



**eClassroom**

GCSE Mathematics

# **Vectors**

**Questions**

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Pearson Edexcel GCSE & iGCSE Mathematics



## Section A — Foundation

### Worked Examples

#### [Fluency]

$\mathbf{a} = (3, 4)$ . Find  $|\mathbf{a}|$ .

$$|\mathbf{a}| = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

#### [Reasoning]

$\mathbf{OA} = \mathbf{a}$ ,  $\mathbf{OB} = \mathbf{b}$ .  $\mathbf{M}$  is the midpoint of  $\mathbf{AB}$ . Find  $\mathbf{OM}$ .

$$\vec{\mathbf{OM}} = \mathbf{a} + \frac{1}{2}\vec{\mathbf{AB}} = \mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a}) = \frac{1}{2}(\mathbf{a} + \mathbf{b})$$

#### [Problem Solving]

$\mathbf{OA} = \mathbf{a}$ ,  $\mathbf{OB} = \mathbf{b}$ .  $\mathbf{P}$  divides  $\mathbf{AB}$  in ratio 2:1. Find  $\mathbf{OP}$ .

$$\vec{\mathbf{OP}} = \mathbf{a} + \frac{2}{3}(\mathbf{b} - \mathbf{a}) = \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$$

#### [Fluency]

1.

$\mathbf{a} = (3, 4)$ . Find the magnitude  $|\mathbf{a}|$ .

(2 marks)

#### [Fluency]

2.

$\mathbf{a} = (2, 3)$  and  $\mathbf{b} = (1, -1)$ .

Find  $\mathbf{a} + \mathbf{b}$ .

(1 mark)

#### [Fluency]

3.

$\mathbf{a} = (4, 1)$  and  $\mathbf{b} = (2, 3)$ .

Find  $2\mathbf{a} - \mathbf{b}$ .

(2 marks)

#### [Fluency]

4.

Show that vectors  $(4, 6)$  and  $(2, 3)$  are parallel.

(2 marks)





[Fluency]

5.

A has position vector  $(2, 5)$  and B has position vector  $(8, 1)$ .  
Find the position vector of the midpoint M of AB.

(2 marks)

[Reasoning]

6.



ABCD is a parallelogram.  $AB = \mathbf{a}$  and  $AD = \mathbf{b}$ .  
Express AC as a vector in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

(2 marks)

[Reasoning]

7.

$OA = \mathbf{a}$  and  $OB = \mathbf{b}$ . M is the midpoint of AB.  
Find OM in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

(3 marks)

[Reasoning]

8.

$OA = \mathbf{a}$  and  $OB = \mathbf{b}$ . P divides AB in ratio 2:1 from A.  
Find OP in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

(3 marks)

[Problem Solving]

9.

Find the unit vector in the direction of  $(3, 4)$ .

(2 marks)

[Problem Solving]

10.

OABC is a quadrilateral where  $OA = \mathbf{a}$ ,  $AB = \mathbf{b}$  and  $CB = \mathbf{a}$ .

(a) Find OC in terms of  $\mathbf{a}$  and  $\mathbf{b}$ . (2)

(b) What type of quadrilateral is OABC? Give a reason. (2)

(4 marks)



## Section B — Higher

### Worked Examples

#### [Fluency]

Prove the midpoint theorem: M and N are midpoints of AB and AC. Show MN is parallel to BC and  $MN = \frac{1}{2}BC$ .

$$\vec{MN} = \vec{MA} + \vec{AN} = \frac{1}{2}\vec{BA} + \frac{1}{2}\vec{AC} = \frac{1}{2}\vec{BC}$$

$MN = \frac{1}{2}BC$  and parallel to BC ✓

#### [Reasoning]

P divides AB in ratio 3:2.  $OA = \mathbf{a}$ ,  $OB = \mathbf{b}$ . Find OP.

$$\vec{OP} = \mathbf{a} + \frac{3}{5}(\mathbf{b} - \mathbf{a}) = \frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$$

#### [Problem Solving]

Find k:  $k(2,1) + 3(0,1) = (4,5)$ .

$(2k, k+3) = (4,5) \rightarrow k = 2$ , check:  $2+3=5$  ✓

#### [Fluency]

1.

In triangle OAB, M is the midpoint of AB, N is the midpoint of OA.

$OA = \mathbf{a}$ ,  $OB = \mathbf{b}$ .

Prove that MN is parallel to OB and find the ratio MN:OB.

(4 marks)

#### [Fluency]

2.

$OA = \mathbf{a}$ ,  $OB = \mathbf{b}$ . P divides AB in ratio 3:2 from A.

Find OP in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

(3 marks)

#### [Fluency]

3.

$\mathbf{a} = (2, -1, 3)$ .

Find  $|\mathbf{a}|$ . Give your answer in surd form.

(2 marks)





[Reasoning]

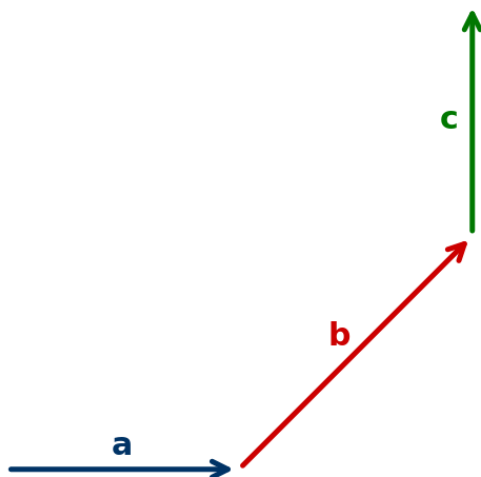
4.

Find  $k$  if  $k\mathbf{a} + 3\mathbf{b} = (4, 7)$  where  $\mathbf{a} = (1, 2)$  and  $\mathbf{b} = (0, 1)$ .

(3 marks)

[Reasoning]

5.



In the diagram,  $OA = \mathbf{a}$ ,  $AB = \mathbf{b}$ .

$C$  is the midpoint of  $OB$ .

Show that  $AC = \frac{1}{2}\mathbf{b} - \mathbf{a}$ .

(3 marks)

[Reasoning]

6.

Determine whether points  $A$ ,  $B$  and  $C$  are collinear:

$A$  has position vector  $(1, 2)$ ,  $B$  has  $(4, 5)$ ,  $C$  has  $(7, 8)$ .

(3 marks)

[Problem Solving]

7.

$OA = \mathbf{a}$ ,  $OB = \mathbf{b}$ .

$M$  is the midpoint of  $OA$ .  $N$  is the midpoint of  $OB$ .

Show that  $MN$  is parallel to  $AB$  and half its length.

(4 marks)

[Problem Solving]

8.

In triangle  $OAB$ :  $OA = \mathbf{a}$ ,  $OB = \mathbf{b}$ .

$P$  divides  $OA$  in ratio  $2:1$ .  $Q$  divides  $OB$  in ratio  $2:1$ .

Show that  $PQ$  is parallel to  $AB$ .

(4 marks)

**[Problem Solving]****9.**

OABC is a parallelogram.  $OA = \mathbf{a}$ ,  $OC = \mathbf{c}$ .

M is the midpoint of OB. N is the midpoint of AC.

Prove that M and N are the same point.

**(4 marks)****[Problem Solving]****10.**

Prove using vectors that the diagonals of a parallelogram bisect each other.

**(4 marks)**