

Vectors

Question Paper 2

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Vectors
Sub Topic	
Booklet	Question Paper 2

Time Allowed: 58 minutes

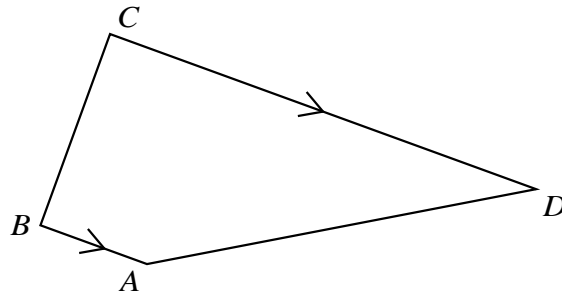
Score: /48

Percentage: /100

Grade Boundaries:

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

1



The diagram shows a trapezium $ABCD$ in which BA is parallel to CD . The position vectors of A , B and C relative to an origin O are given by

$$\vec{OA} = \begin{pmatrix} 3 \\ 4 \\ 0 \end{pmatrix}, \quad \vec{OB} = \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix} \quad \text{and} \quad \vec{OC} = \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix}.$$

(i) Use a scalar product to show that AB is perpendicular to BC . [3]

(ii) Given that the length of CD is 12 units, find the position vector of D . [4]

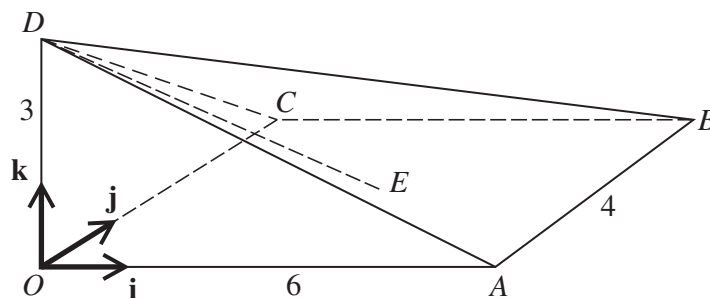
2 The position vectors of points A , B and C relative to an origin O are given by

$$\vec{OA} = \begin{pmatrix} 2 \\ 1 \\ 3 \end{pmatrix}, \quad \vec{OB} = \begin{pmatrix} 6 \\ -1 \\ 7 \end{pmatrix} \quad \text{and} \quad \vec{OC} = \begin{pmatrix} 2 \\ 4 \\ 7 \end{pmatrix}.$$

(i) Show that angle $BAC = \cos^{-1}(\frac{1}{3})$. [5]

(ii) Use the result in part (i) to find the exact value of the area of triangle ABC . [3]

3



The diagram shows a pyramid $OABCD$ in which the vertical edge OD is 3 units in length. The point E is the centre of the horizontal rectangular base $OABC$. The sides OA and AB have lengths of 6 units and 4 units respectively. The unit vectors \mathbf{i} , \mathbf{j} and \mathbf{k} are parallel to \vec{OA} , \vec{OC} and \vec{OD} respectively.

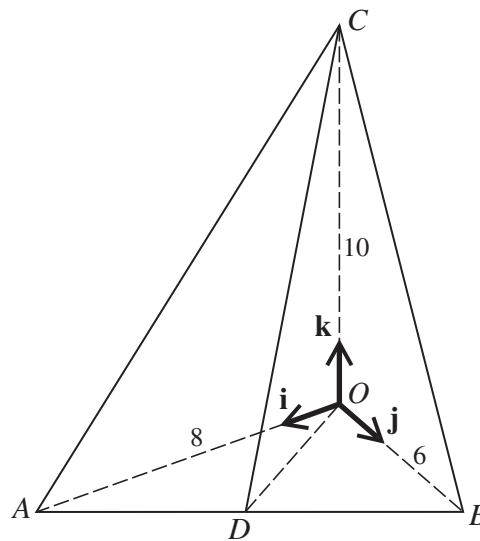
- (i) Express each of the vectors \vec{DB} and \vec{DE} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} . [2]
- (ii) Use a scalar product to find angle BDE . [4]

4 Relative to an origin O , the position vectors of points A and B are given by

$$\vec{OA} = \mathbf{i} + 2\mathbf{j} \quad \text{and} \quad \vec{OB} = 4\mathbf{i} + p\mathbf{k}.$$

- (i) In the case where $p = 6$, find the unit vector in the direction of \vec{AB} . [3]
- (ii) Find the values of p for which angle $AOB = \cos^{-1}\left(\frac{1}{5}\right)$. [4]

5



The diagram shows a pyramid $OABC$ in which the edge OC is vertical. The horizontal base OAB is a triangle, right-angled at O , and D is the mid-point of AB . The edges OA , OB and OC have lengths of 8 units, 6 units and 10 units respectively. The unit vectors \mathbf{i} , \mathbf{j} and \mathbf{k} are parallel to \overrightarrow{OA} , \overrightarrow{OB} and \overrightarrow{OC} respectively.

- (i) Express each of the vectors \overrightarrow{OD} and \overrightarrow{CD} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} . [2]
- (ii) Use a scalar product to find angle ODC . [4]

6 Relative to an origin O , the position vectors of three points, A , B and C , are given by

$$\overrightarrow{OA} = \mathbf{i} + 2p\mathbf{j} + q\mathbf{k}, \quad \overrightarrow{OB} = q\mathbf{j} - 2p\mathbf{k} \quad \text{and} \quad \overrightarrow{OC} = -(4p^2 + q^2)\mathbf{i} + 2p\mathbf{j} + q\mathbf{k},$$

where p and q are constants.

- (i) Show that \overrightarrow{OA} is perpendicular to \overrightarrow{OC} for all non-zero values of p and q . [2]
- (ii) Find the magnitude of \overrightarrow{CA} in terms of p and q . [2]
- (iii) For the case where $p = 3$ and $q = 2$, find the unit vector parallel to \overrightarrow{BA} . [3]

7 Relative to an origin O , the position vectors of points A and B are given by

$$\overrightarrow{OA} = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k} \quad \text{and} \quad \overrightarrow{OB} = 3\mathbf{i} + p\mathbf{j} + q\mathbf{k},$$

where p and q are constants.

- (i) State the values of p and q for which \overrightarrow{OA} is parallel to \overrightarrow{OB} . [2]
- (ii) In the case where $q = 2p$, find the value of p for which angle BOA is 90° . [2]
- (iii) In the case where $p = 1$ and $q = 8$, find the unit vector in the direction of \overrightarrow{AB} . [3]