

A Level Maths: 3d Vectors

1 Given that the point A has position vector $3\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$ and the point B has position vector $-4\mathbf{i} + 7\mathbf{j} + 5\mathbf{k}$

(a) Find the vector \overrightarrow{AB} (3)

(b) Find $|\overrightarrow{AB}|$ (3)

(Total for question 1 is 6 marks)

2 Given that $|3\mathbf{i} + k\mathbf{j} + 2\mathbf{k}| = 7$

Find the two possible values of k

(Total for question 2 is 3 marks)

3 Given that the point A has position vector $-5\mathbf{i} + 7\mathbf{j} - 3\mathbf{k}$ and the point B has position vector $-8\mathbf{i} + 2\mathbf{j} - \mathbf{k}$

(a) Find the vector \overrightarrow{AB} (3)

(b) Find $|\overrightarrow{AB}|$ (3)

(Total for question 3 is 6 marks)

4 $\mathbf{a} = -5\mathbf{i} + 7\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$

Given that the resultant force of \mathbf{a} and \mathbf{b} is $-2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$ find the values of x , y and z

(Total for question 4 is 3 marks)

5 In triangle ABC , $\overrightarrow{AB} = 6\mathbf{i} + 2\mathbf{j} - \mathbf{k}$, $\overrightarrow{AC} = 8\mathbf{i} - 5\mathbf{j} + 4\mathbf{k}$

(a) Find the vector \overrightarrow{BC} (3)

(b) Find the length of the line AB (3)

(Total for question 5 is 6 marks)

6 Three forces act on an object $\mathbf{F}_1 = -5\mathbf{i} + 7\mathbf{j} + 4\mathbf{k}$, $\mathbf{F}_2 = 4\mathbf{i} + 6\mathbf{j} - 2\mathbf{k}$ and $\mathbf{F}_3 = 3\mathbf{i} - 5\mathbf{j} + 3\mathbf{k}$
Find the resultant force.

(Total for question 6 is 3 marks)

7 The points P , Q , R and S have position vectors $\mathbf{p} = -3\mathbf{i} + 10\mathbf{j} - 7\mathbf{k}$, $\mathbf{q} = 5\mathbf{i} + 4\mathbf{j} + 3\mathbf{k}$
 $\mathbf{r} = -4\mathbf{i} + 6\mathbf{j} - 12\mathbf{k}$ $\mathbf{s} = 8\mathbf{i} - 3\mathbf{j} + 3\mathbf{k}$

Show that \overrightarrow{PQ} is parallel to \overrightarrow{RS}

(Total for question 7 is 4 marks)

8 Relative to a fixed origin O ,
the point A has position vector $(3\mathbf{i} + 4\mathbf{j} - 2\mathbf{k})$,
the point B has position vector $(7\mathbf{i} - 5\mathbf{j} + 3\mathbf{k})$,
and the point C has position vector $(a\mathbf{i} + 3\mathbf{j} - 4\mathbf{k})$, where a is a constant and $a > 0$,
 D is the point such that $\overrightarrow{AB} = \overrightarrow{BD}$

(a) Find the position vector of D . (2)

Given that $|\overrightarrow{AC}| = 5$

(b) Find the value of a . (3)

(Total for question 8 is 5 marks)

9 Relative to a fixed origin O ,
the point A has position vector $(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k})$,
the point B has position vector $(5\mathbf{i} - 10\mathbf{j} + 2\mathbf{k})$,
the point C has position vector $(3\mathbf{i} - 7\mathbf{j} - 2\mathbf{k})$,

(a) Find \overrightarrow{BC} (2)

(b) Show that the quadrilateral $OABC$ is a parallelogram, giving reasons for your answer. (3)

(Total for question 9 is 5 marks)

10 Relative to a fixed origin O ,
the point A has position vector $(4\mathbf{i} - 2\mathbf{j} - 5\mathbf{k})$,
the point B has position vector $(6\mathbf{i} + \mathbf{j} - 9\mathbf{k})$,
the point C has position vector $(4\mathbf{i} + 6\mathbf{j} - 8\mathbf{k})$,

(a) Find \overrightarrow{AB} (2)

(b) Show that the quadrilateral $OABC$ is a trapezium, giving reasons for your answer. (2)

(Total for question 10 is 4 marks)

11 The points A and B have position vectors $\begin{pmatrix} 1 \\ -2 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ -5 \\ 2 \end{pmatrix}$ respectively.

(a) Find the exact length of AB . **(2)**

(b) Find the position vector of the midpoint of AB . **(1)**

The points P and Q have position vectors $\begin{pmatrix} 4 \\ 2 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ 5 \\ 3 \end{pmatrix}$ respectively.

(c) Show that $ABPQ$ is a parallelogram. **(3)**

(Total for question 11 is 6 marks)

12 The point A has the position vector $\begin{pmatrix} a \\ b \\ 3 \end{pmatrix}$ where a and b are positive constants, point B has the position vector $\begin{pmatrix} 2 \\ 3 \\ 4 \end{pmatrix}$ and point C has the position vector $\begin{pmatrix} 0 \\ 1 \\ 2 \end{pmatrix}$

ABC is an isosceles triangle with $AB = AC$

(a) Show that $a + b = 3$ **(4)**

Given that the area of ABC is $\sqrt{8}$

(b) Find the exact values of a and b . **(6)**

(Total for question 12 is 10 marks)

13 The points A and B have position vectors $\begin{pmatrix} -3 \\ 5 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 4 \\ 7 \end{pmatrix}$ respectively.

Find the exact length of AB .

(Total for question 13 is 2 marks)
