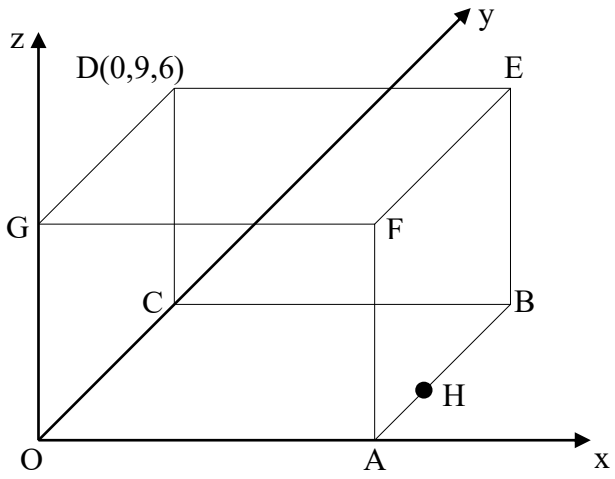
Higher Mathematics – vectors

1. The diagram shows a square based cuboid.
The point D has coordinates (0,9,6).

H divides the line AB in the ratio 1:2.

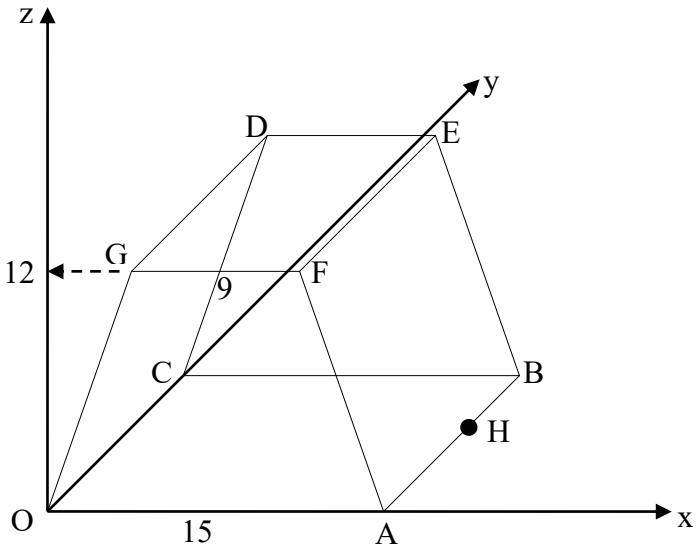
(a) Write down the coordinates of A, B and E.
(b) Find the coordinates of H.
(c) Calculate the size of angle DHE.



2. The diagram shows a prism OABCDEFG with a square base.
GF = 9 units, OA = 15 units and
OG = AF.

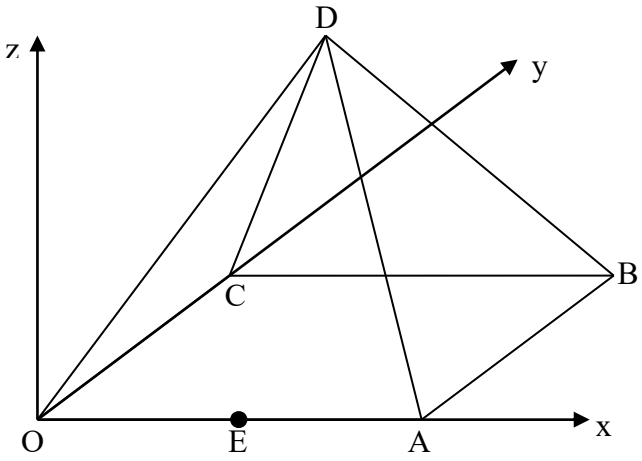
AH = $\frac{2}{3}$ AB.

(a) Find the coordinates of F, D, B and H.
(b) Calculate angle FHD.



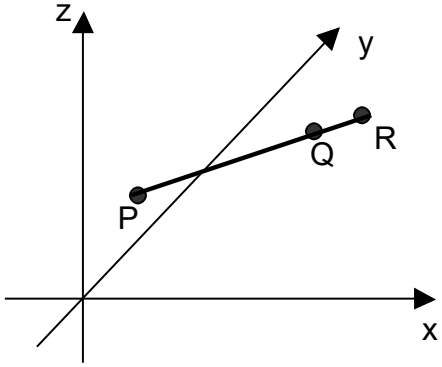
3. The diagram shows a pyramid with a square base of length 14 units and vertical height is 16 units.

(a) Write down the coordinates of B and D.
(b) E is the midpoint of OA. Write down the coordinates of E.
(c) Calculate angle BDE.



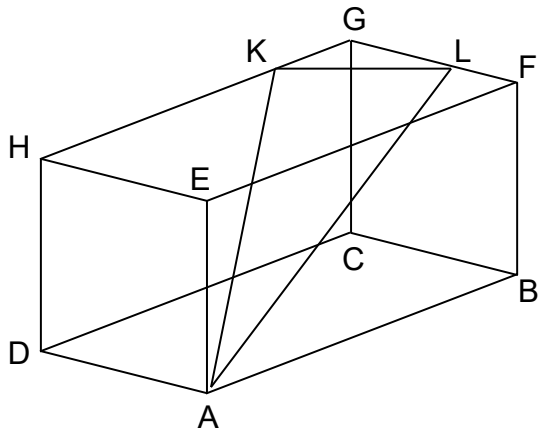
4. In the diagram opposite P(-2,4,4) and Q(6,0,8). represent points on a road.
The road is extended to the point R such that $\overrightarrow{PR} = \frac{5}{4}\overrightarrow{PQ}$.

(a) Find the coordinates of R.
(b) Roads from P and R are built to meet at the point S(-3,4,6).
Calculate the size of angle PSR.



5. ABCDEFGH is a cuboid.
K divides HG in the ratio 2:1 and L divides FG in the ratio 1:3.

$\overrightarrow{AB} = \begin{pmatrix} 3 \\ 6 \\ 3 \end{pmatrix}$ $\overrightarrow{AD} = \begin{pmatrix} -8 \\ 4 \\ 4 \end{pmatrix}$ $\overrightarrow{AE} = \begin{pmatrix} 1 \\ -3 \\ 5 \end{pmatrix}$.



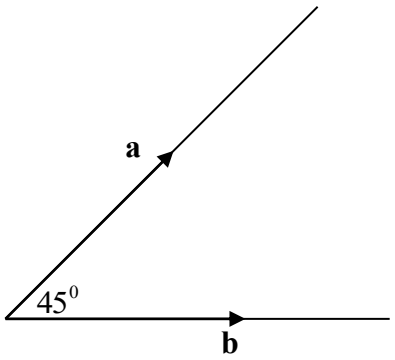
(a) Calculate the components of $\overrightarrow{AK}$ and $\overrightarrow{AL}$
(b) Calculate the size of angle KAL.

6. (a) A and B are the points (1,2,-1) and B(2,0,-4).
Given AC = 3AB, find the coordinates of C.

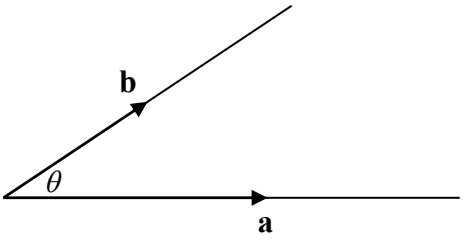
(b) D is the point (10,-4,-8).
Show that AB and CD are perpendicular.

7. The diagram shows vectors **a** and **b** with
$|\mathbf{a}| = 6$ and $|\mathbf{b}| = 3\sqrt{2}$.

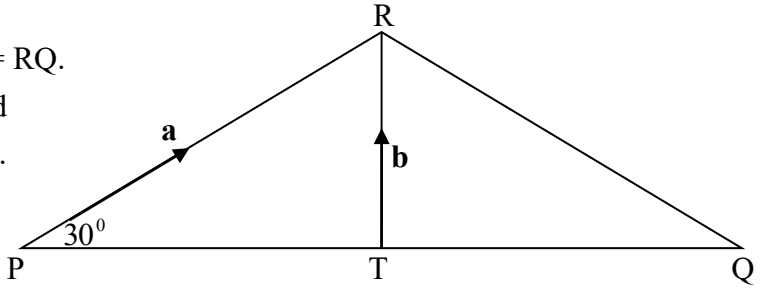
Calculate the value of **a** . (**a** + **b**)



8. The diagram shows the vectors **a** and **b**.
If $|\mathbf{a}| = 8$ and $|\mathbf{b}| = 3\sqrt{3}$ and **a**.(**a** + **b**) = 100,
Find the size of angle θ.



9. PQR is an isosceles triangle with PR = RQ.
$\overrightarrow{PR}$ is represented by the vector **a** and
$\overrightarrow{TR}$ is the vector **b**. Angle TPR = 30^0.
$|\mathbf{a}| = 4$ and $|\mathbf{b}| = 3$



(a) Express $\overrightarrow{PT}$ and $\overrightarrow{PQ}$ in terms of **a** and **b**.

(b) Hence show that the exact value of $\overrightarrow{PR}$. $\overrightarrow{PQ}$ is 44.