Vectors in two dimensions – 2023 Additional Math 0606

1. Nov/2023/Paper_0606/11/No.3

The point A has position vector $\begin{pmatrix} 2 \\ -6 \end{pmatrix}$. The point B has position vector $\begin{pmatrix} -3 \\ 6 \end{pmatrix}$.

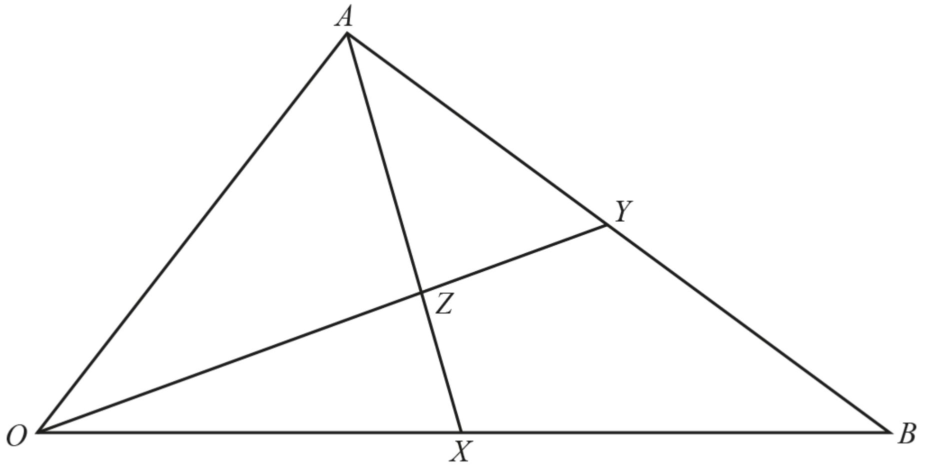
(a) Find, in vector form, the displacement of B from A. [2]

(b) Find the distance AB. [1]

The point X is such that $3\overrightarrow{AB} = 2\overrightarrow{AX}$.

(c) Find the position vector of X. [2]

2. Nov/2023/Paper_0606/12/No.11



In the triangle OAB, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$. The mid-point of the line OB is X, and the mid-point of the line AB is Y. The lines OY and AX intersect at the point Z. It is given that $\overrightarrow{AZ} = \lambda\overrightarrow{AX}$ and $\overrightarrow{OZ} = \mu\overrightarrow{OY}$ where λ and μ are rational numbers.

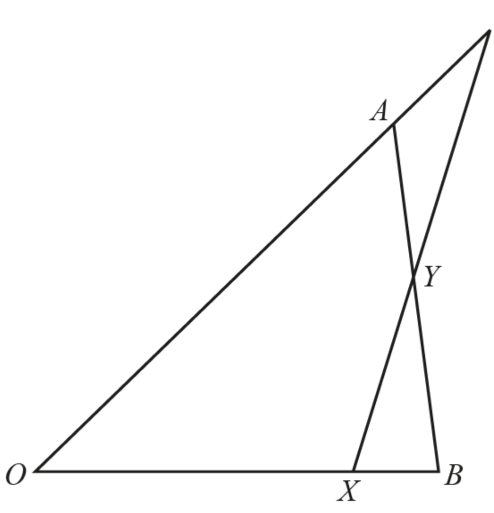
(a) Find $\overrightarrow{OZ}$ in terms of **a**, **b** and λ. [3]

(b) Find $\overrightarrow{OZ}$ in terms of **a**, **b** and μ. [2]

(c) Find the values of λ and μ. [3]

(d) Hence find $\overrightarrow{OZ}$ in terms of **a** and **b** only. [1]

3. Nov/2023/Paper_0606/13/No.11



In the triangle OAB, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

The straight line XYZ is such that:

- $\overrightarrow{OX} = \frac{4}{5}\mathbf{b}$
- $\overrightarrow{AY} = \frac{1}{3}\overrightarrow{AB}$
- $\overrightarrow{AZ} = \mu\mathbf{a}$, where μ is a constant
- $\overrightarrow{YZ} = \lambda\overrightarrow{XY}$, where λ is a constant.

(a) Show that $\overrightarrow{XY} = \frac{2}{3}\mathbf{a} - \frac{7}{15}\mathbf{b}$. [3]

(b) Find $\overrightarrow{YZ}$ in terms of λ, **a** and **b**. [1]

(c) Find $\overrightarrow{YZ}$ in terms of μ, **a** and **b**. [2]

(d) Hence find the values of λ and μ, [3]

4. March/2023/Paper_0606/12/No.9

In this question, all lengths are in metres.

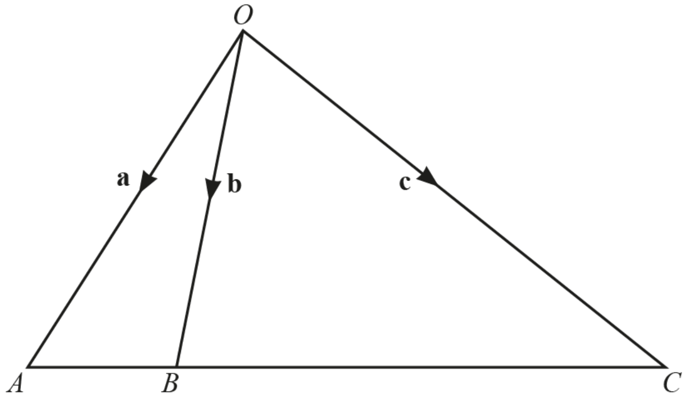
(a) A particle P has position vector $\begin{pmatrix} 2+12t \\ 5-5t \end{pmatrix}$ at a time t seconds, $t \geqslant 0$.

(i) Write down the initial position vector of P. [1]

(ii) Find the speed of P. [2]

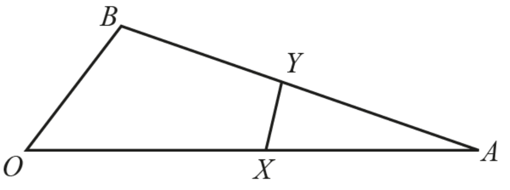
(iii) Determine whether P passes through the point with position vector $\begin{pmatrix} 158 \\ -48 \end{pmatrix}$. [2]

(b)



The diagram shows the triangle OAC. The point B lies on AC such that $AB : AC = 1 : 4$. Given that $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$, find $\mathbf{c}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [3]

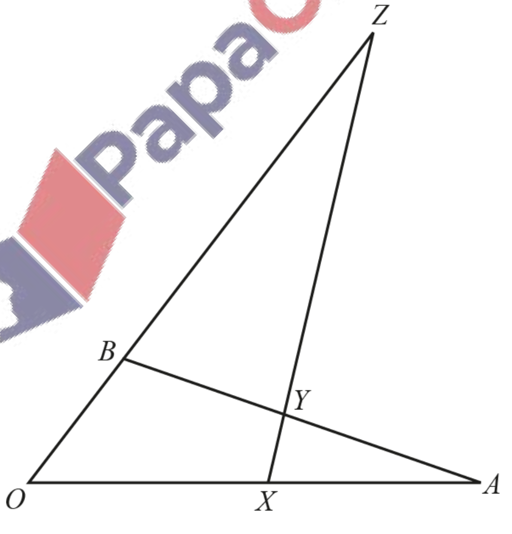
5. June/2023/Paper_0606/13/No.8



The diagram shows the triangle OAB with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$. The point X lies on the line OA such that $\overrightarrow{OX} = \frac{3}{5}\mathbf{a}$. The point Y is the mid-point of the line AB. Find, in terms of $\mathbf{a}$ and $\mathbf{b}$,

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

(b) $\overrightarrow{XY}$. [2]



The lines OB and XY are extended to meet at the point Z. It is given that $\overrightarrow{YZ} = \lambda\overrightarrow{XY}$ and $\overrightarrow{BZ} = \mu\mathbf{b}$.

(c) Find $\overrightarrow{XZ}$ in terms of λ, $\mathbf{a}$ and $\mathbf{b}$. [2]

(d) Find $\overrightarrow{XZ}$ in terms of μ, $\mathbf{a}$ and $\mathbf{b}$. [2]

(e) Hence find the values of λ and μ. [3]

6. June/2023/Paper_0606/21/No.6

(a) The position vectors of the points P, Q and R relative to an origin O are $\begin{pmatrix}4\\7\end{pmatrix}$, $\begin{pmatrix}8\\5\end{pmatrix}$ and $\begin{pmatrix}x\\y\end{pmatrix}$ respectively. The point R lies on PQ extended such that $3\overrightarrow{QR} = 2\overrightarrow{PR}$. Use a vector method to find the values of x and y. [3]

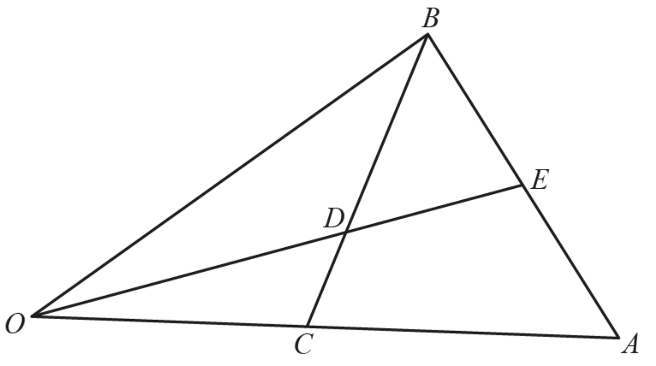
(b) You are given that **i** is a unit vector due east and **j** is a unit vector due north.

Three vectors, **a**, **b** and **c** are in the same horizontal plane as **i** and **j** and are such that $\mathbf{a}+\mathbf{b}=\mathbf{c}$.
The magnitude and bearing of **a** are 5 and 210°.
The magnitude and bearing of **c** are 10 and 330°.

(i) Find **a** and **c** in terms of **i** and **j**. [2]

(ii) Find the magnitude and bearing of **b**. [5]

7. June/2023/Paper_0606/22/No.10



The diagram shows a triangle OAB. The point C is the mid-point of OA. The point D lies on CB such that $CD : DB = 2 : 3$.

$$\overrightarrow{OC} = \mathbf{c} \qquad \overrightarrow{CB} = \mathbf{b}$$

The point E lies on AB such that $\overrightarrow{OE} = \lambda\overrightarrow{OD}$ and $\overrightarrow{AE} = \mu\overrightarrow{AB}$ where λ and μ are scalars.
Find two expressions for $\overrightarrow{OE}$, each in terms of $\mathbf{b}$, $\mathbf{c}$ and a scalar, and hence find $AE : EB$. [8]

Continuation of working space for Question 10.