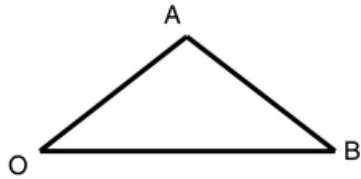


Maths Rules

Vector Pathway Problems

Section A

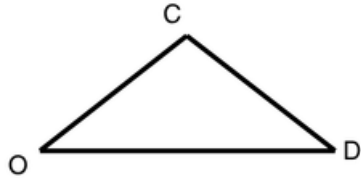
1. The triangle below shows three points, O, A, and B.



You are given that $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

Find an expression for $\overrightarrow{AB}$ and an expression for $\overrightarrow{BA}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

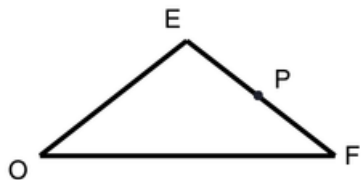
2. The triangle below shows three points, O, C, and D.



You are given that $\overrightarrow{OC} = 2\mathbf{a} - \mathbf{b}$ and $\overrightarrow{OD} = \mathbf{b} - \mathbf{a}$.

Find an expression for $\overrightarrow{CD}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

3. The triangle below shows three points, O, E, and F.

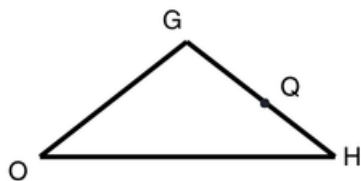


The point P is the midpoint of the line segment EF.

You are given that $\overrightarrow{OE} = \mathbf{e}$ and $\overrightarrow{OF} = \mathbf{f}$.

- (a) Find an expression for $\overrightarrow{EF}$ in terms of $\mathbf{e}$ and $\mathbf{f}$.

- (b) Hence find an expression for $\overrightarrow{EP}$ in terms of $\mathbf{e}$ and $\mathbf{f}$.
 (c) Hence find an expression for $\overrightarrow{OP}$ in terms of $\mathbf{e}$ and $\mathbf{f}$.
4. The triangle below shows three points, O, G, and H.

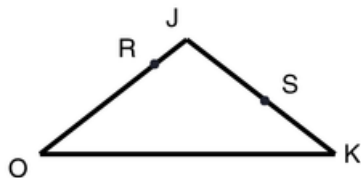


The point Q is such that $GQ:QH = 3:2$.

You are given that $\overrightarrow{OG} = 2\mathbf{a}$ and $\overrightarrow{OH} = \frac{1}{2}\mathbf{b}$.

Find an expression for $\overrightarrow{OQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

5. The triangle below shows three points, O, J, and K.



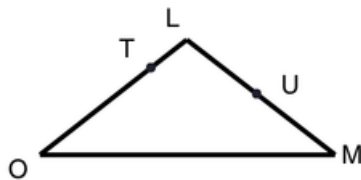
The point R is such that $OR:RJ = 4:1$ and the point S is such that $JS:SK = 5:4$.

You are given that $\overrightarrow{OJ} = \mathbf{a}$ and $\overrightarrow{OK} = \mathbf{b}$.

Find an expression for $\overrightarrow{RS}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Section B

1. The triangle below shows three points, O, L, and M.

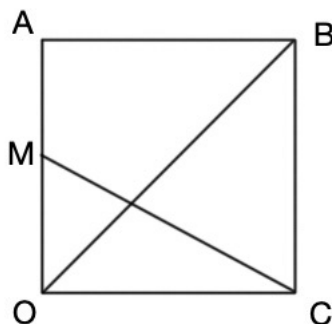


The point T is on the line OL such that $OT:TL = 3:1$ and the point U is the midpoint of the line LM. Let $\overrightarrow{OL} = \mathbf{a}$ and $\overrightarrow{OM} = \mathbf{b}$.

Let X be the intersection of the line which passes through T and U and the line which passes through O and M.

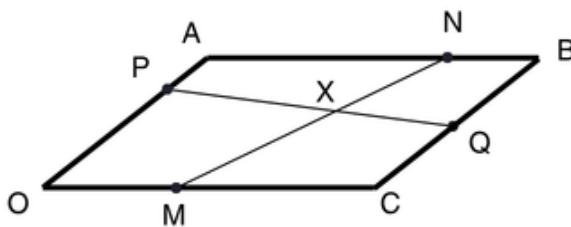
Find $OM:MX$.

2. $OABC$ is a square. Suppose $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$. M is the midpoint of O and A . Let P be the intersection of the two lines OB and MC .



Find the ratio of $OP:PB$.

3. $OABC$ is a parallelogram.



Suppose $\overrightarrow{OA} = \mathbf{a} + \mathbf{b}$ and $\overrightarrow{OC} = 2\mathbf{a} - \mathbf{b}$. M is the point on OC such that $OM:MC = 2:5$ and N is the point on AB such that $AN:NB = 6:1$. P is the point on OA such that $OP:PA = 3:1$ and Q is the midpoint of CB .

Let X be the intersection of the two line MN and PQ .

Find the ratio of $PX:XQ$.