

Vectors

Question Paper 6

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Vectors
Sub Topic	
Booklet	Question Paper 6

Time Allowed: 60 minutes

Score: /50

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 and C are given by

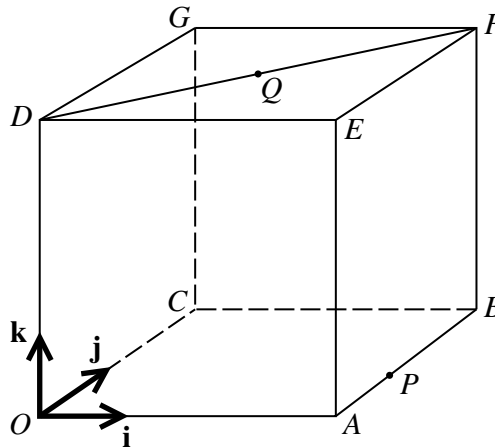
$$\vec{OA} = \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix}, \quad \vec{OB} = \begin{pmatrix} 0 \\ -6 \\ 8 \end{pmatrix} \quad \text{and} \quad \vec{OC} = \begin{pmatrix} -2 \\ 5 \\ -2 \end{pmatrix}.$$

(i) Find angle AOB . [4]

(ii) Find the vector which is in the same direction as \vec{AC} and has magnitude 30. [3]

(iii) Find the value of the constant p for which $\vec{OA} + p\vec{OB}$ is perpendicular to \vec{OC} . [3]

2



In the diagram, $OABCDEFG$ is a cube in which each side has length 6. Unit vectors \mathbf{i} , \mathbf{j} and \mathbf{k} are parallel to \vec{OA} , \vec{OC} and \vec{OD} respectively. The point P is such that $\vec{AP} = \frac{1}{3}\vec{AB}$ and the point Q is the mid-point of DF .

(i) Express each of the vectors \vec{OQ} and \vec{PQ} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} . [3]

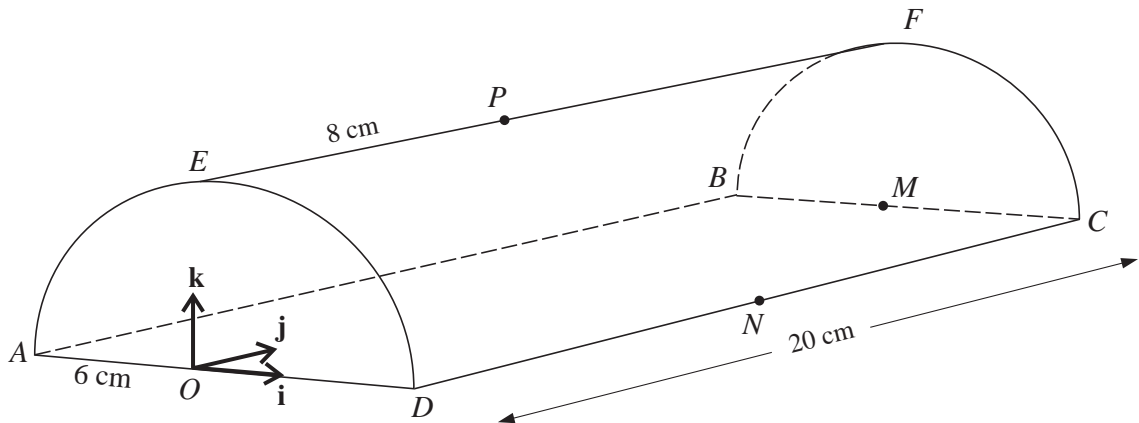
(ii) Find the angle OQP . [4]

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

$$\vec{OA} = 2\mathbf{i} - 8\mathbf{j} + 4\mathbf{k} \quad \text{and} \quad \vec{OB} = 7\mathbf{i} + 2\mathbf{j} - \mathbf{k}.$$

- (i) Find the value of $\vec{OA} \cdot \vec{OB}$ and hence state whether angle AOB is acute, obtuse or a right angle. [3]
- (ii) The point X is such that $\vec{AX} = \frac{2}{5}\vec{AB}$. Find the unit vector in the direction of OX . [4]

4



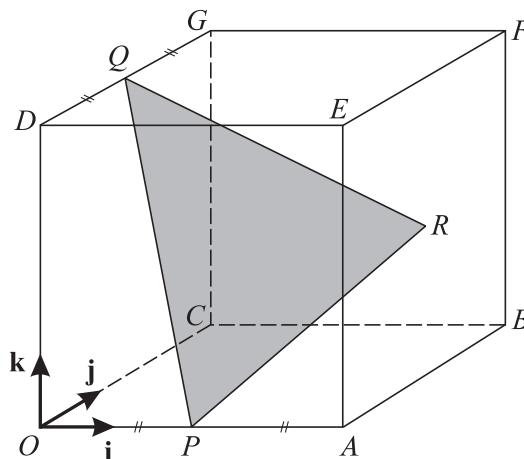
The diagram shows a semicircular prism with a horizontal rectangular base $ABCD$. The vertical ends AED and BFC are semicircles of radius 6 cm. The length of the prism is 20 cm. The mid-point of AD is the origin O , the mid-point of BC is M and the mid-point of DC is N . The points E and F are the highest points of the semicircular ends of the prism. The point P lies on EF such that $EP = 8$ cm.

Unit vectors \mathbf{i} , \mathbf{j} and \mathbf{k} are parallel to OD , OM and OE respectively.

- (i) Express each of the vectors \vec{PA} and \vec{PN} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} . [3]
- (ii) Use a scalar product to calculate angle APN . [4]

- 5 Relative to an origin O , the position vectors of points A and B are $2\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ and $3\mathbf{i} - 2\mathbf{j} + p\mathbf{k}$ respectively.
- (i) Find the value of p for which OA and OB are perpendicular. [2]
- (ii) In the case where $p = 6$, use a scalar product to find angle AOB , correct to the nearest degree. [3]
- (iii) Express the vector \overrightarrow{AB} in terms of p and hence find the values of p for which the length of AB is 3.5 units. [4]

6



The diagram shows a cube $OABCDEFG$ in which the length of each side is 4 units. The unit vectors \mathbf{i} , \mathbf{j} and \mathbf{k} are parallel to \overrightarrow{OA} , \overrightarrow{OC} and \overrightarrow{OD} respectively. The mid-points of OA and DG are P and Q respectively and R is the centre of the square face $ABFE$.

- (i) Express each of the vectors \overrightarrow{PR} and \overrightarrow{PQ} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} . [3]
- (ii) Use a scalar product to find angle QPR . [4]
- (iii) Find the perimeter of triangle PQR , giving your answer correct to 1 decimal place. [3]