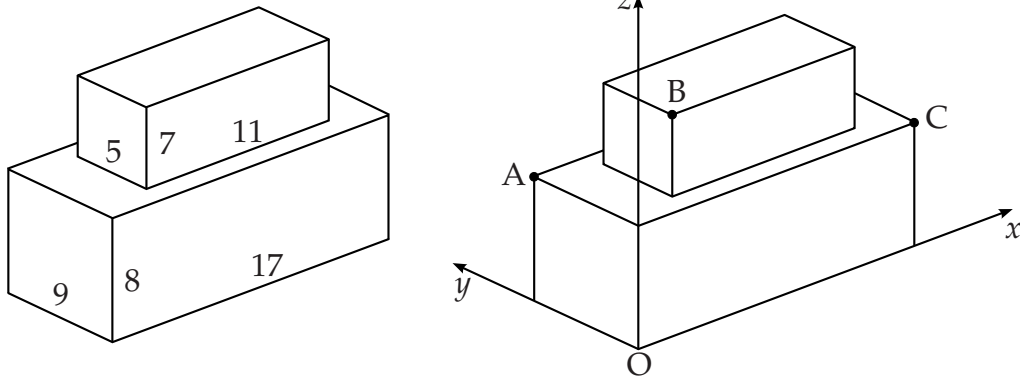


angle between vectors

- [SQA] 1. A cuboid measuring 11 cm by 5 cm by 7 cm is placed centrally on top of another cuboid measuring 17 cm by 9 cm by 8 cm.

Coordinates axes are taken as shown.



- (a) The point A has coordinates $(0, 9, 8)$ and C has coordinates $(17, 0, 8)$.

Write down the coordinates of B.

1

- (b) Calculate the size of angle ABC.

6

- [SQA] 2. The diagram shows a square-based pyramid of height 8 units.

Square OABC has a side length of 6 units.

The coordinates of A and D are $(6, 0, 0)$ and $(3, 3, 8)$.

C lies on the y -axis.

- (a) Write down the coordinates of B.

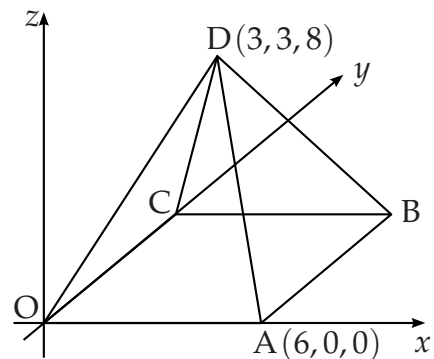
1

- (b) Determine the components of \overrightarrow{DA} and \overrightarrow{DB} .

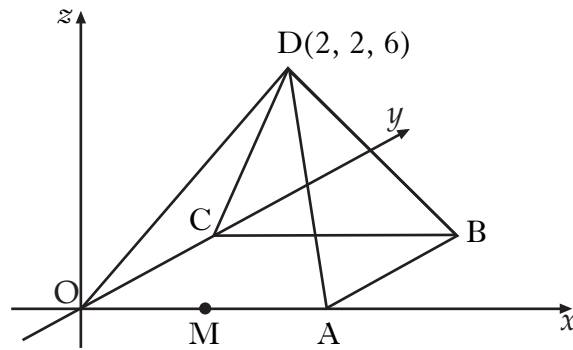
2

- (c) Calculate the size of angle ADB.

4



3. D,OABC is a square based pyramid as shown in the diagram below.



O is the origin, D is the point $(2, 2, 6)$ and $OA = 4$ units.

M is the mid-point of OA.

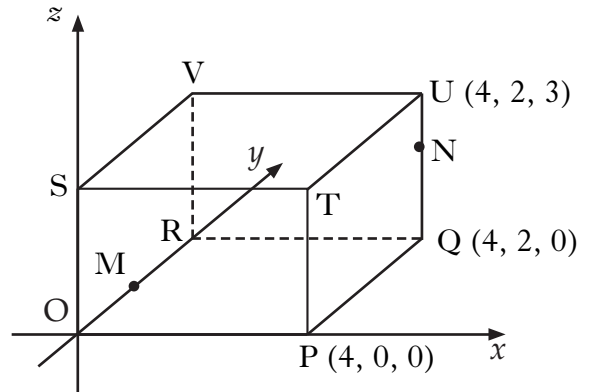
- (a) State the coordinates of B. 1
- (b) Express \vec{DB} and \vec{DM} in component form. 3
- (c) Find the size of angle BDM. 5

4. The diagram shows a cuboid OPQR,STUV relative to the coordinate axes.

P is the point $(4, 0, 0)$, Q is $(4, 2, 0)$ and U is $(4, 2, 3)$.

M is the midpoint of OR.

N is the point on UQ such that $UN = \frac{1}{3}UQ$.



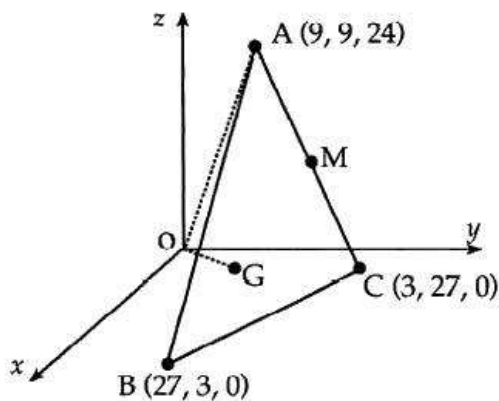
- (a) State the coordinates of M and N. 2
- (b) Express the vectors \vec{VM} and \vec{VN} in component form. 2
- (c) Calculate the size of angle MVN. 5

[SQA]

5. (a) Relative to mutually perpendicular axes Ox , Oy and Oz , the vertices of triangle ABC have coordinates $A(9, 9, 24)$, $B(27, 3, 0)$ and $C(3, 27, 0)$. M is the mid-point of AC .

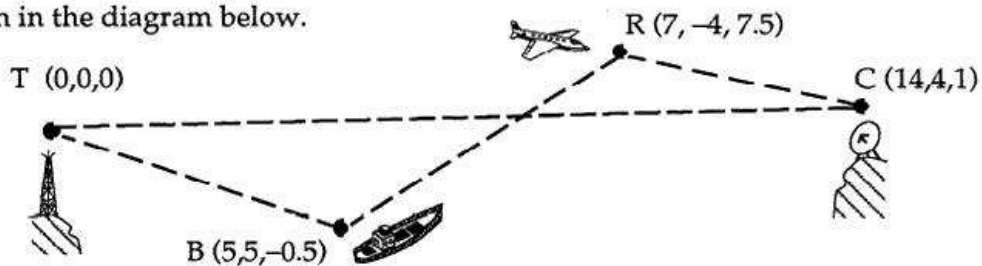
Find the coordinates of G which divides BM in the ratio $2:1$. (3)

- (b) Calculate the size of angle GOA . (5)



[SQA]

6. Relative to a suitable set of co-ordinate axes with a scale of 1 unit to 2 kilometres, the positions of a transmitter mast, ship, aircraft and satellite dish are shown in the diagram below.



The top T of the transmitter mast is the origin, the bridge B on the ship is the point $(5, 5, -0.5)$, the centre C of the dish on the top of a mountain is the point $(14, 4, 1)$ and the reflector R on the aircraft is the point $(7, -4, 7.5)$.

- (a) Find the distance from the bridge of the ship to the reflector on the aircraft. (3)
- (b) Three minutes earlier the aircraft was at the point $M(-2, 4, 8.5)$. Find the speed of the aircraft in kilometres per hour. (2)
- (c) Prove that the direction of the beam TC is perpendicular to the direction of the beam BR . (3)
- (d) Calculate the size of angle TCR . (5)

[SQA]

7.

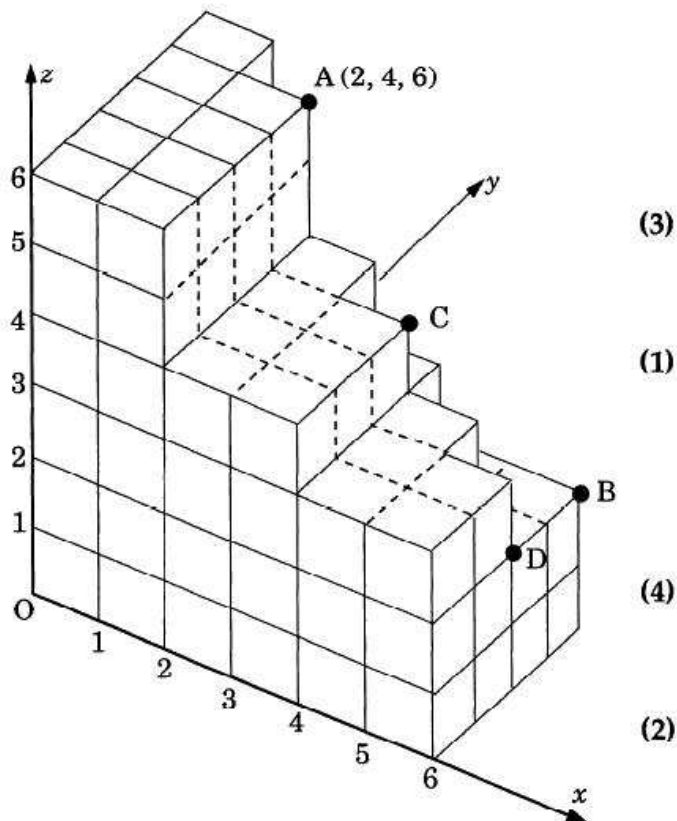
With coordinate axes as shown, the point A is (2,4,6).

(a) Write down the coordinates of B, C and D.

(b) Show that C is the midpoint of AD.

(c) By using the components of the vectors \vec{OA} and \vec{OB} , calculate the size of angle AOB, where O is the origin.

(d) Hence calculate the size of angle OAB.

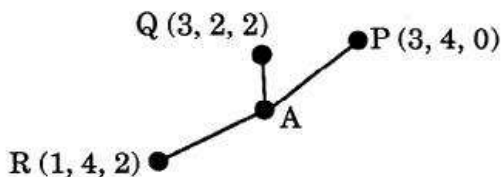
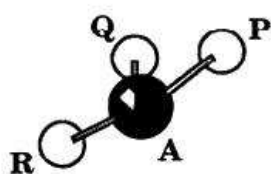
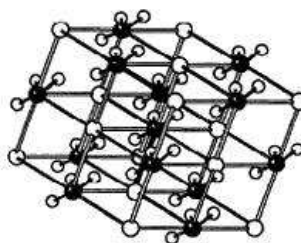


[SQA]

8.

The diagram shows the rhombohedral crystal lattice of calcium carbonate.

The three oxygen atoms P, Q and R around the carbon atom A have coordinates as shown below.



(a) Calculate the size of angle PQR.

(b) M is the midpoint of QR and T is the point which divides PM in the ratio 2:1.

(i) Find the coordinates of T.

(ii) Show that P, Q and R are equidistant from T.

(c) The coordinates of A are (2, 3, 1).

(i) Show that P, Q and R are also equidistant from A

(ii) Explain why T, and not A, is the centre of the circle through P, Q and R.

- [SQA] 9. The first four levels of a stepped pyramid with a square base are shown in Diagram 1.

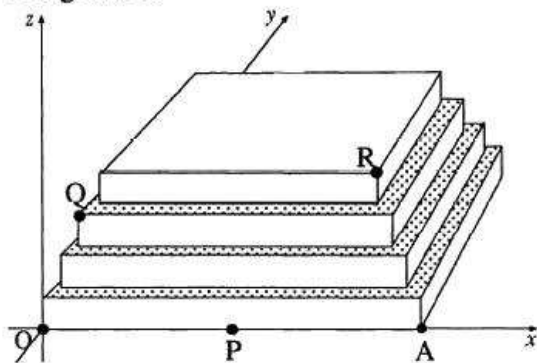


Diagram 1

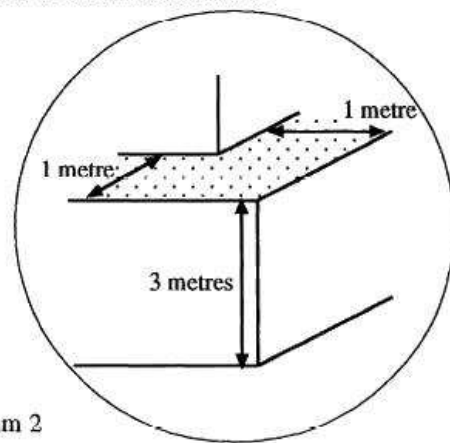


Diagram 2

Each level is a square-based cuboid with a height of 3 m. The shaded parts indicate the steps which have a “width” of 1 m.

The height and “width” of a step at a corner are shown in the enlargement in Diagram 2.

With coordinate axes as shown and 1 unit representing 1 metre, the coordinates of P and A are (12, 0, 0) and (24, 0, 0).

(a) Find the coordinates of Q and R.

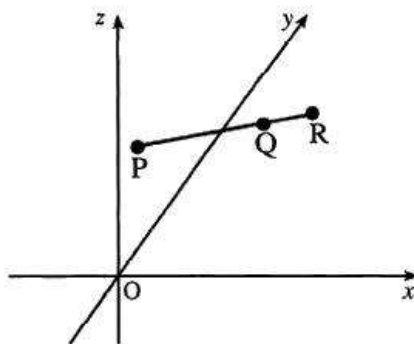
(2)

(b) Find the size of angle QPR.

(7)

- [SQA] 10.

Relative to the axes shown and with an appropriate scale, $P(-1, 3, 2)$ and $Q(5, 0, 5)$ represent points on a road. The road is then extended to the point R such that $\vec{PR} = \frac{4}{3}\vec{PQ}$.

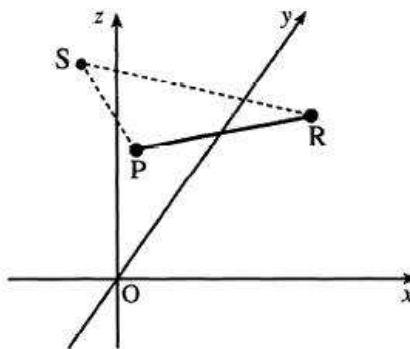


(3)

(a) Find the coordinates of R.

(b) Roads from P and R are built to meet at the point S (-2, 2, 5).

Calculate the size of angle PSR.



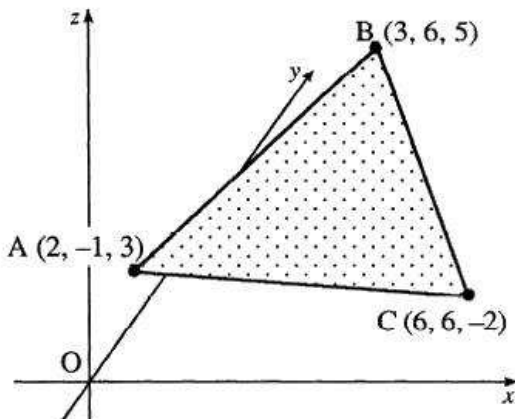
(7)

[SQA] 11.

A triangle ABC has vertices

A (2, -1, 3), B(3, 6, 5) and C (6, 6, -2).

- Find \vec{AB} and \vec{AC} .
- Calculate the size of angle BAC.
- Hence find the area of the triangle.



(2)

(5)

(2)

[SQA] 12.

ABCDEFGH is a cuboid.

K lies two thirds of the way along HG.

(i.e. HK:KG = 2:1).

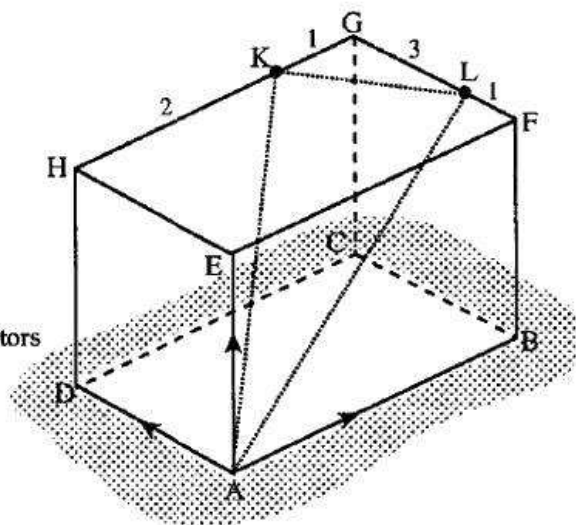
L lies one quarter of the way along FC.

(i.e. FL:LG = 1:3).

\vec{AB} , \vec{AD} and \vec{AE} can be represented by the vectors

$$\begin{pmatrix} 3 \\ 6 \\ 3 \end{pmatrix}, \begin{pmatrix} -8 \\ 4 \\ 4 \end{pmatrix} \text{ and } \begin{pmatrix} 1 \\ -3 \\ 5 \end{pmatrix} \text{ respectively.}$$

- Calculate the components of \vec{AK} .
- Calculate the components of \vec{AL} .
- Calculate the size of angle KAL.



2

2

5

[SQA]

13. Diagram 1 shows a christmas tree decoration which is made of coloured glass rods in the shape of a square-based prism topped by a square pyramid. Diagram 2 shows the decoration relative to the origin and rectangular coordinate axes OX , OY and OZ .

The vertex F has position vector $\begin{pmatrix} 2 \\ 2 \\ -7 \end{pmatrix}$

and the vertex V has position vector $\begin{pmatrix} 1 \\ 1 \\ 3 \end{pmatrix}$

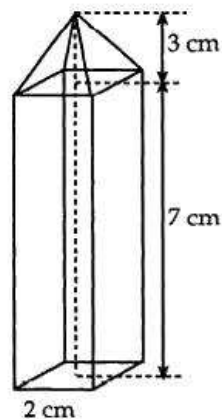


Diagram 1

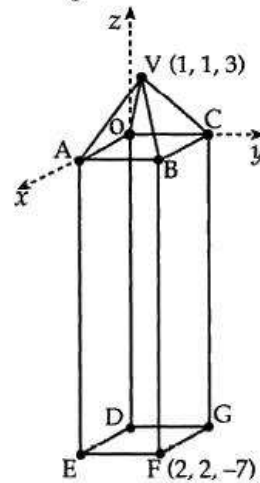


Diagram 2

(a) Find

- (i) the components of the vectors represented by \vec{VF} and \vec{VE} ;
 (ii) the size of angle EVF .

(7)

(b) To make the decoration more attractive, triangular sheets of coloured glass VEF and VDG are added to it.

Calculate the area of the glass triangle VEF .

(3)

[END OF QUESTIONS]