

## E3.4 Length and midpoint

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

Total: 14 marks

**KEY WORDS** midpoint 中点 • line segment 线段 • distance between two points 两点间的距离  
• exact form 精确值 • coordinates 坐标

### Objective

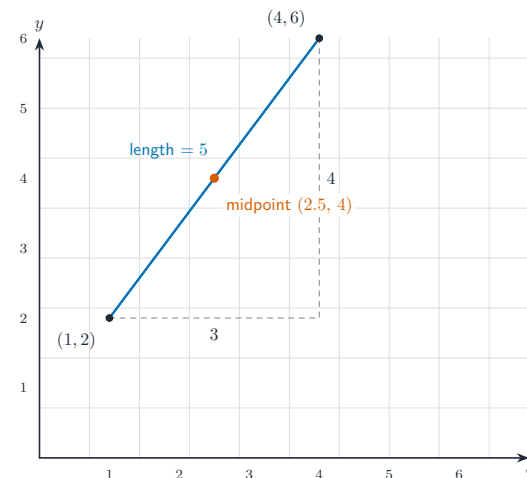
Build the skills to answer Extended exam questions on **length and midpoint** 长度与中点 — finding the **distance between two points** 两点间的距离 with Pythagoras, finding the **midpoint** 中点 of a line segment, and working backwards from a midpoint to a missing endpoint.

**You must be able to:**

- find the length of a line segment from the coordinates of its ends
- find the midpoint of a line segment
- find one endpoint when the midpoint and the other endpoint are known

### 1 Worked examples

#### ■ Length is Pythagoras; midpoint is an average



The horizontal and vertical differences are the two short sides of a right-angled triangle

- **Length:**  $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ . Both differences are SQUARED, so their signs do not matter.
- **Midpoint:**  $M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$  — the average of the  $x$ 's and the average of the  $y$ 's.
- **Worked:** for  $A(1, 2)$  and  $B(7, 10)$ ,  $AB = \sqrt{6^2 + 8^2} = \sqrt{100} = 10$  and  $M = (4, 6)$ .
- **Backwards:** if  $M$  is the midpoint of  $PQ$ , then  $Q = (2x_M - x_P, 2y_M - y_P)$ .

**Answer shapes** (marked by **method marks** — M1 for a correct method, A1 for the correct answer): the line showing the squares being added, before the root is taken, is the method mark.

### 2 Practice

2.1  $A$  is  $(1, 2)$  and  $B$  is  $(7, 10)$ . Find the length of  $AB$ .

[2]

**2.2** Find the midpoint of  $AB$  for the same two points. [2]

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**2.3**  $P$  is  $(-3, 5)$  and  $Q$  is  $(2, -7)$ . Find the length of  $PQ$ . [2]

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### 3 Exam-style questions

**3.1**  $A$  is the point  $(-2, 1)$  and  $B$  is the point  $(4, 6)$ .

(a) Find the coordinates of the midpoint of  $AB$ . [2]

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(b) Find the length of  $AB$ , giving your answer in exact form. [3]

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**3.2**  $M(3, -1)$  is the midpoint of  $PQ$ , and  $P$  is the point  $(-1, 4)$ . Find the coordinates of  $Q$ . [3]

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