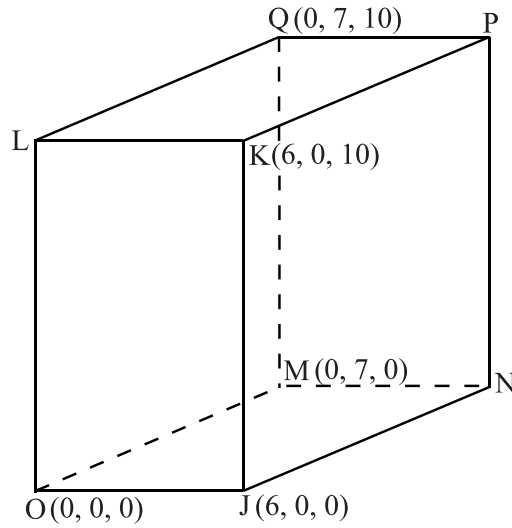


Vectors 4 Calculator

- 1) The diagram below shows a cuboid (rectangular solid) OJKLMNPQ. The vertex O is $(0, 0, 0)$, J is $(6, 0, 0)$, K is $(6, 0, 10)$, M is $(0, 7, 0)$ and Q is $(0, 7, 10)$.



(a) (i) Show that $\vec{JQ} = \begin{pmatrix} -6 \\ 7 \\ 10 \end{pmatrix}$.

(ii) Find \vec{MK} .

[2 marks]

(b) An equation for the line (MK) is $\mathbf{r} = \begin{pmatrix} 0 \\ 7 \\ 0 \end{pmatrix} + s \begin{pmatrix} 6 \\ -7 \\ 10 \end{pmatrix}$.

(i) Write down an equation for the line (JQ) in the form $\mathbf{r} = \mathbf{a} + t\mathbf{b}$.

(ii) Find the acute angle between (JQ) and (MK).

[9 marks]

(c) The lines (JQ) and (MK) intersect at D. Find the position vector of D.

[5 marks]

- 2) Let $\mathbf{v} = 3\mathbf{i} + 4\mathbf{j} + \mathbf{k}$ and $\mathbf{w} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$. The vector $\mathbf{v} + p\mathbf{w}$ is perpendicular to \mathbf{w} . Find the value of p .

3) Let $\mathbf{v} = \begin{pmatrix} 2 \\ -3 \\ 6 \end{pmatrix}$ and $\mathbf{w} = \begin{pmatrix} k \\ -2 \\ 4 \end{pmatrix}$, for $k > 0$. The angle between \mathbf{v} and \mathbf{w} is $\frac{\pi}{3}$.

Find the value of k .

Vectors 4 Calculator

4) Consider the points $P(2, -1, 5)$ and $Q(3, -3, 8)$. Let L_1 be the line through P and Q.

(a) Show that $\vec{PQ} = \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$. [1 mark]

(b) The line L_1 may be represented by $\mathbf{r} = \begin{pmatrix} 3 \\ -3 \\ 8 \end{pmatrix} + s \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$.

(i) What information does the vector $\begin{pmatrix} 3 \\ -3 \\ 8 \end{pmatrix}$ give about L_1 ?

(ii) Write down another vector representation for L_1 using $\begin{pmatrix} 3 \\ -3 \\ 8 \end{pmatrix}$. [3 marks]

The point $T(-1, 5, p)$ lies on L_1 .

(c) Find the value of p . [3 marks]

The point T also lies on L_2 with equation $\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -3 \\ 9 \\ 2 \end{pmatrix} + t \begin{pmatrix} 1 \\ -2 \\ q \end{pmatrix}$.

(d) Show that $q = -3$. [3 marks]

(e) Let θ be the **obtuse** angle between L_1 and L_2 . Calculate the size of θ . [7 marks]