

Sec 4 Integrated Mathematics : Vectors Worksheet

1 It is given that $\vec{OP} = \mathbf{p}$ and $\vec{OQ} = \mathbf{q}$. R, S, T and U are points on the grid.

Express, in terms of \mathbf{p} and/or \mathbf{q} ,

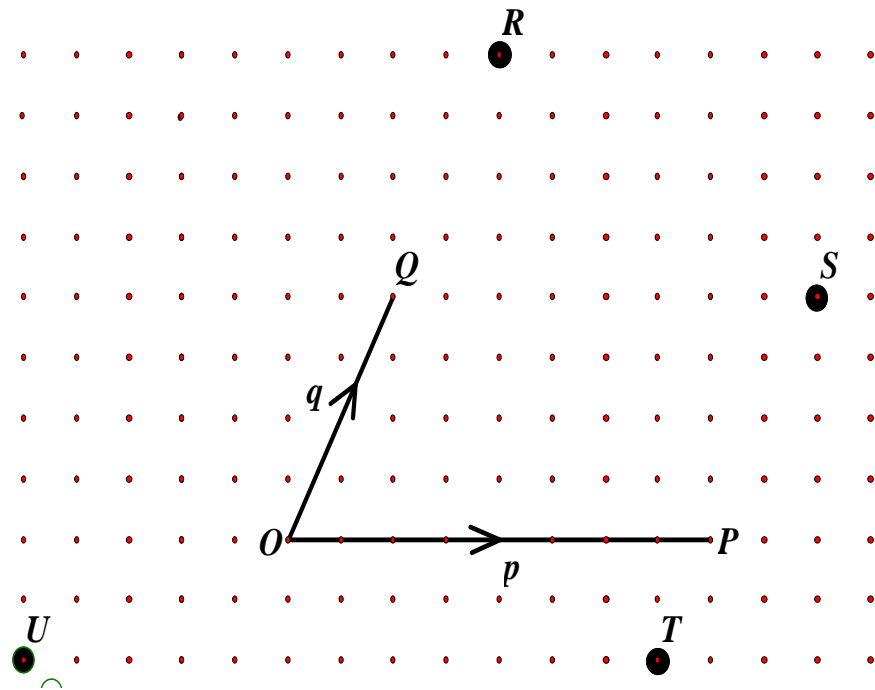
(i) \vec{OR}

(ii) \vec{OS}

(iii) \vec{OT}

(iv) \vec{OU}

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2 In the triangle ABC , P is the mid-point of BC . The line RQ is drawn parallel to BC intersecting AP at G . Given that

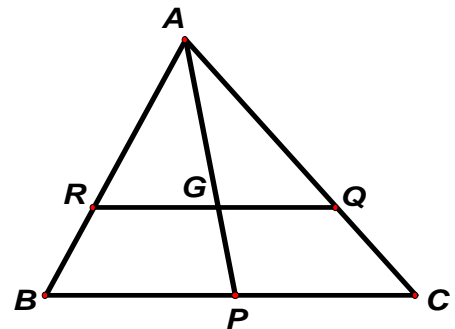
$\vec{AG} = 2\mathbf{p}$, $\vec{GP} = \mathbf{p}$ and $\vec{GQ} = 2\mathbf{q}$, express

(i) \vec{PC} ,

(ii) \vec{AC} ,

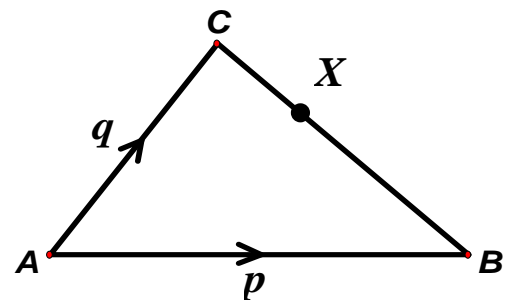
(iii) \vec{PR} in terms of \mathbf{p} and/or \mathbf{q} .

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3 In the diagram, $\vec{AB} = \mathbf{p}$, $\vec{AC} = \mathbf{q}$ and X is the point on CB such that $\vec{CX} = \frac{1}{3}\vec{CB}$. Given that $\vec{AX} = h\mathbf{p} + k\mathbf{q}$ and that T is the point such that $\vec{AT} = h\mathbf{p}$, mark and label the point T on the diagram.

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- 4 Given that P is the point $(1, 1)$, $\vec{PQ} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$, $\vec{PR} = \begin{pmatrix} 5 \\ 4 \end{pmatrix}$ and that T is the midpoint of QR , find
- \vec{QR} ,
 - \vec{PT} ,
 - the coordinates of the point X such that $PQXR$ is a parallelogram. GCE "O" EM J95/2/8a
- 5 It is given that A is the point $(3, 4)$, B is the point $(12, 10)$ and P is the point on AB such that $\vec{AP} = \frac{1}{2}\vec{PB}$.
- Express as column vectors
 - \vec{AB} ,
 - \vec{AP} ,
 - the **position vector** of P relative to the origin O .
 - If O , A and B are three of the vertices of a parallelogram, find the coordinates of two possible positions of the fourth vertex. GCE "O" EM J85/2/5b
- 6 $ABCDEF$ is a regular hexagon, centre G . The position vectors A , B and C relative to an origin O are \mathbf{a} , \mathbf{b} and \mathbf{c} respectively. Express \vec{OG} and \vec{CD} in terms of \mathbf{a} , \mathbf{b} and \mathbf{c} . GCE "O" N85/2/32
- 7 The position vectors of points P , Q and R relative to an origin O are $\mathbf{p} + \mathbf{q}$, $2\mathbf{p} + 3\mathbf{q}$ and $4\mathbf{p} - \mathbf{q}$ respectively.
- Given that $PQRS$ is a parallelogram find, in terms of \mathbf{p} and \mathbf{q} , the position vector of S .
 - Given that T is a point whose position vector relative to O is $5\mathbf{p}$, show that $OPTR$ is a parallelogram. GCE "O" N85/2/32
- 8 Given that A is $(0, 4)$ and B is $(3, 6)$.
- Calculate the coordinates of the point D , where $\vec{BD} = 2\vec{AB}$.
 - Given that $\vec{AC} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$. Calculate the length of AC .
 - Write down the equation of the line AC .
 - The point E lies on AC and EB is parallel to the y -axis. Calculate the coordinates of E . GCE "O" EM J96/2/5
- 9 In the diagram, $ABCD$ is a parallelogram, X is the midpoint of AC , Y is the midpoint of AX and

W is the point on AD such that $AW = 2WD$.

GCE "O"EM, J94/2/11

(a) Given that $\vec{AB} = \mathbf{p}$ and $\vec{AD} = 3\mathbf{q}$, express, as simply as possible, in terms of \mathbf{p} and/or \mathbf{q}

(i) \vec{AY} ,

(ii) \vec{BY} ,

(iii) \vec{XW} .

(b) What do your answer to (a)(ii) and (a)(iii) tell you about BY and XW ?

(b) What is the special name given to the quadrilateral $BXWY$?

(c) Write down the value of each of the following

(i) $\frac{\text{Area of } \triangle ABY}{\text{Area of } \triangle BCY}$,

(ii) $\frac{\text{Area of } \triangle BCY}{\text{Area of } \triangle AXW}$.

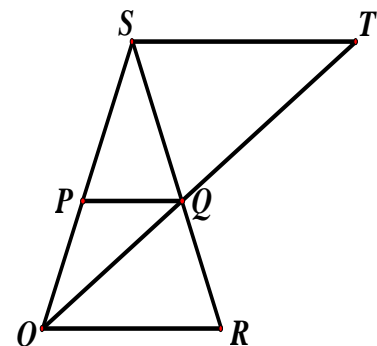
GCE "O" EM J94/2/11

10 In the diagram, the lines ST , PQ and OR are parallel. OPS , OQT and RQS are straight lines.

(a) Given that $\vec{OR} = 3\mathbf{a}$, $\vec{OP} = \mathbf{b}$, $\vec{PS} = 2\mathbf{b}$ and $\vec{OQ} = 2\mathbf{a} + \mathbf{b}$, express, as simply as possible, in terms of \mathbf{a} and/or \mathbf{b}

(i) \vec{QT} ,

(ii) \vec{ST} .



(b) Find the numerical value of

(i) $\frac{\text{the area of } \triangle OPQ}{\text{the area of } \triangle SPQ}$,

(ii) $\frac{\text{the area of } \triangle OPQ}{\text{the area of } \triangle OST}$,

(iii) $\frac{\text{the area of } \triangle OPQ}{\text{the area of } \triangle ORQ}$.

GCE "O" EM J92/2/11b