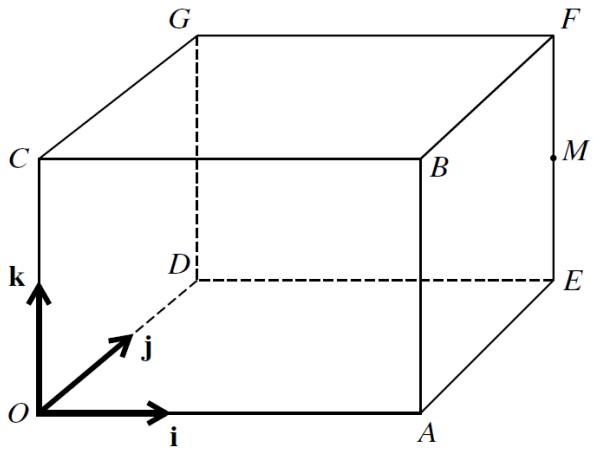
Vectors – 2023 Nov CIE Mathematics

1. Nov/2023/Paper_9709/31/No.11



In the diagram, $OABCDEFG$ is a cuboid in which $OA = 3$ units, $OC = 2$ units and $OD = 2$ units. Unit vectors $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$ are parallel to OA, OD and OC respectively. M is the midpoint of EF.

(a) Find the position vector of M. [1]

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The position vector of P is $\mathbf{i} + \mathbf{j} + 2\mathbf{k}$.

(b) Calculate angle PAM. [4]

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(c) Find the exact length of the perpendicular from P to the line passing through O and M. [5]

2. Nov/2023/Paper_9709/32/No.10

The equations of the lines l and m are given by

$$l: \ \mathbf{r} = \begin{pmatrix} 3 \\ -2 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix} \qquad \text{and} \qquad m: \ \mathbf{r} = \begin{pmatrix} 6 \\ -3 \\ 6 \end{pmatrix} + \mu \begin{pmatrix} -2 \\ 4 \\ c \end{pmatrix},$$

where c is a positive constant. It is given that the angle between l and m is $60°$.

(a) Find the value of c. [4]

(b) Show that the length of the perpendicular from $(6, -3, 6)$ to l is $\sqrt{11}$. [5]

3. Nov/2023/Paper_9709/33/No.11

The line l has equation $\mathbf{r} = \mathbf{i} - 2\mathbf{j} - 3\mathbf{k} + \lambda(-\mathbf{i} + \mathbf{j} + 2\mathbf{k})$. The points A and B have position vectors $-2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $3\mathbf{i} - \mathbf{j} + \mathbf{k}$ respectively.

(a) Find a unit vector in the direction of l. [2]

The line m passes through the points A and B.

(b) Find a vector equation for m. [2]

(c) Determine whether lines l and m are parallel, intersect or are skew. [5]