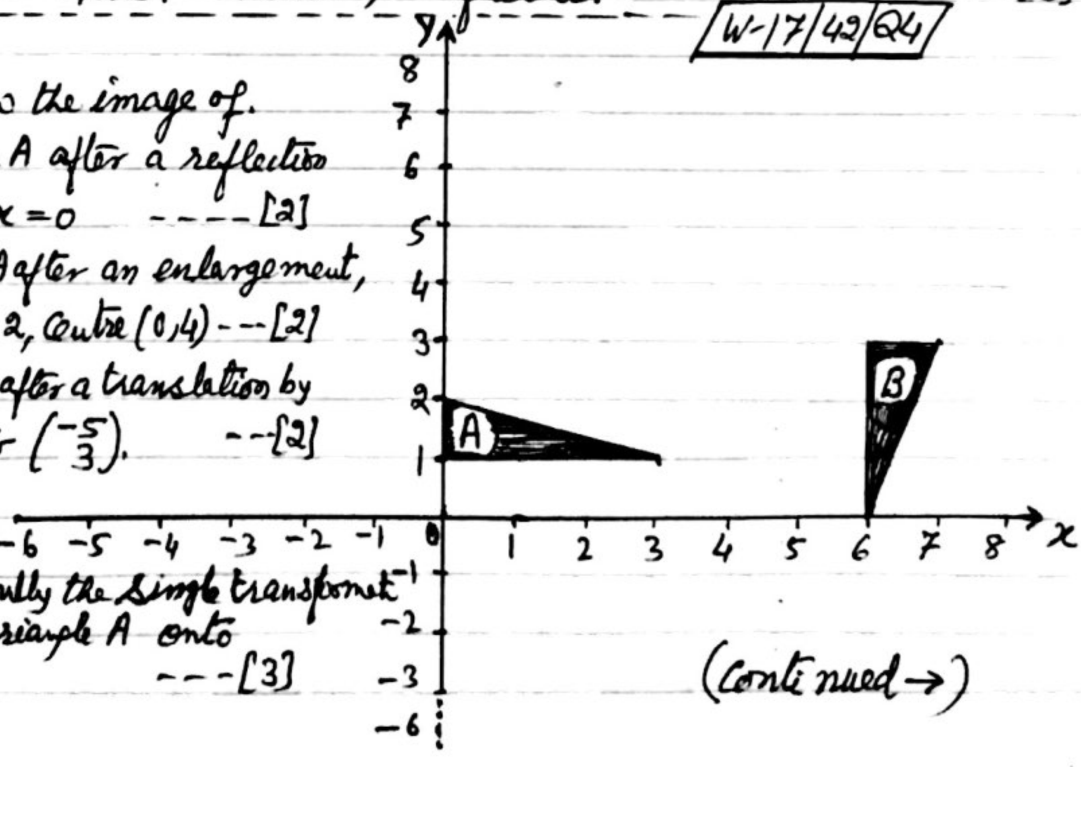
W-17/42/Q4

Q20 (a) Draw the image of.

(i) triangle A after a reflection in 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]

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IG-Maths 0580 — Matrices and Transformation — Exercise — P-11

(continued →)

Q20 (c) $T = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ $U = \begin{pmatrix} 3 & 1 \\ 0 & 2 \end{pmatrix}$

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

(i) Find $T(P)$ --- [2]

(ii) Find $TU(P)$ --- [2]

(iii) Describe the single transformation represented by the matrix T. --- [3]

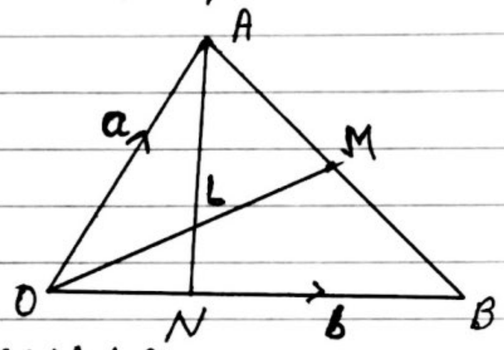
W-17/43/Q5

Q21 (a) $\overrightarrow{PQ} = \begin{pmatrix} 5 \\ -8 \end{pmatrix}$

(i) Find the value of $|\overrightarrow{PQ}|$ --- [2]

(ii) Q is the point $(2, -3)$. Find the coordinate of the point P. --- [1]

(b) In the diagram, M is the midpoint of AB and L is the midpoint of OM. The lines OM and AN intersect at L. and $ON = \frac{1}{3} OB$.
$\overrightarrow{OA} = \vec{a}$ and $\overrightarrow{OB} = \vec{b}$



(i) Find in terms of a and b, in its simplest form.

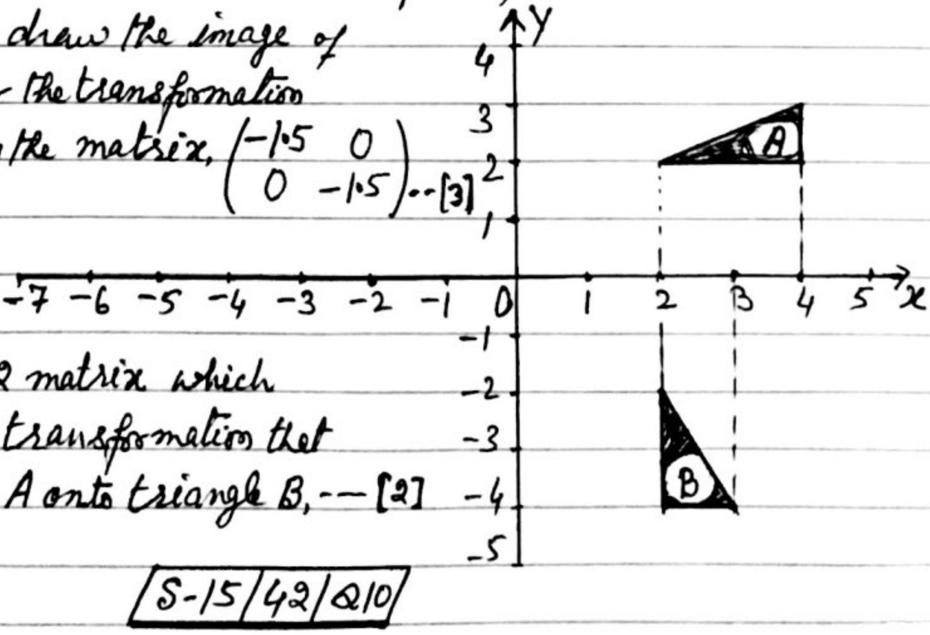
(a) $\overrightarrow{OM}$ --- [2]

(b) $\overrightarrow{OL}$ --- [1]

(c) $\overrightarrow{AL}$ --- [2]

(ii) Find the ratio AL : AN in its simplest form. --- [3]

(c) (i) On the grid, draw the image of triangle A after the transformation represented by the matrix, $\begin{pmatrix} -1.5 & 0 \\ 0 & -1.5 \end{pmatrix}$ --- [3]



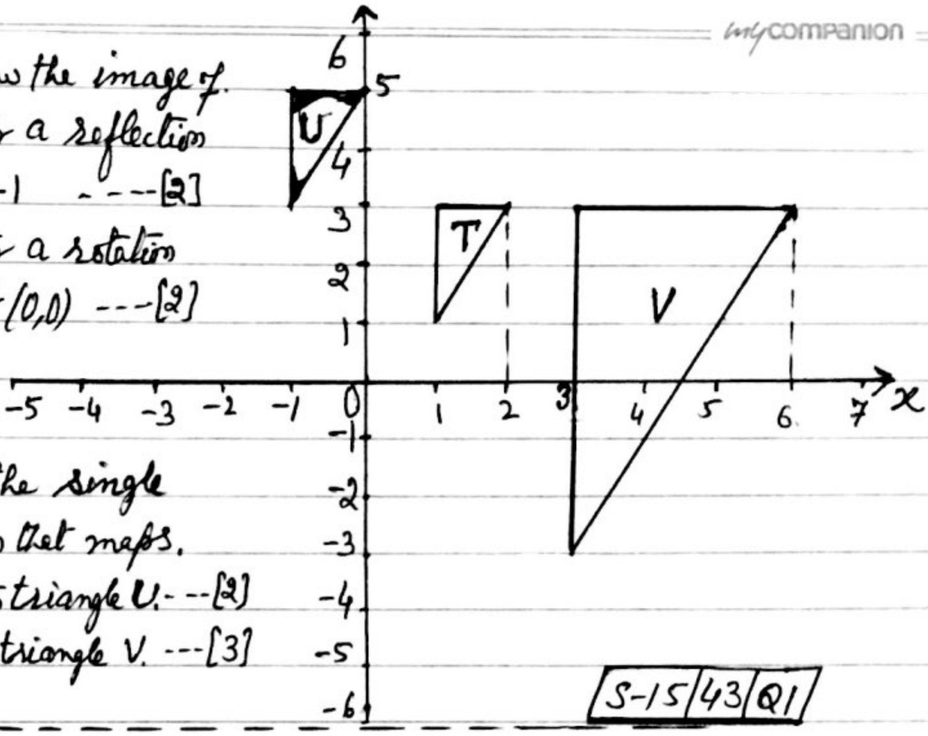
(ii) Find the 2×2 matrix which represents the transformation that maps triangle A onto triangle B. --- [2]

S-15/42/Q10

Q22 (a) On the grid, draw the image of.

(i) Triangle T after a reflection in the line $x=-1$ ---[2]

(ii) Triangle T after a rotation through 180° about (0,0) ---[2]



(b) Describe fully the single transformation that maps.

(i) triangle T onto triangle U. ---[2]

(ii) triangle T onto triangle V. ---[3]

S-15/43/Q1

Q23 $P=\begin{pmatrix}2&3\\1&4\end{pmatrix}$ $Q=\begin{pmatrix}1&2\\0&3\end{pmatrix}$ $R=\begin{pmatrix}0&u\\1&v\end{pmatrix}$ $S=\begin{pmatrix}w&3\\8&2\end{pmatrix}$

(a) Work out PQ ---[2]

(b) Find Q^{-1} ---[2]

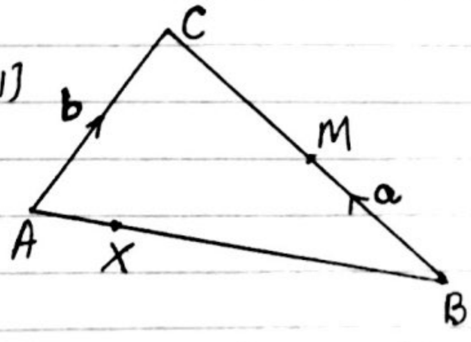
(c) PR = RP, Find the value of u and the value of v. --[3]

(d) The determinant of S is 0, Find the value of w. --[2]

S-15/43/Q9

Q24 $\vec{BC} = \mathbf{a}$ and $\vec{AC} = \mathbf{b}$

(a) Find $\vec{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. ---[1]



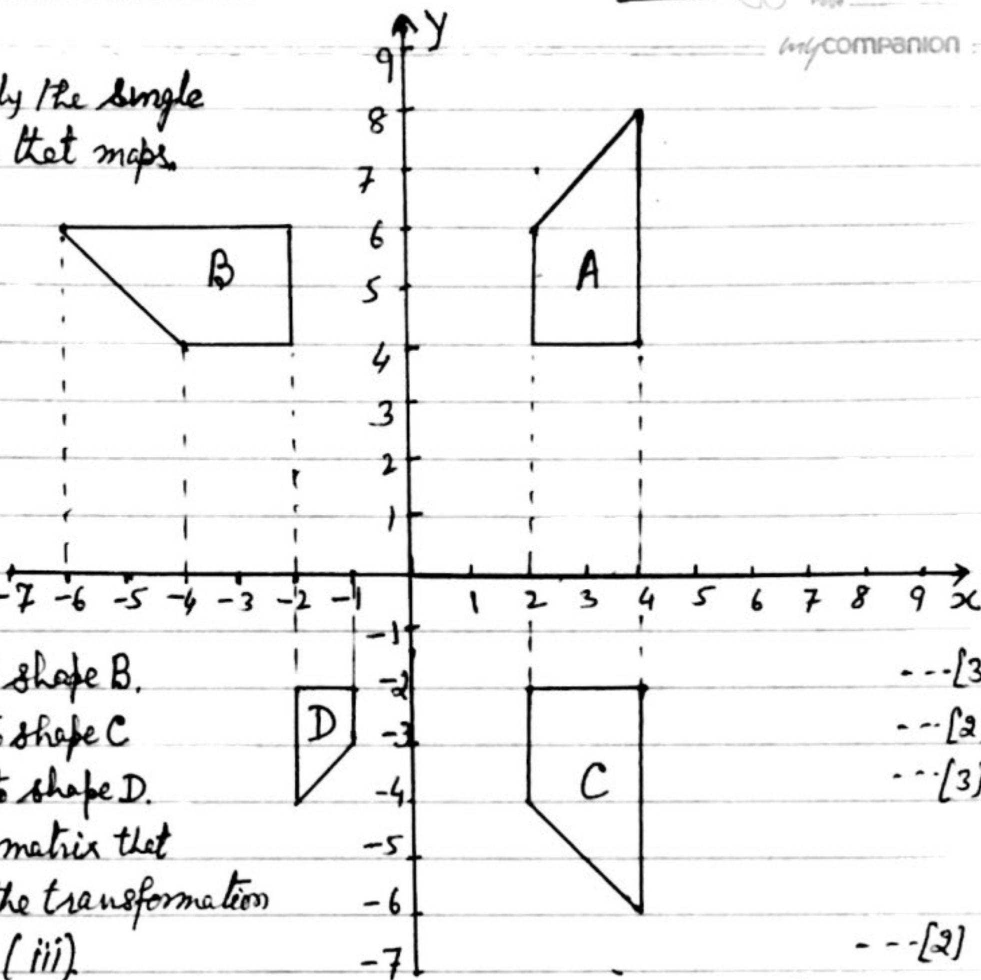
(b) M is the midpoint of BC.
X divides AB in the ratio 1:4.
Find $\vec{XM}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. Show all your working and give your answer in its simplest form. ---[4]

W-15/41/Q10

16-Maths 0580

Matrices and Transformation

Exercise P-13



Q-25 (a) Describe fully the single transformation that maps.

(i) Shape A onto shape B. ---[3]

(ii) Shape A onto shape C ---[2]

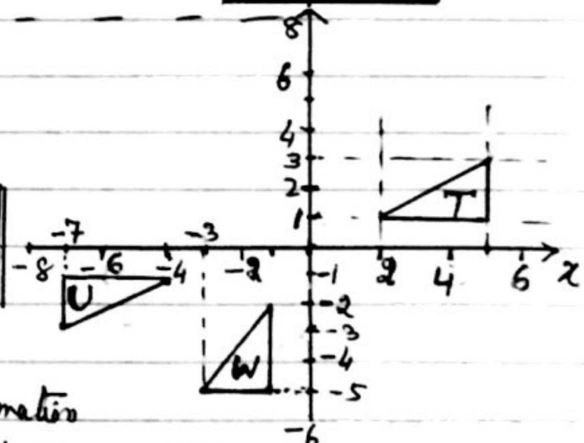
(iii) Shape A onto shape D. ---[3]

(b) Find 2×2 matrix that represent the transformation in part (a) (iii). ---[2]

(C) On the grid, draw the image of shape A after a translation by the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$. ---[2]

(d) Describe fully the single transformation represented by the matrix. $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ ---[2]

W-15/42/Q7



Q26 (a) On the grid, draw the image of.

(i) triangle T after a translation by the vector $\begin{pmatrix} -4 \\ 4 \end{pmatrix}$ ---[2]

(ii) triangle T after a reflection in the line $y = -1$ ---[2]

(b) Describe fully the single transformation that maps triangle T onto triangle U. ---[2]

(C)(i) Describe fully the single transformation that maps triangle T onto triangle W. ---[2]

(ii) Find the 2×2 matrix that represents the transformation in part C(i) ---[2]

W-15/43/Q2

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Q27 $A = \begin{pmatrix} 3 & 2 \\ -1 & 1 \end{pmatrix}$ $B = \begin{pmatrix} -2 & 5 \end{pmatrix}$ $C = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ $D = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$

(a) Work out when possible, each of the following.
If it is not possible, write 'not possible' in the answer space.

(i) $2A$ ---[1]

(ii) $B+C$ ---[1]

(iii) AD ---[2]

(iv) A^{-1} the inverse of A. ---[2]

(b) Explain why it is not possible to work out CD ---[1]

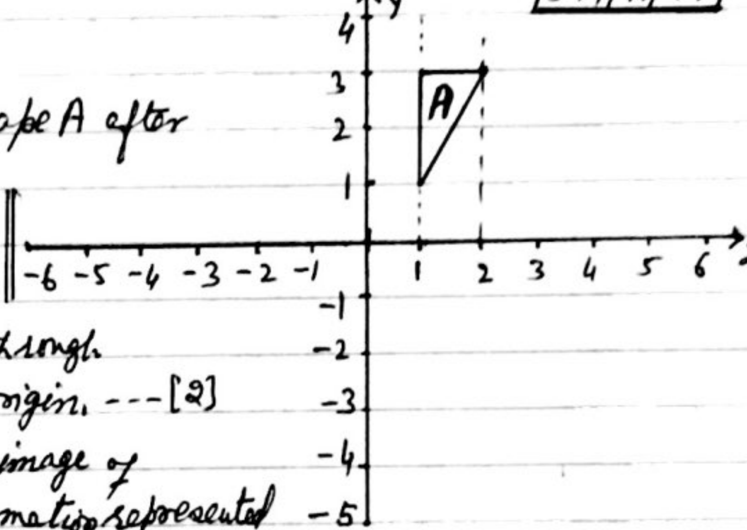
(C) Describe fully the single transformation represented by the Matrix D - [3]

S-14/41/Q1

Q28 (a) On the grid,

(i) Draw the image of Shape A after a translation by the vector $\begin{pmatrix} -5 \\ -4 \end{pmatrix}$ ---- [2]

(ii) Draw the image of Shape A after a rotation through 90° clockwise about the origin. --- [2]



(b) (i) On the grid, draw the image of shape A after the transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$. --- [3]

(ii) Describe fully the single transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$. --- [3]

S-14/41/Q7

Q29 (a) $\vec{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$

(i) P is the point (-2,3). Work out the co-ordinates of Q. --[1]

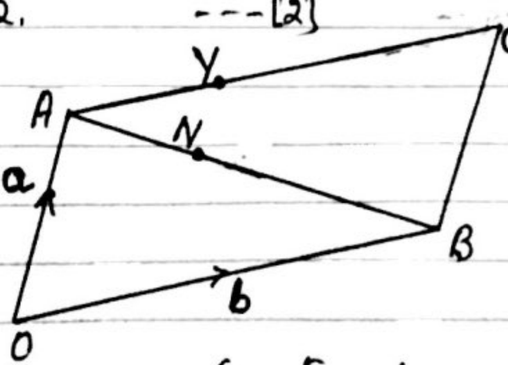
(ii) Work out $|\vec{PQ}|$, the magnitude of $\vec{PQ}$. --- [2]

(b) OACB is parallelogram.

$\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$

$AN : NB = 2 : 3$ and $AY = \frac{2}{5} AC$

Write each of the following in terms of **a** and/or **b**. Give your answers in the simplest form.



(Continued →)

(Continued→)

Q29 (b)(i) (a) $\overrightarrow{ON}$ ---[2]

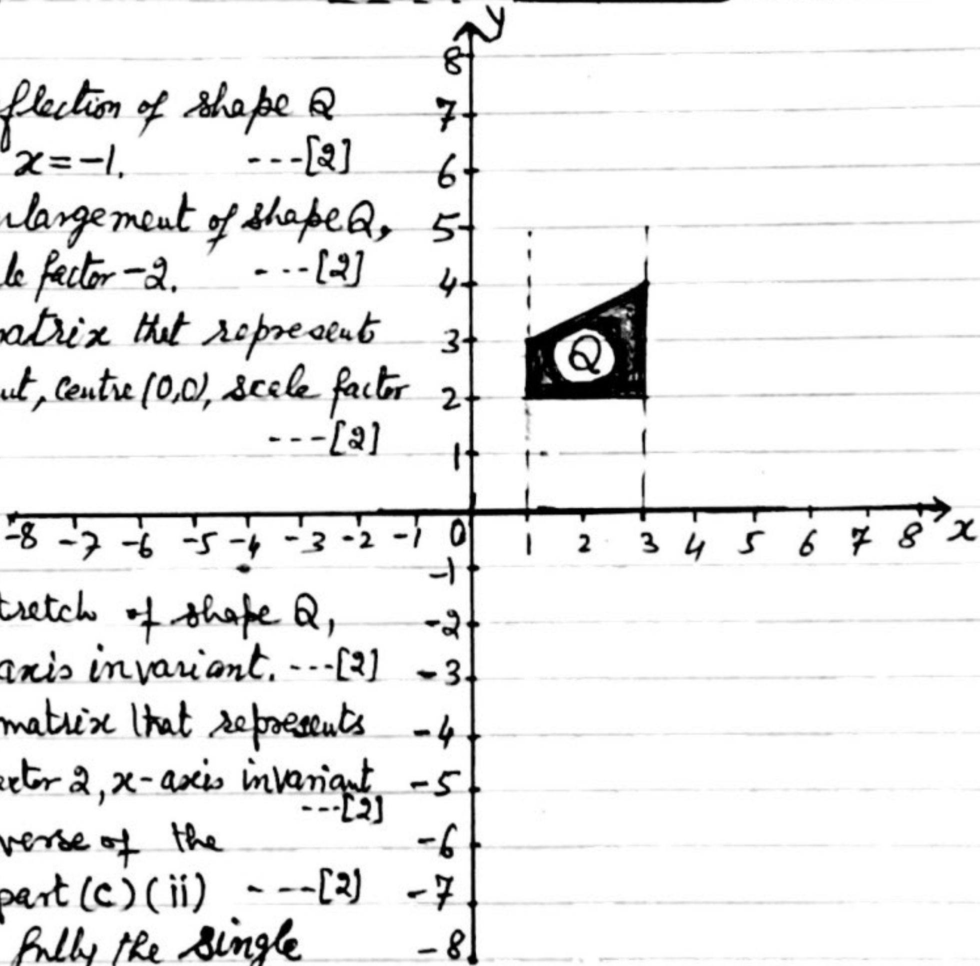
(b) $\overrightarrow{NY}$ ---[2]

(ii) Write down two conclusions you can make about the line segment NY and BC. [S-14/41/Q11] ---[2]

Q 30. (a) Draw the reflection of shape Q in the line $x=-1$. ---[2]

(b)(i) Draw the enlargement of shape Q, Centre (0,0), scale factor -2. ---[2]

(ii) Find 2×2 matrix that represent an enlargement, centre (0,0), scale factor -2. ---[2]



(c) (i) Draw the stretch of shape Q, factor 2, x-axis invariant. ---[2]

(ii) Find 2×2 matrix that represents a stretch, factor 2, x-axis invariant ---[2]

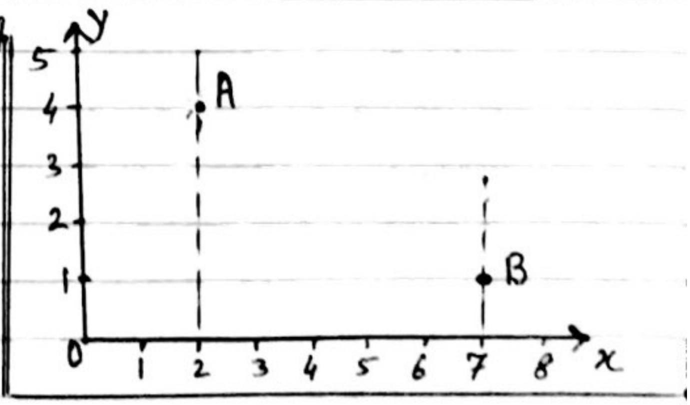
(iii) Find the inverse of the matrix in part (c)(ii) ---[2]

(iv) Describe fully the single transformation represented by the matrix in part (c)(iii). ---[3]

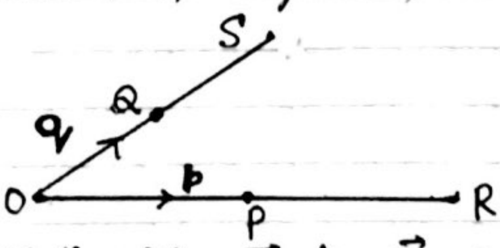
[S-14/42/Q4]

Q31 (a)(i) Write down the position vector of A. ---[1]

(ii) Find $|\overrightarrow{AB}|$, the magnitude of $\overrightarrow{AB}$ ---[2]



(b)



O is the origin, $\overrightarrow{OP} = p$, $\overrightarrow{OQ} = q$

OP is extended to R so that OP = PR; OQ is extended to S, so that OQ = QS

(i) Write down $\overrightarrow{RQ}$ in terms of p and q. ---[1]

(Continued→)

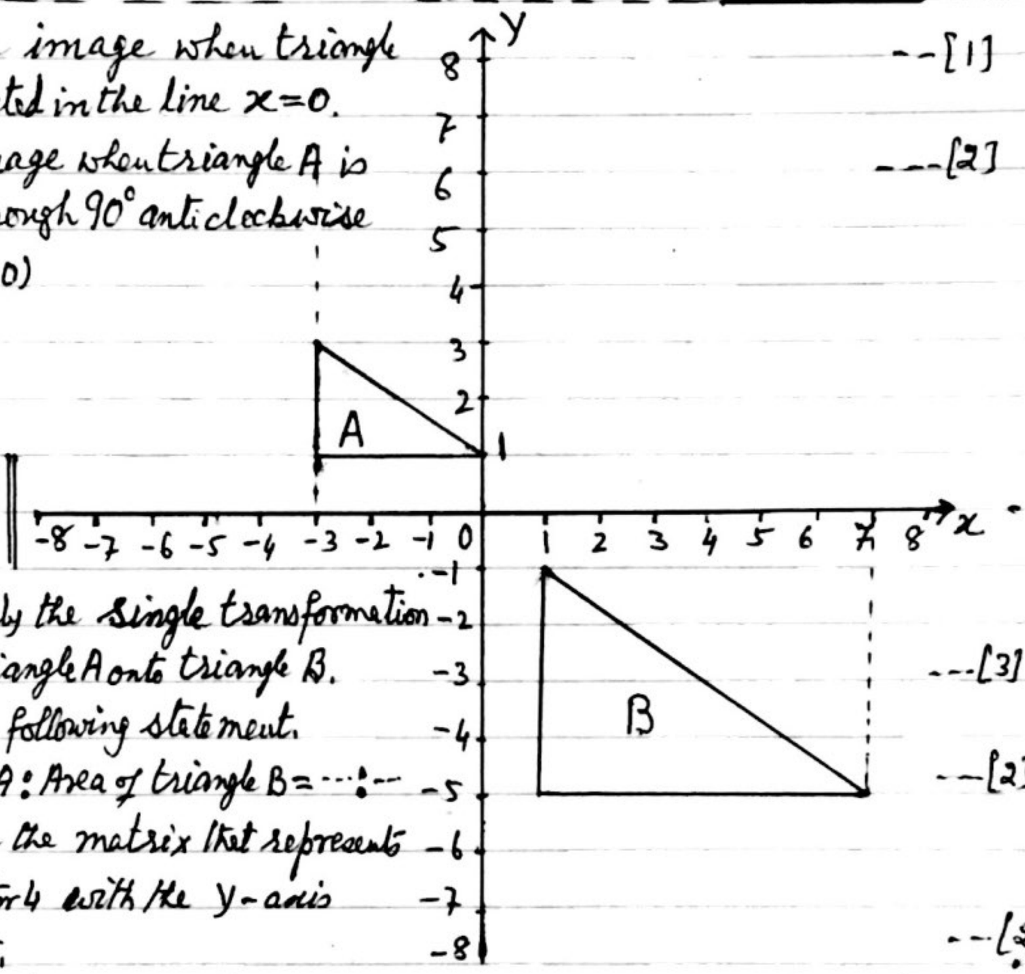
(Continued→)

Q31 (b) (ii) PS and RQ intersect at M and RM = 2MQ
Use vectors to find the ratio PM : PS, showing all your working. --[4]

S-14/43/Q5

Q32 (a) Draw the image when triangle A is reflected in the line $x=0$. --[1]

(b) Draw the image when triangle A is rotated through 90° anticlockwise about (-4,0) ---[2]



(c) (i) Describe fully the single transformation that maps triangle A onto triangle B. ---[3]

(ii) Complete the following statement.
Area of triangle A : Area of triangle B = ...:... --[2]

(d) Write down the matrix that represents a stretch, factor 4 with the y-axis invariant. --[2]

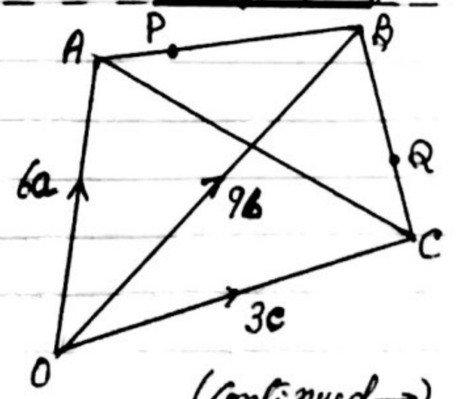
(e) (i) On the grid, draw the image of triangle A after the transformation represented by the matrix $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$ ---[3]

(ii) Describe fully this single transformation. --[3]

(iii) Find the inverse of the matrix $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$ ---[2]

W-14/41/Q3

Q33 In the diagram, O is the origin and $\vec{OA} = 6a$, $\vec{OB} = 9b$ and $\vec{OC} = 3c$.
The point P lies on AB such that $\vec{AP} = 3b - 2a$.
The point Q lies on BC such that $\vec{BQ} = 2c - 6b$.



(Continued→)

(Continued→)

Q33 (a) Find, in terms of **b** and **c**, the position vector of Q.
Give your answer in its simplest form. ---[2]

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

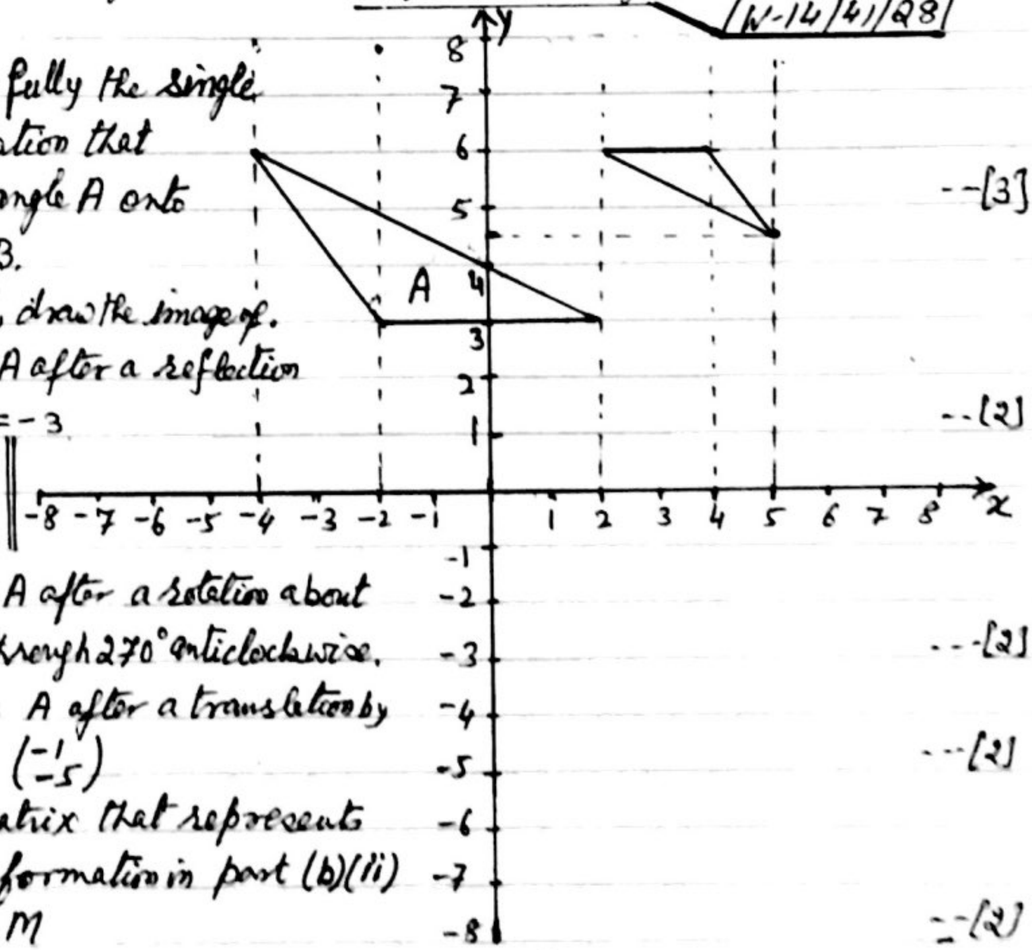
(i) $\vec{AC}$ ---[1]

(ii) $\vec{PQ}$ ---[2]

(C) Explain what your answers in part (b) tells you about PQ and AC. --[2]

W-14/41/Q8

Q34 (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 line $x = -3$ --[2]

(ii) triangle A after a rotation about the origin through 270° anticlockwise. ---[2]

(iii) triangle A after a translation by the vector $\begin{pmatrix} -1 \\ -5 \end{pmatrix}$ ---[2]

(C) M is a matrix that represents the transformation in part (b)(ii)

(i) Find M --[2]

(ii) Describe fully the single transformation represented by M^{-1}, the inverse of M. ---[2]

W-14/42/Q4

Q35 $P = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ $Q = \begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}$ $R = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$

(a) Work out.

(i) 4P ---[1]

(ii) P-Q ---[1]

(iii) P^2 ---[2]

(iv) QR ---[2]

(b) Find the matrix S, so that $QS = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$. ---[3]

W-14/43/Q5

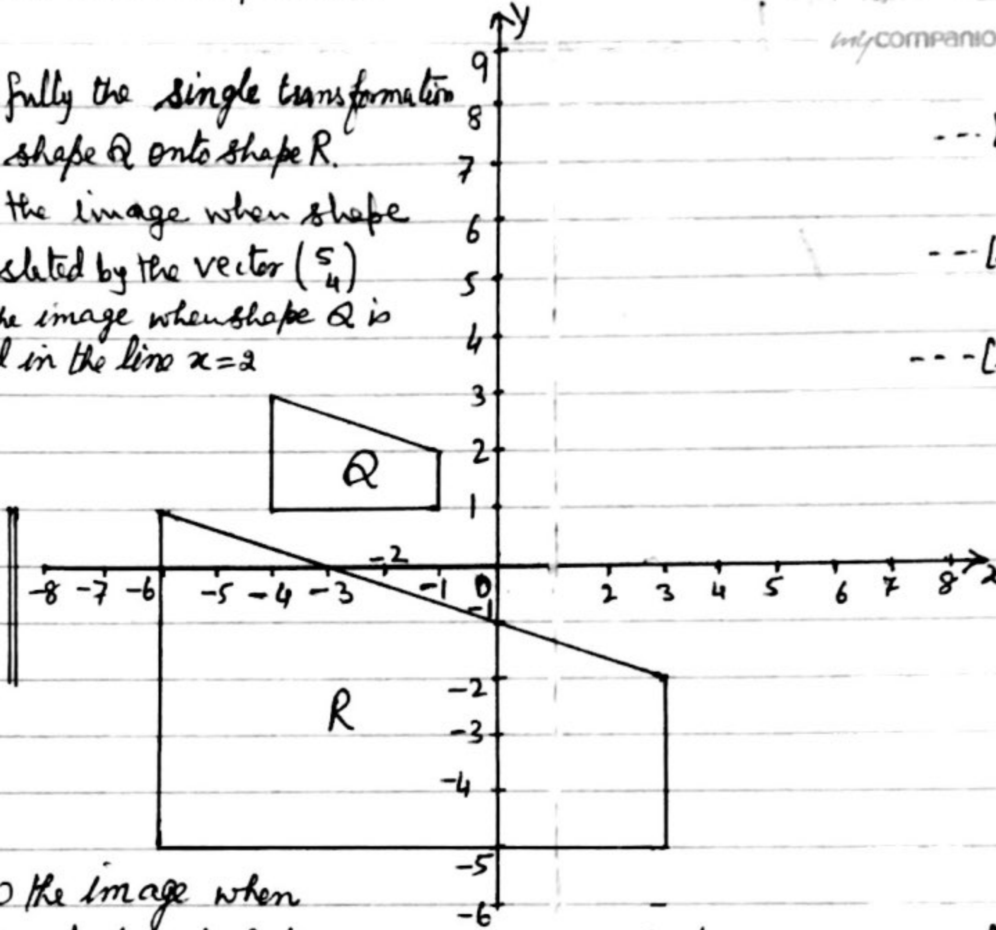
Matrices and Transformation

Exercise.

Q36 (a) Describe fully the single transformation that maps shape Q onto shape R. --- [3]

(b)(i) Draw the image when shape Q is translated by the vector $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$ --- [2]

(ii) Draw the image when shape Q is reflected in the line $x=2$ --- [2]



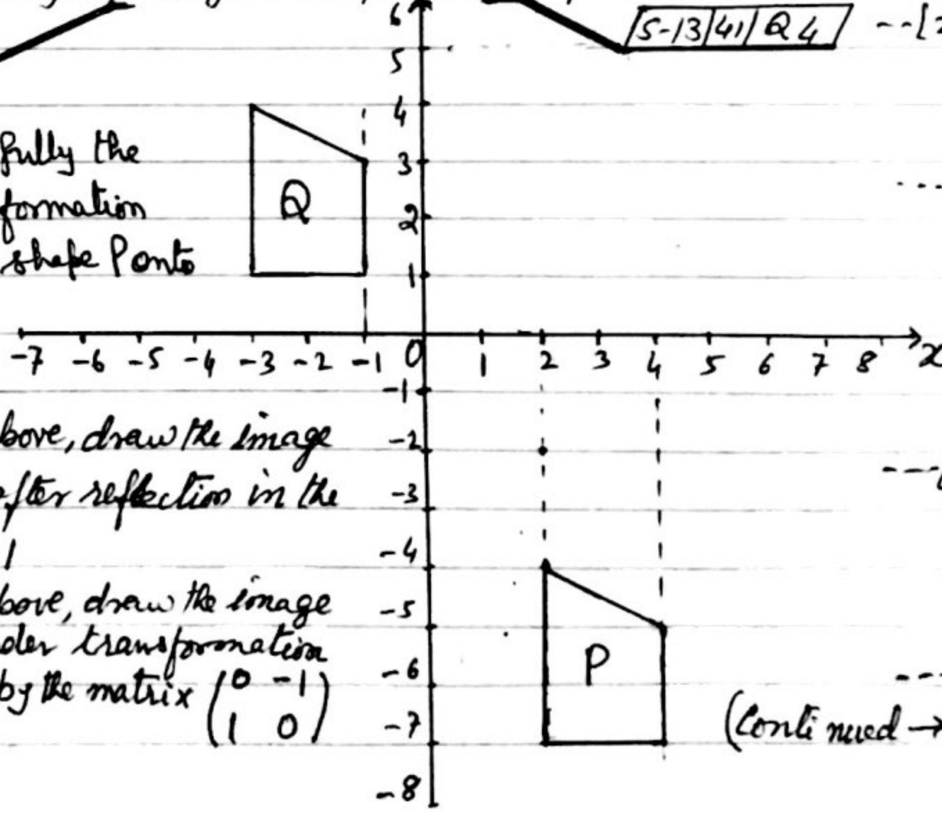
(iii) Draw the image when shape Q is stretched, factor 3, x-axis invariant. --- [2]

(iv) Find the 2×2 matrix that represents a stretch of factor 3, x-axis invariant. --- [2]

(c) Describe fully the single transformation represented by the matrix. $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. --- [2]

5-13/41/Q4

Q37 (a)(i) Describe fully the single transformation which maps shape P onto shape Q. --- [2]



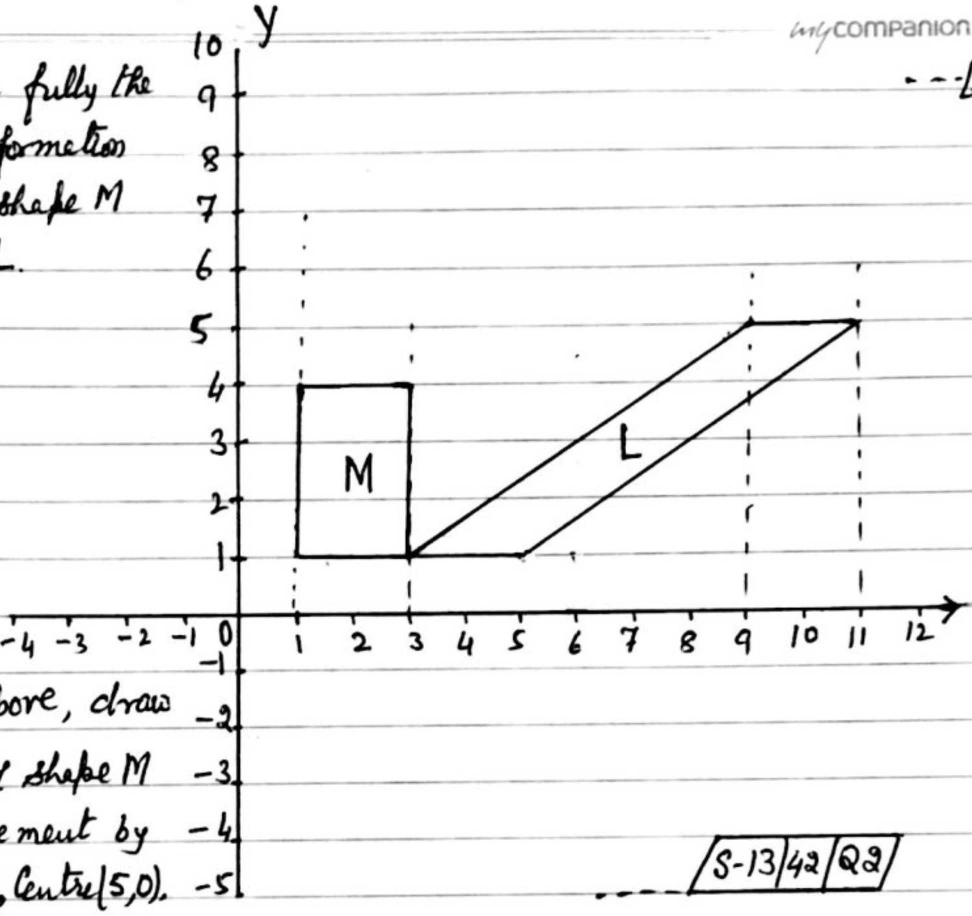
(ii) On the grid above, draw the image of shape P after reflection in the line $y=-1$ --- [2]

(iii) On the grid above, draw the image of shape P under transformation represented by the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ --- [3]

(Continued →)

(→ Continued)

Q37 (b)(i) describe fully the single transformation which maps shape M onto shape L. ---[3]



(ii) On the grid above, draw the image of shape M after enlargement by scale factor 2, Centre (5,0).

---- S-13 | 42 | Q2

Q38 $A = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$ $B = \begin{pmatrix} 6 & -4 \end{pmatrix}$ $C = \begin{pmatrix} 2 & 4 \\ 1 & 3 \end{pmatrix}$ $D = \begin{pmatrix} 2 & 9 \\ -1 & -3 \end{pmatrix}$

(a) Calculate the result of each of the following, if possible.
If a calculation is not possible, write "not possible" in the answer space.

(i) $3A$ ---[1]

(ii) AC ---[1]

(iii) BA ---[2]

(iv) $C + D$ ---[1]

(v) D^2 ---[2]

(b) Calculate C^{-1}, the inverse of C. ---[2]

S-13 | 42 | Q7

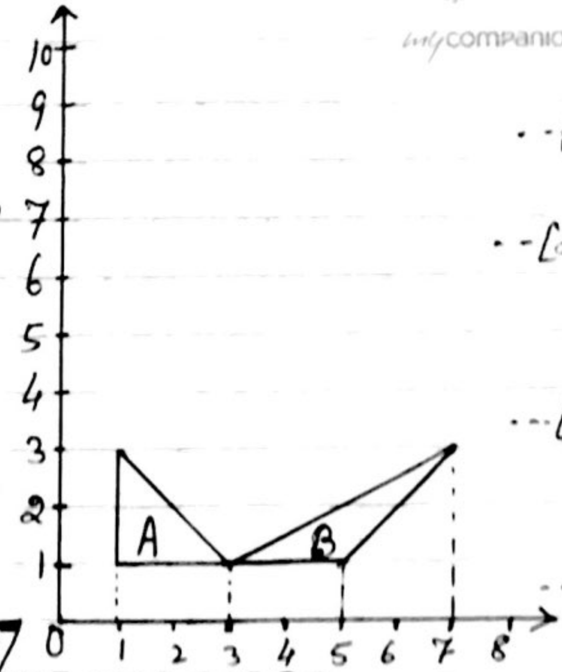
Q 39 (a)(i) Draw the image of shape A after a stretch, factor 3, x-axis invariant. ---[2]

(ii) Write down the matrix representing a stretch, factor 3, x-axis invariant. ---[2]

(b)(i) Describe fully the single transformation which maps shape A onto shape B. ---[3]

(ii) Write down the matrix representing the transformation which maps shape A onto shape B. ---[2]

S-13/43/Q7

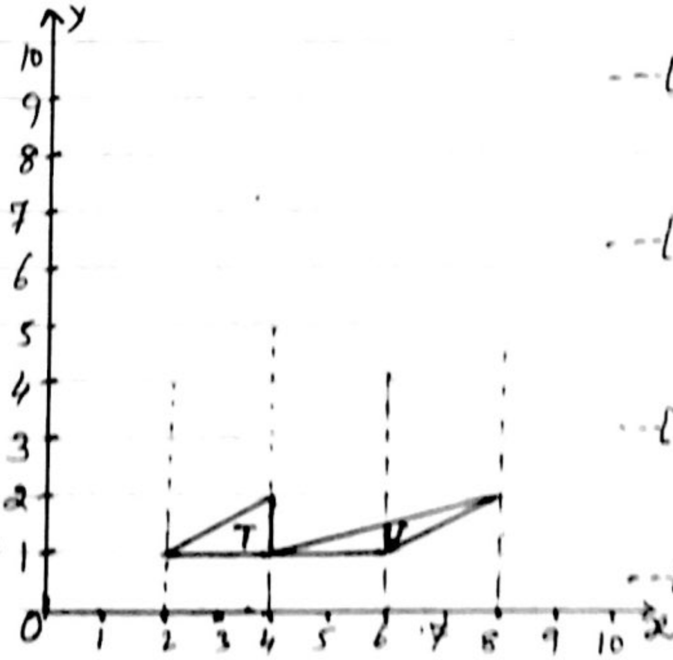


Q40 (a)(i) Draw the reflection of triangle T in the line y = 5. ---[2]

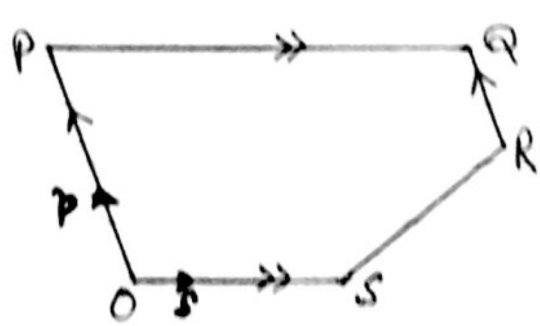
(ii) Draw the rotation of triangle T about the point (4, 2) through 180°. ---[2]

(iii) Describe fully the single transformation that maps triangle T onto triangle U ---[3]

(iv) Find the 2×2 matrix which represents the transformation in part (a)(iii) ---[2]



(b) In the pentagon OPQRS, OP is parallel to RQ and OS is parallel to PQ. PQ = 2OS and OP = 2RQ. O is the origin, $\vec{OP} = p$ and $\vec{OS} = s$.



Find in terms of p and s, in their simplest form,

(i) the position vector of Q. ---[2]

W-13/41/Q5

(ii) $\vec{SR}$ ---[2]

(c) Explain what your answer in part (b) tell you about OQ and SR. ---[1]

IG - Maths 0580 Matrices and Transformation Vectors

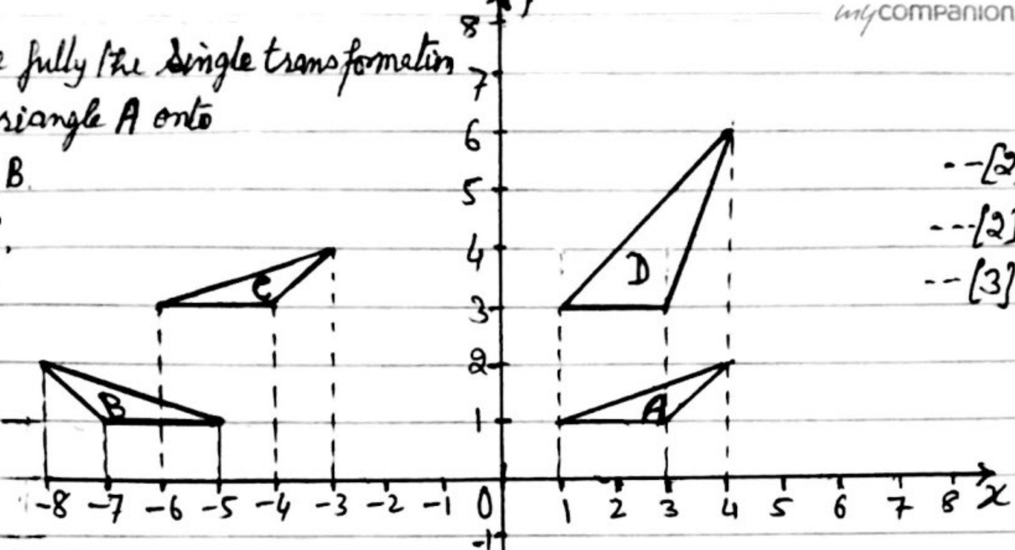
Exercise

Q41 (a) Describe fully the single transformation that maps triangle A onto

(i) triangle B. --[2]

(ii) triangle C. --[2]

(iii) triangle D. --[3]



(b) On the grid, draw

(i) rotation of triangle A about (6,0) through 90° clockwise. ---[2]

(ii) the enlargement of triangle A by factor −2 with centre (0,−1) --[2]

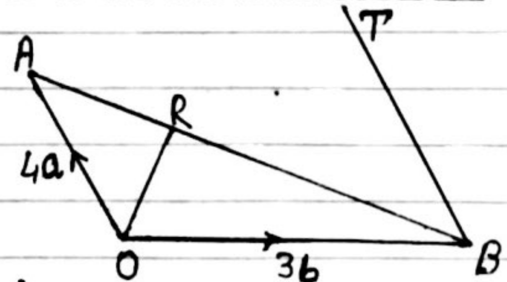
(iii) the shear of triangle A by shear factor −2 with y-axis invariant. --[2]

(c) Find the matrix that represents the transformation in part (b)(iii). W-13/42/Q9 --[2]

Q42 In diagram, $\vec{OA} = 4a$ and $\vec{OB} = 3b$

R lies on AB such that $\vec{OR} = \frac{1}{5}(12a + 6b)$

T is the point such that $\vec{BT} = \frac{3}{2}\vec{OA}$



(i) Find the following in terms of a and b, giving your answers in its simplest form.

(a) $\vec{AB}$ --[1]

(b) $\vec{AR}$ --[2]

(c) $\vec{OT}$ --[1]

(ii) Complete the following statement.

The points O, R and T are in a straight line because - - - --[1]

(iii) Triangle OAR and Triangle TBR are similar.

Find the value of $\dfrac{\text{area of triangle } TBR}{\text{area of triangle } OAR}$ --[2]

W-13/43/Q7(b)

IG-Maths 0580

Vector- Matrices and Transformations

Exercise - Paper 4

Answers

Q1 (a)(i) Reflection in $y=-2$

(ii) Enlargement, centre $(1,4)$ scale factor $\frac{1}{2}$

(iii) Rotation by 90° clockwise around $(1,-3)$.

(b) (i) Triangle $(-4,4),(-1,4),(-1,5)$

(ii) Triangle $(2,4),(8,4),(8,6)$

(c) Rotation by 180° through origin or Enlargement by scale factor -1, through origin.

Q2 (a)(i) Rotation by 90°, anticlockwise through $(9,5)$.

(ii) Translation $\begin{pmatrix}-8\\-14\end{pmatrix}$

(iii) Enlargement, scale factor $1/3$ centre $(-8,-2)$.

b(i) Image at $(1,-3),(2,-3),(2,-5)$

(ii) $\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$

Q3 (a)(i) $(5,1),(7,1),(7,4)$

(ii) $(-1,1),(-4,1),(-1,3)$

(iii) $(2,-4),(4,-4),(2,-1)$.

(b) Enlargement s.f = -0.5 Centre $(5,5)$.

(c) $\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}$

(d) (i) $(4,2)$, (ii) $(-4,2)$

(iii) $\frac{1}{2}\begin{pmatrix}2 & 0\\0 & 1\end{pmatrix}$

Q4 (a)(i) Image at $(8,1),(10,5),(8,5)$

(ii) Image at $(4,10),(4,8),(8,8)$

(iii) Image at $(6,3),(6,5),(7,5)$.

2(b) Reflection in $y=-x$.

(c)(i)(a) $\begin{pmatrix}13\\16\end{pmatrix}$ (b) $\begin{pmatrix}2 & 10\\3 & 15\end{pmatrix}$ (c) $\frac{1}{2}\begin{pmatrix}4 & -3\\-2 & 2\end{pmatrix}$

(c)(ii) NM or MP or N^2 or P^2

Q5 (a)(i) Translation $\begin{pmatrix}3\\-13\end{pmatrix}$

a(ii) Enlargement, s.f $= -\frac{1}{2}$, $(0,-4)$

(b) Image at $(0,0),(0,6),(-4,6),(-4,2)$

(c) Image at $(4,0),(10,0),(10,-4),(6,-4)$.

(d) Enlargement, sf -3, origin

Q6 (a)(i) Rotation by 90° anticlockwise about $(4,4)$

(ii) Enlargement, centre $(5,1)$, sf -2.

b(i) Image at $(-2,5),(-2,7),(-1,7)$

(ii) Image at $(-2,1),(-2,-1),(-1,-1)$

(c) Image at $(-2,3),(-4,3),(-4,-4)$

Q7 (a) (i) y (ii) $x+y$ (iii) $x+2y$

(b) $-(\frac{1}{2}x+y)$ (c)(i) $\vec{MG} = 2x+2y$

(c)(ii) $\vec{MH} = x+y$, $\vec{HG} = x+y$

$\vec{MG} = 2\vec{MH}$ ∴ H lies on MG.

Q8 (a)(i) Vertices $(2,-4),(2,-5),(4,-4)$.

(ii) Image at $(-3,4),(-3,5),(-1,4)$

(iii) Enlargement, s.f $= 3$, Centre $(-6,-5)$.

(Continued →)

IG-Maths 0580

Vectors, Matrices and Transformation

Exercise - Paper- 4

Answers

Q8 (b) (i) $\begin{pmatrix} 2 & 5 \\ 3 & 10 \end{pmatrix}$ (ii) $\begin{pmatrix} 10 & 14 \\ 18 & 24 \end{pmatrix}$

(iii) $\frac{1}{4}$

c (i) Rotation, 90° anticlockwise about (0,0).

(ii) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

Q9 (a) (i) $\frac{1}{2}p$ (ii) $\frac{1}{2}p - \frac{1}{3}r$

(iii) $p + \frac{2}{3}r$

(b) $r + \frac{1}{2}p$

(c) 6

Q10 (a) (i) Not possible (ii) $\begin{pmatrix} 4 & 0 \\ -2 & 10 \\ 6 & -8 \end{pmatrix}$

(iii) $\begin{pmatrix} 14 & 35 \\ -8 & -20 \end{pmatrix}$ (iv) (-6)

(v) $\begin{pmatrix} -2 & 18 \\ -6 & 22 \end{pmatrix}$

(b) $\frac{1}{8}\begin{pmatrix} 5 & -3 \\ 1 & 1 \end{pmatrix}$

Q11 (a) (i) Image at (3,1), (5,1), (5,4), (4,4), (4,2), (3,2)

(a) (ii) Image at (2,1), (6,1), (6,-5), (4,-5), (4,-1), (2,-1)

(iii) Image at (-1,-1), (-2,-1), (-2,-2) (-4,-2), (-4,-3), (-1,-3).

(b) Enlargement, Sf-3, about (0,0).

Q12 (a) (i) Image at (2,-5), (4,-5), (4,-1)

(a) (ii) (-2,1), (-6,1), (-6,-1)

(iii) Translation by $\begin{pmatrix} 1 \\ 9 \end{pmatrix}$

(iv) Enlargement S.f- $-\frac{1}{2}$, Centre (2,1).

Q12 (b) (i) $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ (ii) Reflection in $x = 0$

Q13 (a) (i) Image at (-2,-4), (4,-4), (4,0)

(ii) 8.94

(b) (i) Enlargement, S.f- 0.5 Centre (0,0).

(ii) $\begin{pmatrix} 0.5 & 0 \\ 0 & 0.5 \end{pmatrix}$ (iii) 0.25 or $\frac{1}{4}$

Q14 (a) Image at (-4,3), (-1,3), (-1,4)

(b) Image at (1,7), (1,6), (4,6)

(c) Image at (2,3), (2,1), (8,1)

(d) Rotation, 90° clockwise, Centre (7,4).

Q15 (a) (i) $\begin{pmatrix} 12 \\ -5 \end{pmatrix}$ (ii) 13

(b) (i) (a) b − a (b) $\frac{3}{5}(b-a)$

(c) $\frac{1}{5}(2a+3b)$

b (ii) 3/2

Q16 (a) (i) Rotation, centre (0,0), 90° anticlockwise.

(ii) Enlargement, centre (-2,1), Sf- −2.

(b) Image at (-3,4), (-3,5), (-3,6), (-2,6).

(c) Image at (7,3), (7,4), (7,5), (6,5).

(d) Reflection in x-axis.

Q17 (a) (i) Image at (1,4), (1,5), (2,5), (4,4)

(ii) (-2,-1), (-5,-1), (-2,-2), (-3,-2).

(iii) Image at (2,-1), (2,-2), (3,-2), (5,-1).

(b) Enlargement, Centre (1,0) Sf. −3

(c) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

Vectors, Matrices and Transformations

Exercise - Paper - 4

Answers

Q18 (a)(i) $\begin{pmatrix} -1 & 18 \\ 6 & 13 \end{pmatrix}$

(ii) $\frac{1}{11}\begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$

(b) Reflection in y- axis

(c) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

(d)(i) $\frac{1}{7}(4a+3b)$

(ii) $m = \frac{7}{3}$; $k = 4/3$

Q19 (a)(i) Correct translation

(ii) Correct rotation

(iii) Correct reflection.

(b)(i) Enlargement, s.f. $\frac{1}{2}$ Centre (0,0).

b(ii) $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$

(c) ± 2.5

Q20 (a)(i) Image at (0,1), (0,2), (-3,1)

(a)(ii) Image at (0,0), (0,-2), (6,-2).

(iii) Image at (-5,4), (-5,5), (-2,4)

(b) Rotation 90° clockwise Centre (4,-1)

(c)(i) (4,1), (ii) (8,-1).

(iii) Rotation 90° anticlockwise Centre (0,0).

Q21 (a)(i) 9.43 (ii) (-3,5)

(b)(i) (a) $\frac{1}{3}(a+b)$ (b) $\frac{1}{4}(a+b)$

(c) $\frac{1}{4}(b-3a)$

b(ii) 3 : 4

c (i) Image at (-3,-3), (-6,-3), (-6,$-4\frac{1}{2}$)

(ii) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

Q22 (a)(i) Image at, (-3,1), (-3,3), (-4,3)

(ii) Image at, (-1,-1), (-2,-3), (-1,-3).

(b)(i) Translation $\begin{pmatrix} -2 \\ 2 \end{pmatrix}$

(ii) Enlargement, (0,3), s.f. 3

Q23 (a) $\begin{pmatrix} 2 & 13 \\ 1 & 14 \end{pmatrix}$ (b) $\frac{1}{3}\begin{pmatrix} 3 & -2 \\ 0 & 1 \end{pmatrix}$

(c) u = 3 , v = 2

(d) 12

Q24 (a) $b - a$

(b) $\frac{4}{5}b - \frac{3}{10}a$

Q25 (a)(i) Rotation, 90° anticlockwise Centre (0,2)

(ii) Reflection in y = 1

(iii) Enlargement, s.f $-\frac{1}{2}$, Centre (0,0)

(b) $\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}$

(c) Image at (4,1), (6,1), (6,5), (4,3).

(d) Reflection in y = x

Q26 (a)(i) Image at, (-2,5), (1,5), (1,7).

(ii) Image at. (2,-3), (5,-3), (5,-5)

(b) Rotation, 180°, Centre (-1,0).

(c)(i) Reflection in y = -x

(ii) $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$

Q27 (i) $\begin{pmatrix} 6 & 4 \\ -2 & 2 \end{pmatrix}$ (ii) not possible

(iii) $\begin{pmatrix} 6 & 4 \\ -2 & 2 \end{pmatrix}$ (iv) $\frac{1}{5}\begin{pmatrix} 1 & -2 \\ 1 & 3 \end{pmatrix}$

(b) 1 column in C and 2 rows in D.

(c) Enlargement, s.f. 2 Centre (0,0).

Answers

Q28 (a) (i) Image at, (-4,-3), (-4,-1), (-3,-1)
(ii) Image at, (1,-1), (3,-1), (3,-2).
(b) (i) Image at, (2,1), (2,3), (4,3).
(ii) Stretch, factor 2,
Invariant line y-axis.

Q29 (a) (i) (-5,7), (ii) 5
(b) (i) (a) $\frac{1}{5}(3a+2b)$ (b) $\frac{2}{5}a$
(b) (ii) $NY = \frac{2}{5} BC$
∴ NY is parallel to BC.

Q30 (a) Image at (-3,2), (-5,2), (-5,4), (-3,3)
(b) (i) Image at (-2,-4), (-6,-4), (-6,-8), (-2,-6)
(ii) $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$
(c) (i) Image at (1,4), (3,4), (3,8), (1,6)
(ii) $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ (iii) $\frac{1}{2}\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$
(iv) Stretch, factor $\frac{1}{2}$, invariant line x-axis

Q31 (a) (i) $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$ (ii) 5.83
(b) (i) $-2p+q$ (ii) 1:3

Q32 (a) Image at (0,1), (3,1), (3,3)
(b) Image at (-5,1), (-7,1), (-5,4)
(c) (i) Enlargement, s.f. 2, Centre (-7,7)
(ii) 1:4
(d) $\begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix}$
(e) (i) Image (0,1), (-3,-5), (-3,-3).
(ii) Shear, y-axis invariant, s.f. 2.
(iii) $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}$

Q33 (a) $2c+3b$
(b) (i) $3c-6a$ (ii) $2c-4a$
(c) $PQ = \frac{2}{3} AC$ and PQ is parallel to AC.

Q34 (a) Enlargement, s.f. $-\frac{1}{2}$, Centre (2,5)
(b) (i) Image at (-2,6), (-8,3), (-4,3)
(ii) Image at (3,-2), (3,2), (6,4).
(iii) Image at (-5,1), (-3,-2), (1,-2).
(c) (i) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ (ii) Rotation, 90° anticlockwise, Centre (0,0)

Q35 (a) (i) $\begin{pmatrix} 0 & -4 \\ 4 & 0 \end{pmatrix}$ (ii) $\begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}$
(iii) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ (iv) $\begin{pmatrix} -13 \\ 5 \end{pmatrix}$
(b) $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$

Q36 (a) Enlargement, Centre (-3,4) s.f. 3
(b) (i) Image at (1,5), (4,5), (4,6), (1,7)
(ii) Image at (5,1), (8,1), (8,3), (5,2)
(iii) Image at (-4,8), (-1,8), (-1,6)
(iv) $\begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$ (c) Reflection in $y = x$

Q37 (a) (i) Translation $\begin{pmatrix} -5 \\ 8 \end{pmatrix}$
(ii) Image at (2,2), (4,3), (4,5), (2,5)
(iii) Image at (4,2), (5,4), (7,4), (7,2)
(b) (i) Shear, x-axis invariant, s.f. 2
(ii) Rectangle at, (-3,2), (1,2), (1,8), (-3,8)

Q38 (a) (i) $\begin{pmatrix} 15 \\ 21 \end{pmatrix}$ (ii) Not possible
(iii) (2) (iv) $\begin{pmatrix} 4 & 13 \\ 0 & 0 \end{pmatrix}$ (v) $\begin{pmatrix} -5 & -9 \\ 1 & 0 \end{pmatrix}$
(b) $\frac{1}{2}\begin{pmatrix} 3 & -4 \\ -1 & 2 \end{pmatrix}$

IG-Maths 0580

Vectors, Matrices and Transformations

Exercise - Paper - 4

Answers

Q39 (a) (i) Image at (1,3), (1,9), (3,3)

(ii) $\begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$

(b) (i) Shear, x-axis invariant, s.f. 2

(ii) $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$

Q40 (a) (i) Image at (4,8), (2,9), (4,9)

(ii) Image at (4,2), (4,3), (6,3).

(iii) Shear, x-axis invariant, s.f. 2

(iv) $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$

(b) (i) $p + 2s$ (ii) $s + \frac{1}{2}p$

(c) $\vec{OQ} = 2\vec{SR}$, OQ and SR are parallel.

Q41 (a) (i) Reflection in $x = -2$

(ii) Translation $\begin{pmatrix} -7 \\ 2 \end{pmatrix}$

(iii) Strech, x-axis invariant s.f 3

(b) (i) Image at (8,2), (7,3), (7,5)

(ii) Image at (-2,-5), (-6,-5), (-8,-7)

(iii) Image at (1,-1), (4,-6), (3,-5)

(c) $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}$

Q42 (i) (a) $3b - 4a$ (b) $\frac{1}{5}(6b - 8a)$

(c) $6a + 3b$

(ii) OR is parallel to OT.

(iii) $\frac{9}{4}$

← X — X →