

# Vectors

## Question Paper 1

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Vectors
Sub Topic	
Booklet	Question Paper 1

Time Allowed: **62 minutes**

Score: **/51**

Percentage: **/100**

Grade Boundaries:

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

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

$$\overrightarrow{OA} = \begin{pmatrix} 3 \\ 0 \\ -4 \end{pmatrix} \quad \text{and} \quad \overrightarrow{OB} = \begin{pmatrix} 6 \\ -3 \\ 2 \end{pmatrix}.$$

- (i) Find the cosine of angle  $AOB$ . [3]

The position vector of  $C$  is given by  $\overrightarrow{OC} = \begin{pmatrix} k \\ -2k \\ 2k-3 \end{pmatrix}$ .

- (ii) Given that  $AB$  and  $OC$  have the same length, find the possible values of  $k$ . [4]

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

$$\overrightarrow{OA} = 2\mathbf{i} + 4\mathbf{j} + 4\mathbf{k} \quad \text{and} \quad \overrightarrow{OB} = 3\mathbf{i} + \mathbf{j} + 4\mathbf{k}.$$

- (i) Use a vector method to find angle  $AOB$ . [4]

The point  $C$  is such that  $\overrightarrow{AB} = \overrightarrow{BC}$ .

- (ii) Find the unit vector in the direction of  $\overrightarrow{OC}$ . [4]

- (iii) Show that triangle  $OAC$  is isosceles. [1]

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

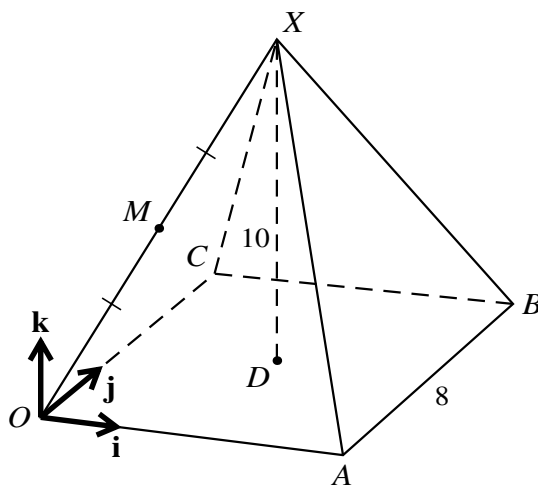
$$\overrightarrow{OA} = \begin{pmatrix} 3 \\ 2 \\ -3 \end{pmatrix}, \quad \overrightarrow{OB} = \begin{pmatrix} 5 \\ -1 \\ -2 \end{pmatrix} \quad \text{and} \quad \overrightarrow{OC} = \begin{pmatrix} 6 \\ 1 \\ 2 \end{pmatrix}.$$

- (i) Show that angle  $ABC$  is  $90^\circ$ . [4]

- (ii) Find the area of triangle  $ABC$ , giving your answer correct to 1 decimal place. [3]

- 4 Relative to an origin  $O$ , the position vector of  $A$  is  $3\mathbf{i} + 2\mathbf{j} - \mathbf{k}$  and the position vector of  $B$  is  $7\mathbf{i} - 3\mathbf{j} + \mathbf{k}$ .
- (i) Show that angle  $OAB$  is a right angle. [4]
- (ii) Find the area of triangle  $OAB$ . [3]

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The diagram shows a pyramid  $OABCX$ . The horizontal square base  $OABC$  has side 8 units and the centre of the base is  $D$ . The top of the pyramid,  $X$ , is vertically above  $D$  and  $XD = 10$  units. The mid-point of  $OX$  is  $M$ . The unit vectors  $\mathbf{i}$  and  $\mathbf{j}$  are parallel to  $\overrightarrow{OA}$  and  $\overrightarrow{OC}$  respectively and the unit vector  $\mathbf{k}$  is vertically upwards.

- (i) Express the vectors  $\overrightarrow{AM}$  and  $\overrightarrow{AC}$  in terms of  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$ . [3]
- (ii) Use a scalar product to find angle  $MAC$ . [4]
- 6 Three points,  $O$ ,  $A$  and  $B$ , are such that  $\overrightarrow{OA} = \mathbf{i} + 3\mathbf{j} + p\mathbf{k}$  and  $\overrightarrow{OB} = -7\mathbf{i} + (1 - p)\mathbf{j} + p\mathbf{k}$ , where  $p$  is a constant.
- (i) Find the values of  $p$  for which  $\overrightarrow{OA}$  is perpendicular to  $\overrightarrow{OB}$ . [3]
- (ii) The magnitudes of  $\overrightarrow{OA}$  and  $\overrightarrow{OB}$  are  $a$  and  $b$  respectively. Find the value of  $p$  for which  $b^2 = 2a^2$ . [2]
- (iii) Find the unit vector in the direction of  $\overrightarrow{AB}$  when  $p = -8$ . [3]

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

$$\vec{OA} = \begin{pmatrix} 3p \\ 4 \\ p^2 \end{pmatrix} \quad \text{and} \quad \vec{OB} = \begin{pmatrix} -p \\ -1 \\ p^2 \end{pmatrix}.$$

- (i) Find the values of  $p$  for which angle  $AOB$  is  $90^\circ$ . [3]
- (ii) For the case where  $p = 3$ , find the unit vector in the direction of  $\vec{BA}$ . [3]