

12A Introduction to 3D Vectors

1. Find the distance from the origin to the point $P(4, 2, 5)$

2. Find the distance between the points $A(1, 3, 4)$ and $B(8, 6, -5)$

- The coordinates of A and B are $(5, 0, 3)$ and $(4, 2, k)$ respectively. Given that $|AB|$ is 3 units, find the possible values of k

12B *ijk* and unit vectors

1. Consider the points $A(1,5,-2)$ and $B(0,-3,7)$.
 - a) Find the position vectors of A and B in *ijk* notation.

 - b) Find the vector \overrightarrow{AB} as a column vector

2. The vectors \mathbf{a} and \mathbf{b} are given as:

$$\mathbf{a} = \begin{pmatrix} 2 \\ -3 \\ 5 \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} 4 \\ -2 \\ 0 \end{pmatrix}.$$

a) Find:

i) $4\mathbf{a} + \mathbf{b}$ ii) $2\mathbf{a} - 3\mathbf{b}$

b) State, with a reason, whether either of these vectors is parallel to $4\mathbf{i} - 5\mathbf{k}$

3. Find the magnitude of

$\mathbf{a} = 2\mathbf{i} - \mathbf{j} + 4\mathbf{k}$, and hence find $\hat{\mathbf{a}}$, the unit vector in the direction of \mathbf{a} .

4. Given the vector:

$\mathbf{a} = 2\mathbf{i} - \mathbf{j} + 4\mathbf{k}$, with magnitude $\sqrt{21}$, calculate the angle between the vector and the x , y , and z axes

5. The points A and B have position vectors $4\mathbf{i} + 2\mathbf{j} + 7\mathbf{k}$ and $3\mathbf{i} + 4\mathbf{j} - \mathbf{k}$ relative to a fixed origin O . Find \overrightarrow{AB} and show that $\triangle OAB$ is isosceles.

12C Modelling with Vectors

1. A, B, C and D are the points $(2, -5, -8)$, $(1, -7, -3)$, $(0, 15, -10)$ and $(2, 19, -20)$ respectively.

a) Find \overrightarrow{AB} and \overrightarrow{DC} , giving your answers in the form $p\mathbf{i} + q\mathbf{j} + r\mathbf{k}$

b) Show that the lines AB and DC are parallel and that $\overrightarrow{AB} = 2\overrightarrow{DC}$

c) Hence, describe the quadrilateral $ABCD$

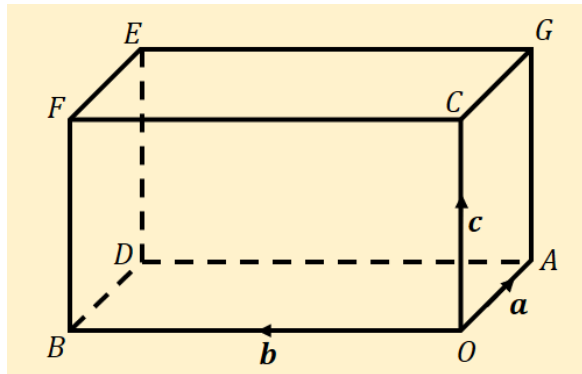
2. P , Q and R are the points $(4, -9, -3)$, $(7, -7, -7)$ and $(8, -2, 0)$ respectively. Find the coordinates of a point S such that $PQRS$ forms a parallelogram.

3. Given that:

$$3\mathbf{i} + (p + 2)\mathbf{j} + 120\mathbf{k} = p\mathbf{i} - q\mathbf{j} + 4pqr\mathbf{k}$$

Find the values of p , q and r .

4. The diagram shows a cuboid whose vertices are O, A, B, C, D, E, F and G . Vectors \mathbf{a} , \mathbf{b} and \mathbf{c} are the position vectors of the vertices A, B and C respectively. Prove that diagonals OE and BG bisect each other.



12D Forces as Vectors

1. A particle of mass 0.5kg is acted on by 3 forces:

$$\mathbf{F}_1 = (2\mathbf{i} - \mathbf{j} + 2\mathbf{k})N$$

$$\mathbf{F}_2 = (-\mathbf{i} + 3\mathbf{j} - 3\mathbf{k})N$$

$$\mathbf{F}_3 = (4\mathbf{i} - 3\mathbf{j} - 2\mathbf{k})N$$

2. Find the resultant force, \mathbf{R} , that acts on the particle.

3. Find the acceleration of the particle

4. Find the magnitude of the acceleration

5. Given that the particle starts at rest, find the distance travelled in the first 6 seconds of its motion