Vectors
Difficulty: Hard

Question Paper 3

Level	IGCSE
Subject	Maths (0580/0980)
Exam Board	CIE
Topic	Vectors
Paper	Paper 4
Difficulty	Hard
Booklet	Question Paper 3

Time allowed: **106 minutes**

Score: **/92**

Percentage: **/100**

Grade Boundaries:

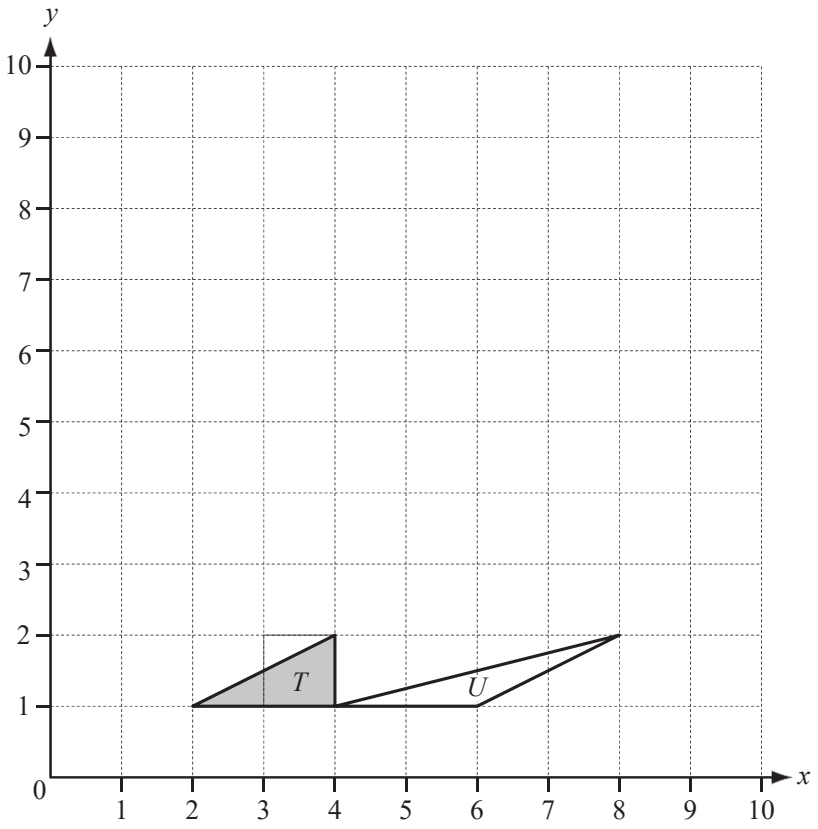
CIE IGCSE Maths (0580)

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%

(a)



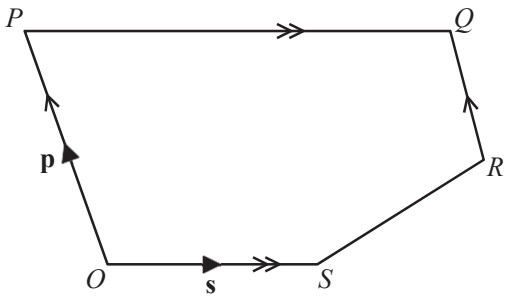
(i) Draw the reflection of triangle T in the line $y = 5$. [2]

(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)



NOT TO SCALE

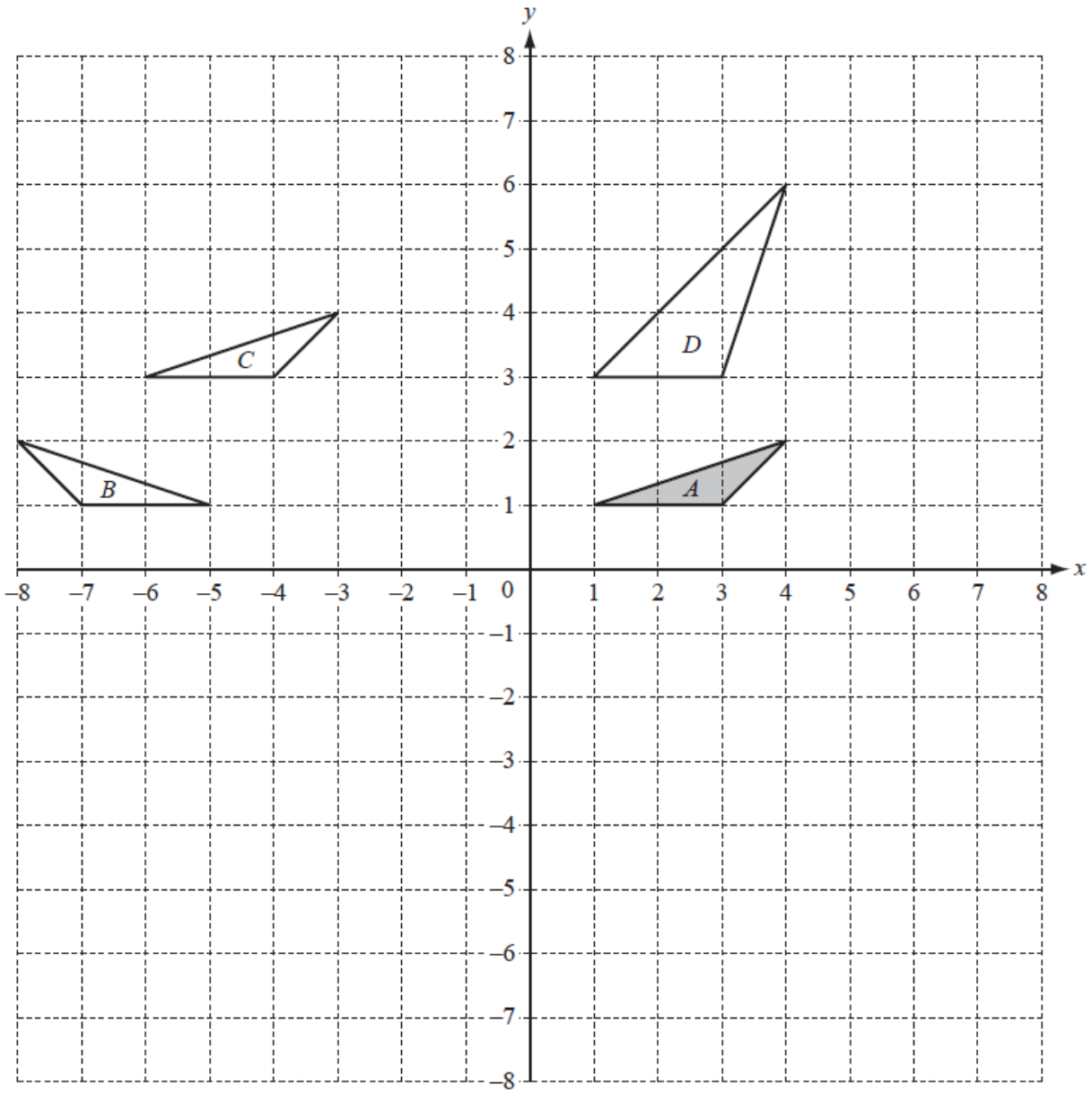
In the pentagon $OPQRS$, OP is parallel to RQ and OS is parallel to PQ.
$PQ = 2OS$ and $OP = 2RQ$.
O is the origin, $\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OS} = \mathbf{s}$.

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

(i) the position vector of Q, [2]

(ii) $\overrightarrow{SR}$. [2]

(c) Explain what your answers in **part (b)** tell you about the lines OQ and SR. [1]



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

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

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

(c) Find the matrix that represents the transformation in **part (b)(iii)**. [2]

(a) The co-ordinates of P are $(-4, -4)$ and the co-ordinates of Q are $(8, 14)$.

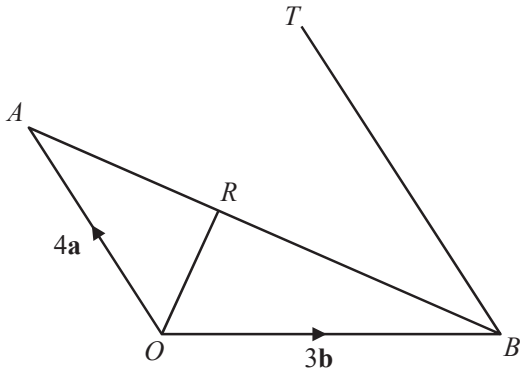
(i) Find the gradient of the line PQ. [2]

(ii) Find the equation of the line PQ. [2]

(iii) Write $\overrightarrow{PQ}$ as a column vector. [1]

(iv) Find the magnitude of $\overrightarrow{PQ}$. [2]

(b)



NOT TO SCALE

In the diagram, $\overrightarrow{OA} = 4\mathbf{a}$ and $\overrightarrow{OB} = 3\mathbf{b}$.

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

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

(i) Find the following in terms of **a** and **b**, giving each answer in its simplest form.

(a) $\overrightarrow{AB}$ [1]

(b) $\overrightarrow{AR}$ [2]

(c) $\overrightarrow{OT}$ [1]

(ii) Complete the following statement. [1]

The points O, R and T are in a straight line because .....

(iii) Triangle OAR and triangle TBR are similar.

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

(a) $\mathbf{a} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 2 \\ -7 \end{pmatrix}$ $\mathbf{c} = \begin{pmatrix} -10 \\ 21 \end{pmatrix}$

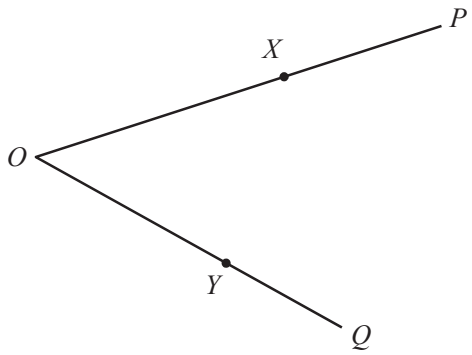
(i) Find $2\mathbf{a} + \mathbf{b}$. [1]

(ii) Find $|\mathbf{b}|$. [2]

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

Find the values of m and n.
Show all your working. [6]

(b)



NOT TO SCALE

In the diagram, $OX:XP = 3:2$ and $OY:YQ = 3:2$.
$\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$.

(i) Write $\overrightarrow{PQ}$ in terms of $\mathbf{p}$ and $\mathbf{q}$. [1]

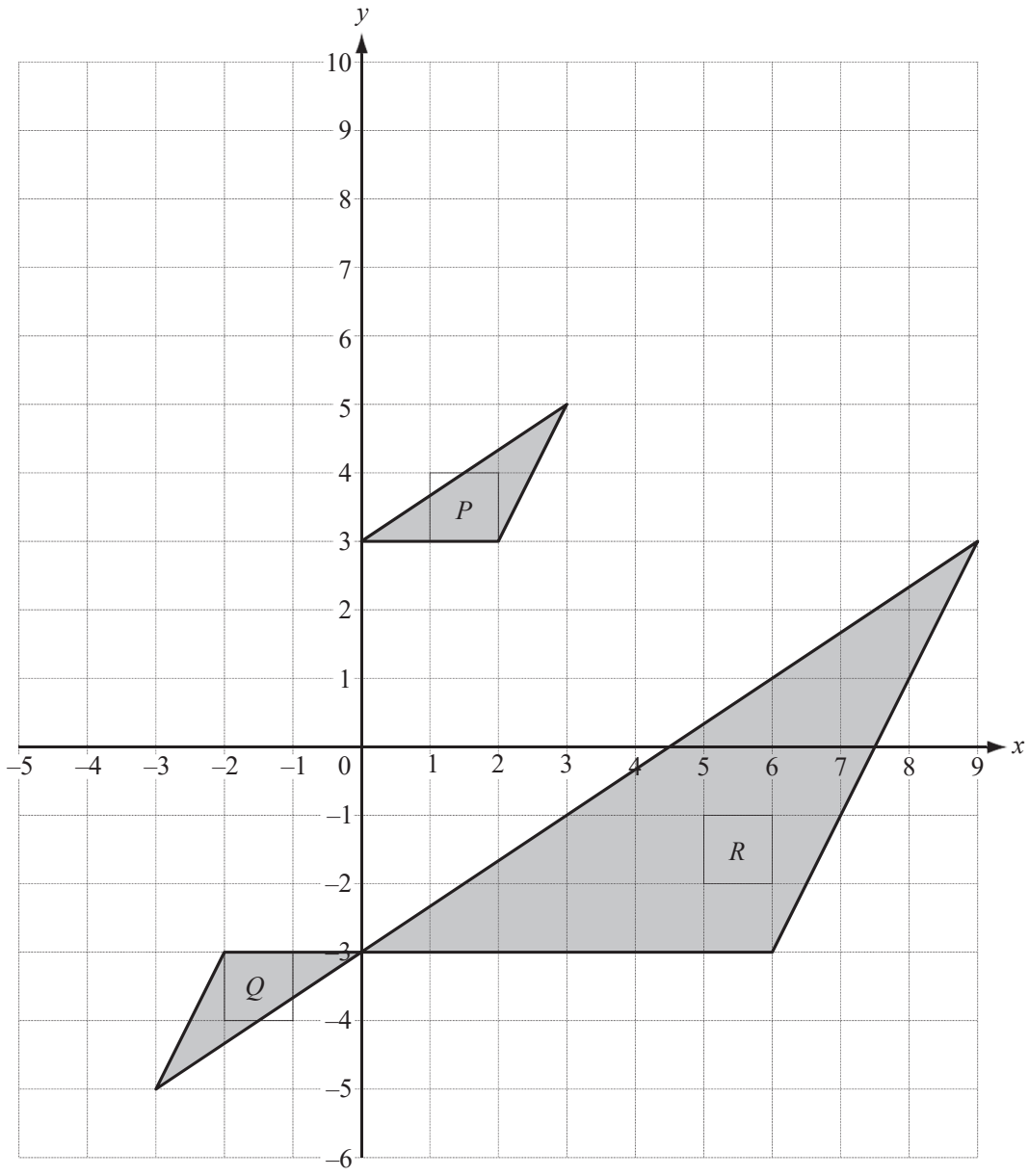
(ii) Write $\overrightarrow{XY}$ in terms of $\mathbf{p}$ and $\mathbf{q}$. [1]

(iii) Complete the following sentences. [3]

The lines XY and PQ are

The triangles OXY and OPQ are

The ratio of the area of triangle OXY to the area of triangle OPQ is



(a) Describe fully

(i) the **single** transformation which maps triangle P onto triangle Q, [3]

(ii) the **single** transformation which maps triangle Q onto triangle R, [3]

(iii) the **single** transformation which maps triangle R onto triangle P. [3]

(b) On the grid, draw the image of

(i) **triangle *P*** after translation by $\begin{pmatrix} -4 \\ -5 \end{pmatrix}$, [2]

(ii) **triangle *P*** after reflection in the line $x = -1$. [2]

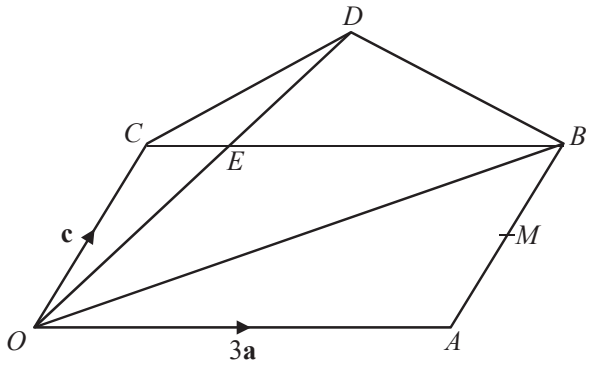
(c) (i) On the grid, draw the image of **triangle *P*** after a stretch, scale factor 2 and the y-axis as the invariant line. [2]

(ii) Find the matrix which represents this stretch. [2]

(a) P is the point (2, 5) and $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$.

Write down the co-ordinates of Q. [1]

(b)



NOT TO SCALE

O is the origin and $OABC$ is a parallelogram.
M is the midpoint of AB.
$\overrightarrow{OC} = \mathbf{c}$, $\overrightarrow{OA} = 3\mathbf{a}$ and $CE = \frac{1}{3}CB$.

OED is a straight line with $OE : ED = 2 : 1$.

Find in terms of **a** and **c**, in their simplest forms

(i) $\overrightarrow{OB}$, [1]

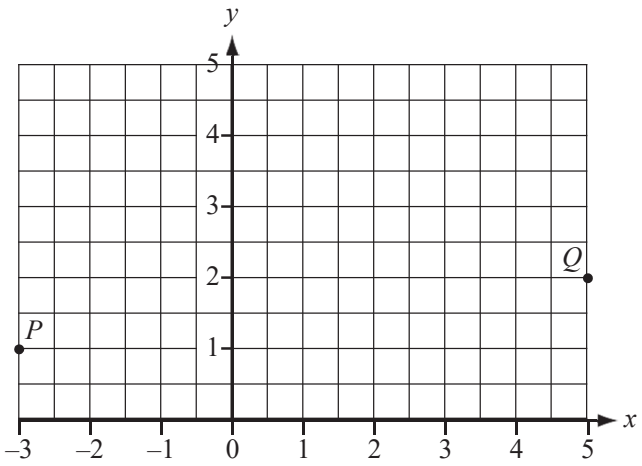
(ii) the position vector of M, [2]

(iii) $\overrightarrow{OE}$, [1]

(iv) $\overrightarrow{CD}$. [2]

(c) Write down two facts about the lines CD and OB. [2]

(a)



The points P and Q have co-ordinates (–3, 1) and (5, 2).

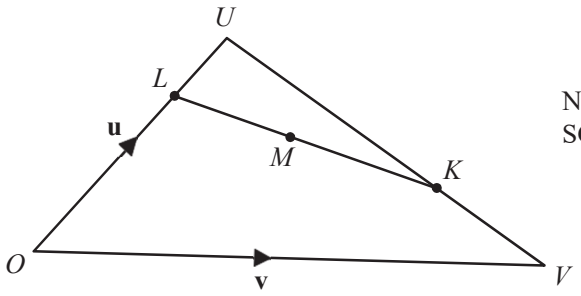
(i) Write $\overrightarrow{PQ}$ as a column vector. [1]

(ii) $\overrightarrow{QR} = 2\begin{pmatrix} -1 \\ 1 \end{pmatrix}$

Mark the point R on the grid. [1]

(iii) Write down the position vector of the point P. [1]

(b)



NOT TO SCALE

In the diagram, $\overrightarrow{OU} = \mathbf{u}$ and $\overrightarrow{OV} = \mathbf{v}$.

K is on UV so that $\overrightarrow{UK} = \frac{2}{3}\overrightarrow{UV}$ and L is on OU so that $\overrightarrow{OL} = \frac{3}{4}\overrightarrow{OU}$.

M is the midpoint of KL.

Find the following in terms of **u** and **v**, giving your answers in their simplest form.

(i) $\overrightarrow{LK}$ [4]

(ii) $\overrightarrow{OM}$ [2]