
AS and A-level MATHS

Vectors

Specification content coverage: J1, J2, J3, J4, J5

In this test you will be assessed on:

- using vectors in two dimensions
- calculating the magnitude and direction of a vector and converting between component form and magnitude/direction form
- adding vectors diagrammatically and performing the algebraic operations of vector addition and multiplication by scalars, understanding their geometrical interpretations
- understanding and using position vectors, and calculating the distance between two points represented by position vectors
- using vectors to solve problems in pure mathematics and in context, including forces.

The test comprises two sections. The questions in section A will test you on the basics of the topic. Those in section B require a bit more thinking.

Section A: The basics

1 Which of the following is a vector quantity?

Circle your answer.

Displacement

Mass

Speed

Time

[1 mark]

2 Which of the following vectors is parallel to the vector $\mathbf{a} - 4\mathbf{b}$?

Circle your answer.

$$\frac{1}{2}\mathbf{a} + 2\mathbf{b}$$

$$8\mathbf{b} - 2\mathbf{a}$$

$$3\mathbf{a} - 6\mathbf{b}$$

$$\mathbf{a} + 4\mathbf{b}$$

[1 mark]

3 In the triangle PQR , $\overrightarrow{PQ} = \mathbf{q}$ and $\overrightarrow{PR} = \mathbf{r}$. M is the midpoint of PR .

Find the vector \overrightarrow{QM} in terms of \mathbf{q} and \mathbf{r} .

[2 marks]

4 $\mathbf{a} = 3\mathbf{i} - \mathbf{j}$ and $\mathbf{b} = 2\mathbf{i} - 3\mathbf{j}$

Find $\mathbf{a} - 2\mathbf{b}$ in terms of \mathbf{i} and \mathbf{j} .

[2 marks]

5 Given that $\mathbf{p} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$, find:

5 (a) $|\mathbf{p}|$

[1 mark]

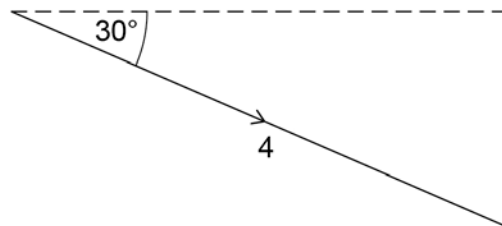
5 (b) a unit vector in the direction of \mathbf{p} .

[1 mark]

5 (c) the angle between \mathbf{p} and the vector \mathbf{j} , giving your answer to 1 decimal place.

[2 marks]

6 Write this vector in the form $x\mathbf{i} + y\mathbf{j}$



[2 marks]

7 The points A and B have coordinates $(4, 5)$ and $(6, 3)$ respectively.

7 (a) Write down the position vector of A in terms of \mathbf{i} and \mathbf{j} .

[1 mark]

7 (b) Find $|\overline{AB}|$, giving your answer as a simplified surd.

[2 marks]

Section B: A bit more thinking

- 8** Two forces, \mathbf{F}_1 and \mathbf{F}_2 , are given by the vectors $\mathbf{F}_1 = (3\mathbf{i} - 4\mathbf{j})$ newtons and $\mathbf{F}_2 = (\mathbf{i} + p\mathbf{j})$ newtons respectively.
- The resultant force acts in a direction parallel to the vector $(2\mathbf{i} - 3\mathbf{j})$.
- Find p .
- [4 marks]**
- 9** In this question, \mathbf{i} and \mathbf{j} represent east and north respectively.
- A boat, A , has position vector $(2\mathbf{i} + \mathbf{j})$ km and a buoy, B , has position vector $(6\mathbf{i} - 8\mathbf{j})$ km.
- 9 (a)** Find the distance between the buoy and the boat.
- [2 marks]**
- 9 (b)** Find the bearing of the buoy from the boat.
- [2 marks]**
- 9 (c)** The boat travels with constant velocity towards the buoy, taking 45 minutes to reach the buoy.
- Find the velocity vector of the boat.
- [2 marks]**
- 10** X , Y and Z are collinear.
- X and Y have position vectors $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 5 \\ -9 \end{pmatrix}$ respectively.
- Given that $XZ = 3YZ$, find the possible position vectors for Z .
- [3 marks]**
- 11** The point A lies on the line $y = 2x - 1$.
- Given that $|\overline{OA}| = \sqrt{34}$, find the possible expressions for \overline{OA} in the form $p\mathbf{i} + q\mathbf{j}$.
- [4 marks]**