

Higher Mathematics

Vectors - Questions - 2013-2017

Marks are indicated in brackets after each question number

2013 Paper 1 Question 12, (2)

If $\mathbf{f} = 3\mathbf{i} + 2\mathbf{k}$ and $\mathbf{g} = 2\mathbf{i} + 4\mathbf{j} + 3\mathbf{k}$, find $|\mathbf{f} + \mathbf{g}|$.

2013 Paper 1 Question 14, (2)

Given that $|\mathbf{a}| = 3$, $|\mathbf{b}| = 2$ and $\mathbf{a} \cdot \mathbf{b} = 5$, what is the value of $\mathbf{a} \cdot (\mathbf{a} + \mathbf{b})$?

2013 Paper 1 Question 24, (4) (5)

(a) (i) Show that the points $A(-7, -8, 1)$, $T(3, 2, 5)$ and $B(18, 17, 11)$ are collinear.

(ii) Find the ratio in which T divides AB .

(b) The point C lies on the x -axis.

If TB and TC are perpendicular, find the coordinates of C .

2014 Paper 1 Question 6, (2)

Given that $\mathbf{u} = \begin{pmatrix} -3 \\ 1 \\ 0 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$, find $2\mathbf{u} - 3\mathbf{v}$ in component form.

2014 Paper 1 Question 14, (2)

The vectors $\mathbf{u} = \begin{pmatrix} 1 \\ k \\ k \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} -6 \\ 2 \\ 5 \end{pmatrix}$ are perpendicular.

What is the value of k ?

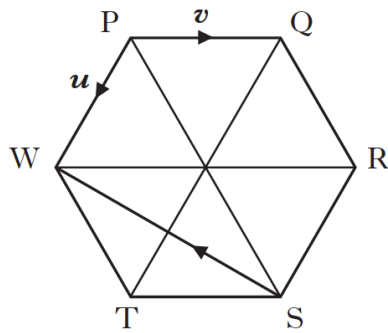
2014 Paper 1 Question 16, (2)

The unit vectors \mathbf{a} and \mathbf{b} are such that $\mathbf{a} \cdot \mathbf{b} = \frac{2}{3}$. Determine the value of $\mathbf{a} \cdot (\mathbf{a} + 2\mathbf{b})$.

2014 Paper 1 Question 19, (2)

The diagram shows a regular hexagon PQRSTW.

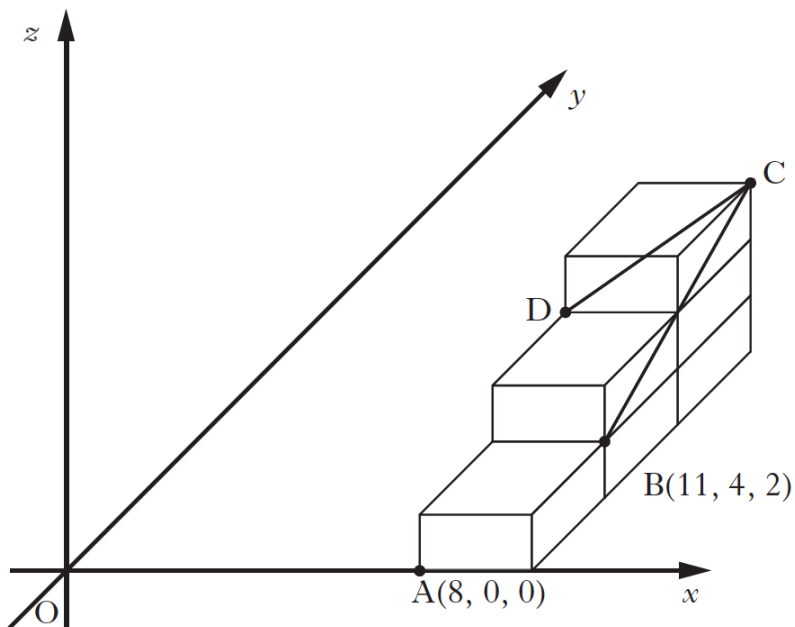
\vec{PW} and \vec{PQ} represent vectors \mathbf{u} and \mathbf{v} respectively.



What is \vec{SW} in terms of \mathbf{u} and \mathbf{v} ?

2014 Paper 2 Question 4, (2) (2) (5)

Six identical cuboids are placed with their edges parallel to the coordinate axes as shown in the diagram.



A and B are the points $(8, 0, 0)$ and $(11, 4, 2)$ respectively.

(a) State the coordinates of C and D.

(b) Determine the components of \vec{CB} and \vec{CD} .

(c) Find the size of the angle BCD.

2015 Paper 1 Question 1, (2)

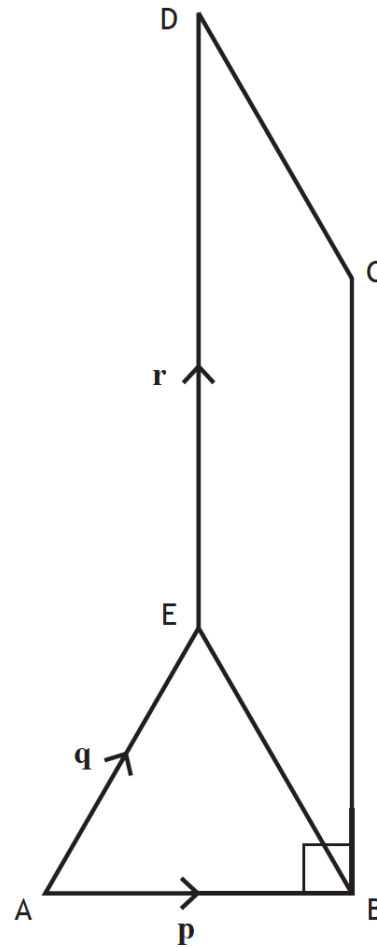
Vectors $\mathbf{u} = 8\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{v} = -3\mathbf{i} + t\mathbf{j} - 6\mathbf{k}$ are perpendicular.

Determine the value of t .

2015 Paper 2 Question 6, (3) (1) (3)

Vectors \mathbf{p} , \mathbf{q} and \mathbf{r} are represented on the diagram as shown.

- BCDE is a parallelogram
- ABE is an equilateral triangle
- $|\mathbf{p}| = 3$
- Angle $ABC = 90^\circ$



- Evaluate $\mathbf{p} \cdot (\mathbf{q} + \mathbf{r})$.
- Express \vec{EC} in terms of \mathbf{p} , \mathbf{q} and \mathbf{r} .
- Given that $\vec{AE} \cdot \vec{EC} = 9\sqrt{3} - \frac{9}{2}$, find $|\mathbf{r}|$.

2016 Paper 1 Question 7, (2) (2)

Three vectors can be expressed as follows:

$$\vec{FG} = -2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k}$$

$$\vec{GH} = 3\mathbf{i} + 9\mathbf{j} - 7\mathbf{k}$$

$$\vec{EH} = 2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$$

(a) Find \vec{FH} .

(b) Hence, or otherwise, find \vec{FE} .

2016 Paper 1 Question 11, (2) (3)

(a) A and C are the points $(1, 3, -2)$ and $(4, -3, 4)$ respectively.

Point B divides AC in the ratio 1 : 2.

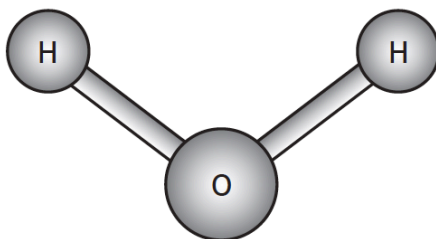
Find the coordinates of B.

(b) $k\vec{AC}$ is a vector of magnitude 1, where $k > 0$.

Determine the value of k .

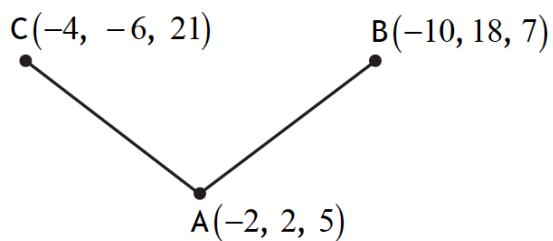
2016 Paper 2 Question 5, (2) (4)

The picture shows a model of a water molecule.



Relative to suitable coordinate axes, the oxygen atom is positioned at point $A(-2, 2, 5)$.

The two hydrogen atoms are positioned at points $B(-10, 18, 7)$ and $C(-4, -6, 21)$ as shown in the diagram below.



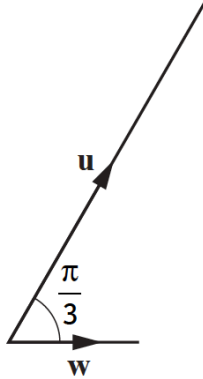
- (a) Express \vec{AB} and \vec{AC} in component form.
- (b) Hence, or otherwise, find the size of angle BAC.

2017 Paper 1 Question 5, (1) (3)

Vectors \mathbf{u} and \mathbf{v} are $\begin{pmatrix} 5 \\ 1 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ -8 \\ 6 \end{pmatrix}$ respectively.

(a) Evaluate $\mathbf{u} \cdot \mathbf{v}$.

(b)

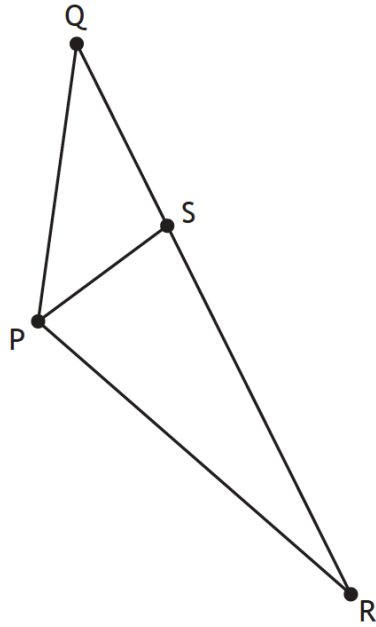


Vector \mathbf{w} makes an angle of $\frac{\pi}{3}$ with \mathbf{u} and $|\mathbf{w}| = \sqrt{3}$.

Calculate $\mathbf{u} \cdot \mathbf{w}$.

2017 Paper 2 Question 5, (2) (2) (5)

In the diagram, $\vec{PR} = 9\mathbf{i} + 5\mathbf{j} + 2\mathbf{k}$ and $\vec{RQ} = -12\mathbf{i} - 9\mathbf{j} + 3\mathbf{k}$.



(a) Express \vec{PQ} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} .

The point S divides QR in the ratio 1:2.

(b) Show that $\vec{PS} = \mathbf{i} - \mathbf{j} + 4\mathbf{k}$.

(c) Hence, find the size of angle QPS.