eClassroom

# Vectors

## Questions

Suitable for:

**Pearson Edexcel International A-Level (iAL) — Pure Mathematics 4**

## Question 1

The vector **a** is given by

$$\begin{bmatrix} 2 \\ 3 \\ -1 \end{bmatrix}$$

**(a)** Find |**a**|.

**(2 marks)**

**(b)** Find the unit vector in the direction of **a**.

**(2 marks)**

**Total for question = 4 marks**

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## Question 2

Find the value(s) of $\lambda$ such that

$$|\lambda\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}| = \sqrt{17}$$

**(3 marks)**

**Total for question = 3 marks**

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## Question 3

Points A and B have coordinates (1, 2, –1) and (4, –1, 3) respectively.

**(a)** Find the vector **AB**.

**(2 marks)**

**(b)** Find |**AB**|.

**(2 marks)**

**Total for question = 4 marks**

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## Question 4

Points P and Q have position vectors

$$\mathbf{p} = 3\mathbf{i} - \mathbf{j} + 2\mathbf{k} \qquad \mathbf{q} = \mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$$

Find the position vector of the midpoint M of PQ.

**(3 marks)**

**Total for question = 3 marks**

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## Question 5

Find the vector equation of the straight line that passes through the point A(2, 1, –3) and has direction vector

$$\begin{bmatrix} 1 \\ -2 \\ 4 \end{bmatrix}$$

**(2 marks)**

**Total for question = 2 marks**

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## Question 6

Find the vector equation of the straight line that passes through the points P(1, 0, 3) and Q(3, 2, –1).

**(3 marks)**

**Total for question = 3 marks**

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## Question 7

A line has equation

$$\mathbf{r} = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix} + t \begin{bmatrix} 2 \\ -1 \\ 3 \end{bmatrix}$$

**(a)** Find the coordinates of the point on the line when t = 2.

**(2 marks)**

**(b)** Determine whether the point (7, –1, 9) lies on the line.

**(2 marks)**

**Total for question = 4 marks**

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## Question 8

Two lines $l_1$ and $l_2$ have equations

$$l_1 : \mathbf{r} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} + s \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} \quad l_2 : \mathbf{r} = \begin{bmatrix} 3 \\ 1 \\ 7 \end{bmatrix} + t \begin{bmatrix} 6 \\ -3 \\ 12 \end{bmatrix}$$

Determine whether $l_1$ and $l_2$ are parallel, giving reasons.

**(2 marks)**

**Total for question = 2 marks**

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## Question 9

Two lines have equations

$$l_1: \mathbf{r} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} + s \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} \quad l_2: \mathbf{r} = \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix} + t \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$$

Show that the two lines are skew.

**(4 marks)**

**Total for question = 4 marks**

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## Question 10

Two lines have equations

$$l_1: \mathbf{r} = \begin{bmatrix} 2 \\ 3 \\ -1 \end{bmatrix} + s \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix} \quad l_2: \mathbf{r} = \begin{bmatrix} 4 \\ 1 \\ 1 \end{bmatrix} + t \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$$

Find the coordinates of the point of intersection.

**(5 marks)**

**Total for question = 5 marks**

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## Question 11

Two lines have equations

$$l_1: \mathbf{r} = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix} + s \begin{bmatrix} 2 \\ 1 \\ -1 \end{bmatrix} \quad l_2: \mathbf{r} = \begin{bmatrix} 3 \\ 4 \\ 1 \end{bmatrix} + t \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$$

Determine whether the two lines intersect or are skew.

**(4 marks)**

**Total for question = 4 marks**

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## Question 12

Given that

$$\mathbf{a} = \begin{bmatrix} 3 \\ -2 \\ 1 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 1 \\ 4 \\ -3 \end{bmatrix}$$

find $\mathbf{a} \cdot \mathbf{b}$.

**(2 marks)**

**Total for question = 2 marks**

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## Question 13

Show that the vectors

$$\mathbf{a} = \begin{bmatrix} 3 \\ -1 \\ 2 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 2 \\ 4 \\ 1 \end{bmatrix}$$

are perpendicular.

**(2 marks)**

**Total for question = 2 marks**

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## Question 14

Find the value of $\lambda$ such that the vectors

$$\mathbf{a} = \begin{bmatrix} \lambda \\ 3 \\ -2 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$$

are perpendicular.

**(3 marks)**

**Total for question = 3 marks**

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## Question 15

Find the angle between the vectors

$$\mathbf{a} = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} 1 \\ -2 \\ 2 \end{bmatrix}$$

giving your answer in degrees to 1 decimal place.

**(4 marks)**

**Total for question = 4 marks**

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## Question 16

Find the acute angle between the lines

$$l_1: \mathbf{r} = \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix} + s \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix} \quad l_2: \mathbf{r} = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} + t \begin{bmatrix} 2 \\ -1 \\ 2 \end{bmatrix}$$

giving your answer in degrees to 2 decimal places.

**(4 marks)**

**Total for question = 4 marks**

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## Question 17

Two lines have direction vectors

$$\mathbf{d}_1 = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix} \quad \mathbf{d}_2 = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$$

Find the exact acute angle between the two lines.

**(4 marks)**

**Total for question = 4 marks**

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## Question 18

The points A, B and C have coordinates (1, 2, 3), (3, 4, 1) and (5, 2, 3) respectively.

Find the angle ABC, giving your answer in degrees to 2 decimal places.

**(5 marks)**

**Total for question = 5 marks**

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## Question 19

Two lines $l_1$ and $l_2$ have equations

$$l_1: \mathbf{r} = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix} + s \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix} \quad l_2: \mathbf{r} = \begin{bmatrix} 2 \\ 3 \\ -1 \end{bmatrix} + t \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$$

**(a)** Show that $l_1$ and $l_2$ intersect and find the coordinates of the point of intersection.

**(4 marks)**

**(b)** Find the angle between $l_1$ and $l_2$.

**(3 marks)**

**Total for question = 7 marks**

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