Vectors in two dimensions – 2021 O Level Additional Math
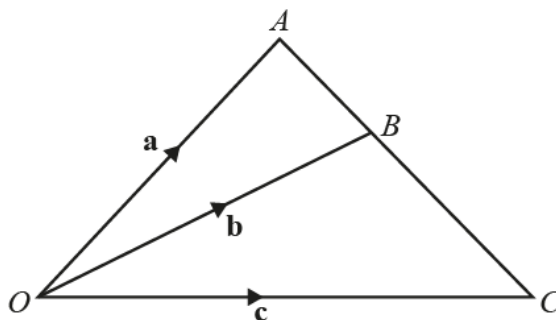
1. Nov/2021/Paper_12/No.7

   (a)

The diagram shows triangle OAC, where $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$. The point B lies on the line AC such that $AB:BC = m:n$, where m and n are constants.

(i) Write down $\overrightarrow{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [1]

(ii) Write down $\overrightarrow{BC}$ in terms of $\mathbf{b}$ and $\mathbf{c}$. [1]

(iii) Hence show that $n\mathbf{a} + m\mathbf{c} = (m+n)\mathbf{b}$. [2]

(b) Given that $\lambda\begin{pmatrix} 2 \\ 1 \end{pmatrix} + (\mu - 1)\begin{pmatrix} -4 \\ 7 \end{pmatrix} = (\lambda + 1)\begin{pmatrix} 4 \\ -2 \end{pmatrix}$, find the value of each of the constants λ and μ. [4]
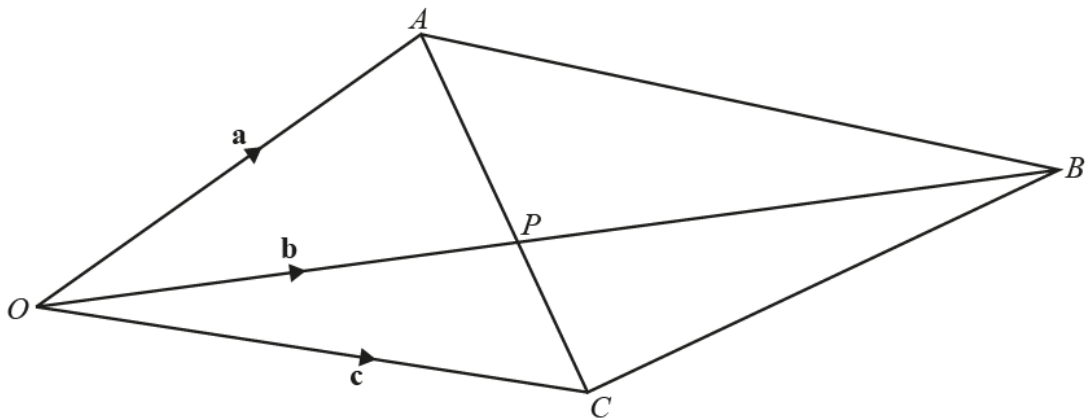
1

2. Nov/2021/Paper_23/No.7

The vector **p** has magnitude 39 and is in the direction $-5\mathbf{i}+12\mathbf{j}$. The vector **q** has magnitude 34 and is in the direction $15\mathbf{i}-8\mathbf{j}$.

(a) Write both **p** and **q** in terms of **i** and **j**.   [4]

(b) Find the magnitude of $\mathbf{p}+\mathbf{q}$ and the angle this vector makes with the positive x-axis.   [4]

2. Nov/2021/Paper_23/No.7

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3. June/2021/Paper_12/No.3

The diagram shows the quadrilateral $OABC$ such that $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$. The lines OB and AC intersect at the point P, such that $AP:PC = 3:2$.

(a) Find $\overrightarrow{OP}$ in terms of $\mathbf{a}$ and $\mathbf{c}$. [3]

(b) Given also that $OP:PB = 2:3$, show that $2\mathbf{b} = 3\mathbf{c} + 2\mathbf{a}$. [2]

4. June/2021/Paper_21/No.10

Relative to an origin O, the position vectors of the points A, B, C and D are

$$\overrightarrow{OA} = \begin{pmatrix} 6 \\ -5 \end{pmatrix}, \quad \overrightarrow{OB} = \begin{pmatrix} 10 \\ 3 \end{pmatrix}, \quad \overrightarrow{OC} = \begin{pmatrix} x \\ y \end{pmatrix} \text{ and } \overrightarrow{OD} = \begin{pmatrix} 12 \\ 7 \end{pmatrix}.$$

(a) Find the unit vector in the direction of $\overrightarrow{AB}$. [3]

(b) The point A is the mid-point of BC. Find the value of x and of y. [2]

(c) The point E lies on OD such that $OE : OD$ is $1 : 1 + \lambda$. Find the value of λ such that $\overrightarrow{BE}$ is parallel to the x-axis. [3]

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5. June/2021/Paper_24/No.11

OAB is a triangle. The position vectors of points A and B relative to the origin O are **a** and **b** respectively.

The side AB is extended to point C such that $AB = \frac{1}{4}AC$.

(a) Show that $\overrightarrow{OC} = 4\mathbf{b} - 3\mathbf{a}$. [2]

(b) The point D lies on OA such that $OD : DA$ is $3 : 2$. The line CD meets OB at the point E. Find the position vector of the point E. [5]