

Vectors

Difficulty: Medium

Question Paper 5

Level	IGCSE
Subject	Maths (0580/0980)
Exam Board	CIE
Topic	Vectors
Paper	Paper 4
Difficulty	Medium
Booklet	Question Paper 5

Time allowed: 85 minutes

Score: /74

Percentage: /100

Grade Boundaries:

CIE IGCSE Maths (0580)

A*	A	B	C	D
>83%	67%	51%	41%	31%

CIE IGCSE Maths (0980)

9	8	7	6	5	4
>95%	87%	80%	69%	58%	46%

Question 1

Answer the whole of this question on a sheet of graph paper.

(a) Draw x and y axes from 0 to 12 using a scale of 1 cm to 1 unit on each axis. [1]

(b) Draw and label triangle T with vertices $(8, 6)$, $(6, 10)$ and $(10, 12)$. [1]

(c) Triangle T is reflected in the line $y = x$.

(i) Draw the image of triangle T . Label this image P . [2]

(ii) Write down the matrix which represents this reflection. [2]

(d) A transformation is represented by the matrix $\begin{pmatrix} 1 & 0 \\ \frac{1}{2} & \frac{1}{2} \\ 0 & \frac{1}{2} \end{pmatrix}$

(i) Draw the image of triangle T under this transformation. Label this image Q . [2]

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

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(e) Triangle T is stretched with the y -axis invariant and a stretch factor of $\frac{1}{2}$.

Draw the image of triangle T . Label this image R . [2]

Question 2

- (a) Draw and label x and y axes from -6 to 6 , using a scale of 1 cm to 1 unit. [1]
- (b) Draw triangle ABC with $A(2,1)$, $B(3,3)$ and $C(5,1)$. [1]
- (c) Draw the reflection of triangle ABC in the line $y = x$. Label this $A_1B_1C_1$. [2]
- (d) Rotate **triangle $A_1B_1C_1$** about $(0,0)$ through 90° anti-clockwise. Label this $A_2B_2C_2$. [2]
- (e) Describe fully the single transformation which maps triangle ABC onto triangle $A_2B_2C_2$. [2]
- (f) A transformation is represented by the matrix $\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$.
- (i) Draw the image of triangle ABC under this transformation. Label this $A_3B_3C_3$. [3]
- (ii) Describe fully the single transformation represented by the matrix $\begin{pmatrix} 1 & 0 \\ -1 & 1 \end{pmatrix}$. [2]
- (iii) Find the matrix which represents the transformation that maps triangle $A_3B_3C_3$ onto triangle ABC . [2]

Question 3

Transformation T is translation by the vector $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$.

Transformation M is reflection in the line $y = x$.

(a) The point A has co-ordinates $(2, 1)$.

Find the co-ordinates of

(i) $T(A)$, [1]

(ii) $MT(A)$. [2]

(b) Find the 2 by 2 matrix \mathbf{M} , which represents the transformation M. [2]

(c) Show that, for any value of k , the point $Q(k - 2, k - 3)$ maps onto a point on the line $y = x$ following the transformation $TM(Q)$. [3]

(d) Find \mathbf{M}^{-1} , the inverse of the matrix \mathbf{M} . [2]

(e) \mathbf{N} is the matrix such that $\mathbf{N} + \begin{pmatrix} 0 & 3 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 4 \\ 0 & 0 \end{pmatrix}$.

(i) Write down the matrix \mathbf{N} . [2]

(ii) Describe completely the **single** transformation represented by \mathbf{N} . [3]

Question 4

Answer the whole of this question on one sheet of graph paper.

(a) Draw and label x and y axes from -8 to $+8$, using a scale of 1 cm to 1 unit on each axis. [1]

(b) Draw and label triangle ABC with $A(2, 2)$, $B(5, 2)$ and $C(5, 4)$. [1]

(c) On your grid:

(i) translate **triangle** ABC by the vector $\begin{pmatrix} 3 \\ -9 \end{pmatrix}$ and label this image $A_1B_1C_1$; [2]

(ii) reflect **triangle** ABC in the line $x = -1$ and label this image $A_2B_2C_2$; [2]

(iii) rotate **triangle** ABC by 180° about $(0, 0)$ and label this image $A_3B_3C_3$. [2]

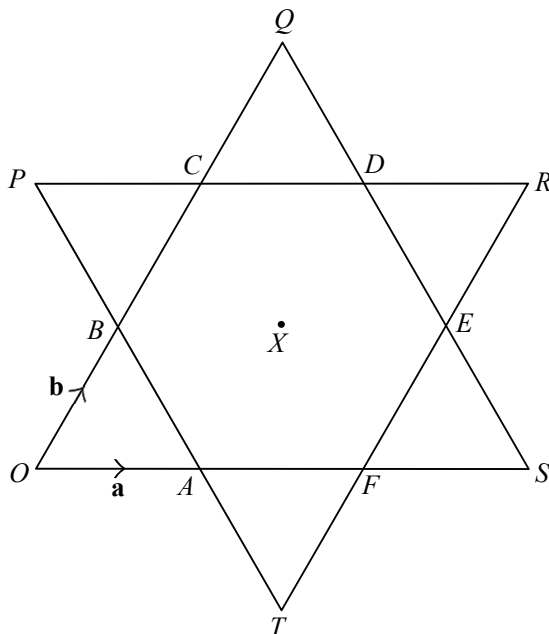
(d) A stretch is represented by the matrix $\begin{pmatrix} 1.5 & 0 \\ 0 & 1 \end{pmatrix}$.

(i) Draw the image of **triangle** ABC under this transformation. Label this image $A_4B_4C_4$. [3]

(ii) Work out the inverse of the matrix $\begin{pmatrix} 1.5 & 0 \\ 0 & 1 \end{pmatrix}$. [2]

(iii) Describe **fully** the single transformation represented by this inverse. [3]

Question 5



A star is made up of a regular hexagon, centre X , surrounded by 6 equilateral triangles.

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

(a) Write the following vectors in terms of \mathbf{a} and/or \mathbf{b} , giving your answers in their simplest form.

- (i) \vec{OS} , [1]
- (ii) \vec{AB} , [1]
- (iii) \vec{CD} , [1]
- (iv) \vec{OR} , [2]
- (v) \vec{CF} . [2]

(b) When $|\mathbf{a}| = 5$, write down the value of

- (i) $|\mathbf{b}|$, [1]
- (ii) $|\mathbf{a} - \mathbf{b}|$. [1]

(c) Describe fully a single transformation which maps

- (i) triangle OBA onto triangle OQS , [2]
- (ii) triangle OBA onto triangle RDE , with O mapped onto R and B mapped onto D . [2]

(d) (i) How many lines of symmetry does the star have? [1]

- (ii) When triangle OQS is rotated clockwise about X , it lies on triangle PRT , with O on P . Write down the angle of rotation. [1]