

# Vectors

## Question Paper 8

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Vectors
Sub Topic	
Booklet	Question Paper 8

Time Allowed: **40 minutes**

Score: **/33**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

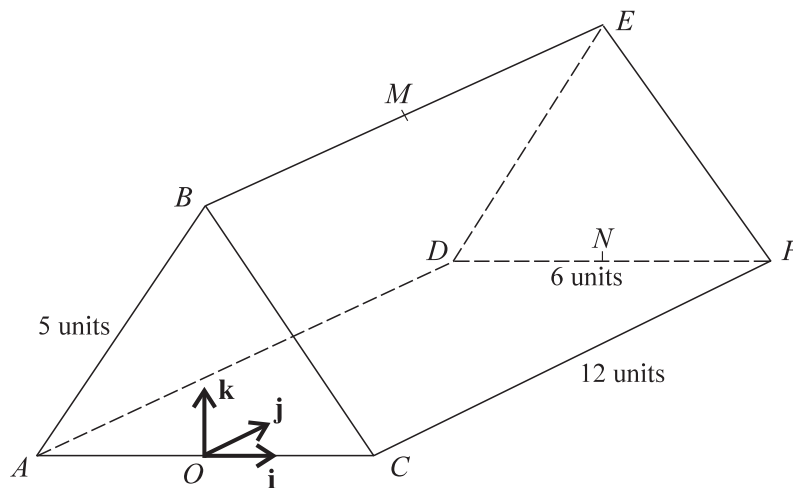
- 1 Relative to an origin  $O$ , the position vectors of the points  $A$ ,  $B$ ,  $C$  and  $D$  are given by

$$\vec{OA} = \begin{pmatrix} 1 \\ 3 \\ -1 \end{pmatrix}, \quad \vec{OB} = \begin{pmatrix} 3 \\ -1 \\ 3 \end{pmatrix}, \quad \vec{OC} = \begin{pmatrix} 4 \\ 2 \\ p \end{pmatrix} \quad \text{and} \quad \vec{OD} = \begin{pmatrix} -1 \\ 0 \\ q \end{pmatrix},$$

where  $p$  and  $q$  are constants. Find

- (i) the unit vector in the direction of  $\vec{AB}$ , [3]
- (ii) the value of  $p$  for which angle  $AOC = 90^\circ$ , [3]
- (iii) the values of  $q$  for which the length of  $\vec{AD}$  is 7 units. [4]

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The diagram shows a triangular prism with a horizontal rectangular base  $ADFC$ , where  $CF = 12$  units and  $DF = 6$  units. The vertical ends  $ABC$  and  $DEF$  are isosceles triangles with  $AB = BC = 5$  units. The mid-points of  $BE$  and  $DF$  are  $M$  and  $N$  respectively. The origin  $O$  is at the mid-point of  $AC$ .

Unit vectors  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$  are parallel to  $OC$ ,  $ON$  and  $OB$  respectively.

- (i) Find the length of  $OB$ . [1]
- (ii) Express each of the vectors  $\vec{MC}$  and  $\vec{MN}$  in terms of  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$ . [3]
- (iii) Evaluate  $\vec{MC} \cdot \vec{MN}$  and hence find angle  $CMN$ , giving your answer correct to the nearest degree. [4]

3 The points  $A$ ,  $B$ ,  $C$  and  $D$  have position vectors  $3\mathbf{i} + 2\mathbf{k}$ ,  $2\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$ ,  $2\mathbf{j} + 7\mathbf{k}$  and  $-2\mathbf{i} + 10\mathbf{j} + 7\mathbf{k}$  respectively.

(i) Use a scalar product to show that  $BA$  and  $BC$  are perpendicular. [4]

(ii) Show that  $BC$  and  $AD$  are parallel and find the ratio of the length of  $BC$  to the length of  $AD$ . [4]

4 Given that  $\mathbf{a} = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$ ,  $\mathbf{b} = \begin{pmatrix} 6 \\ 3 \end{pmatrix}$  and  $\mathbf{c} = \begin{pmatrix} p \\ p+1 \end{pmatrix}$ , find

(i) the angle between the directions of  $\mathbf{a}$  and  $\mathbf{b}$ , [4]

(ii) the value of  $p$  for which  $\mathbf{b}$  and  $\mathbf{c}$  are perpendicular. [3]