

# Vector Proof

GCSE Maths · Written to the shared content for AQA, Edexcel and OCR

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

## 1. Worked example

**OA = a and OB = b. Write AB in terms of a and b.**

Step 1 · Go from A back to O, then O to B

$$AB = AO + OB = -a + b$$

**Answer:  $AB = b - a$**

Check: Going the other way,  $BA = a - b = -AB$  ✓

## 2. Now try one with the steps

**M is the midpoint of AB. Find OM.**

Step 1 ·  $OM = OA + AM$

Step 2 · Substitute  $AB = b - a$

**Answer:**

## 3. Practice

Show your working. The marks tell you how much is expected.

1. OA = a and OB = b. Write AB in terms of a and b. [1]

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2. Using the same vectors, write BA in terms of a and b. [1]

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3. M is the midpoint of OA. Write OM in terms of a. [1]

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4. M is the midpoint of AB. Write OM in terms of a and b. [2]

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5. P is on AB with  $AP : PB = 2 : 1$ . Write OP in terms of a and b. [3]

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6. P is on AB with  $AP : PB = 1 : 3$ . Write AP in terms of a and b. [2]

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7. Are the vectors  $2a + 4b$  and  $a + 2b$  parallel? Explain. [1]

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8. Are the vectors  $3a - b$  and  $6a + 2b$  parallel? Explain. [1]

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9.  $PQ = 2a - b$  and  $RS = 4a - 2b$ . What can you say about PQ and RS? [2]

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10. OABC is a parallelogram with  $OA = a$  and  $OC = c$ . Write OB in terms of a and c. [1]

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11. For the parallelogram in question 10, write AC in terms of a and c. [1]

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12. The diagonals of parallelogram OABC meet at X. Write OX in terms of a and c. [2]

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13.  $OA = a$ ,  $OB = b$  and  $OP = \frac{1}{3}(a + 2b)$ . Show that P lies on AB and find the ratio  $AP : PB$ . [3]

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14. In triangle OAB,  $OA = a$  and  $OB = b$ . M and N are the midpoints of OA and OB. Show that MN is parallel to AB and half its length. [3]

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15.  $OP = 2a + b$ ,  $OQ = 5a + 3b$  and  $OR = 11a + 7b$ . Are P, Q and R collinear? Prove your answer. [4]

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#### 4. Before you hand it in

**$AB = a - b$**

$AB = (\text{where you end}) - (\text{where you start}) = OB - OA = b - a$ . Check with a journey:  $A \rightarrow O$  is  $-a$ ,  $O \rightarrow B$  is  $+b$ .

**$AP : PB = 1 : 2$ , so  $AP = \frac{1}{3}AB$**

The ratio  $1 : 2$  has 3 parts. AP is 1 of them:  $\frac{1}{3}AB$ .

**$3a - b$  and  $6a + 2b$  are parallel because  $6 = 2 \times 3$**

BOTH coefficients must be multiplied by the same number:  $2(3a - b) = 6a - 2b$ , not  $6a + 2b$ .

**$AC = 3AB$ , so A, B, C are collinear — without mentioning A**

Parallel vectors could be on different lines. Say they share point A, so the three points are on one line.