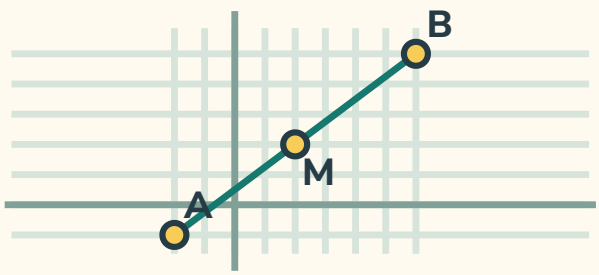
MATHS FIELD GUIDE · GRADE 10

Coordinate geometry applications

OPENING PROBLEM

A(−2, −1) and B(6, 5) share which midpoint?



A (-2, -1)
M (2, 2)
B (6, 5)

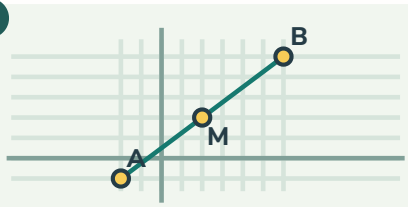
02 Locate a point along a segment
03 Rules and worked cases
04 From the givens to the answer
05 Build the right triangle between two points
06 Check your reasoning
07 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Locate a point along a segment

Moving a fraction of the full displacement locates the corresponding internal point.

1

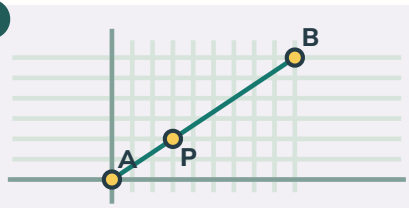


A (-2, -1)
M (2, 2)
B (6, 5)

A(−2, −1) and B(6, 5) share which midpoint?

Half the displacement (8, 6) is (4, 3). Add it to A to get M(2, 2).

2



A (0, 0)
P (3, 2)
B (9, 6)

For A(0, 0) and B(9, 6), where is the 1:2 division point from A?

Travel one of three equal steps, so P = (3, 2).

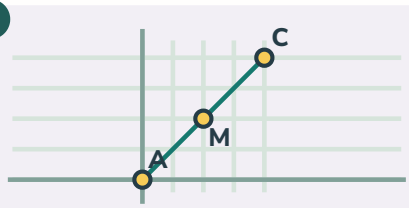
3

A = (−3, 1)
↓
M = (1, 4)
↓
B = (5, 7)

Recover the far endpoint from a midpoint.

From A to M add (4, 3). Add the same vector again to reach B.

4



A (0, 0)
M (2, 2)
C (4, 4)

How can midpoints test a quadrilateral?

Compare both diagonal midpoints. If both bisect each other in a simple quadrilateral, it is a parallelogram.

Midpoint of (0,0) and (8,4)
(4,2).

One quarter of the same trip
(2,1).

CHAPTER PROBLEM

For A=(0,0), B=(4,0), C=(4,5), D=(0,5), find AB^2.

16. A and B have the same y-coordinate. The horizontal distance is 4, so $AB^2 = 4^2 = 16$.

MATHS REFERENCE · GRADE 10

Coordinate geometry applications

Rules, conditions and worked cases

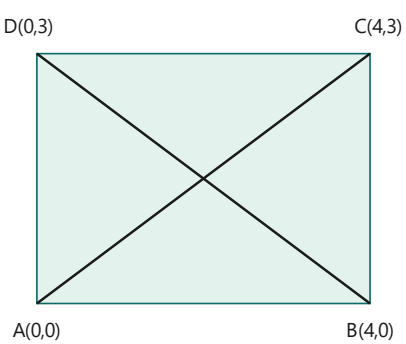
Recognise the case	Mathematical reasoning
Test a right angle	A(0,0), B(4,0), C(4,3) give squared lengths 16, 9 and 25. $AB^2 + BC^2 = AC^2$.
Test a parallelogram	With D(0,3), diagonals AC and BD both have midpoint (2,1.5), so they bisect each other.
Distinguish a square	This rectangle has adjacent sides four and three. Equal diagonals alone cannot establish a square.

Read the representations

A shape claim needs enough evidence

For a quadrilateral in vertex order, equal opposite sides establish a parallelogram; a right angle additionally gives a rectangle.

Distance calculations alone must be matched to a valid geometric criterion. Four equal sides establish a rhombus, which need not be a square.

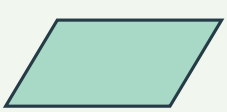


Horizontal and vertical sides meet at right angles.

Bisecting diagonals can be checked with midpoints

If the diagonals of a quadrilateral bisect each other, it is a parallelogram.

After a coordinate calculation, state the geometric conclusion and the theorem that supports it.



Why does a parallelogram map to itself under a half-turn?

Its diagonals bisect each other. Their common midpoint swaps each vertex with its opposite.

WORKED EXAMPLES

From the givens to the answer

Verify A(0,0), B(4,0), C(4,3), D(0,3) is a rectangle

1. Opposite sides have equal lengths: AB=CD=4 and BC=DA=3.
2. AB is horizontal and BC vertical, so they meet at 90°.
3. A parallelogram with a right angle is a rectangle; adjacent unequal sides show it is not a square.

Distinguish a kite from a rhombus

A(0, 3), B(2, 0), C(0, −1), D(−2, 0) are joined in order. Are all four sides equal?

1. $AB^2 = DA^2 = 13$. $BC^2 = CD^2 = 5$. Two pairs of adjacent sides are equal, so this is a kite. Unequal squared lengths rule out a rhombus.

Check another case

Example 1

A rectangle has vertices A(0,0), B(8,0), C(8,9) and D(0,9). Find AC^2.

145

Apply the squared distance formula.

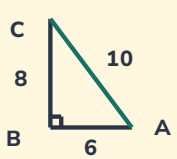
Example 2

A=(−9,0),B=(9,0). Find midpoint x.

0

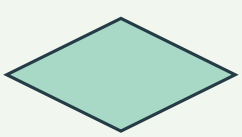
Symmetric endpoints average to zero.

Recognise a right angle from lengths



Take A(0, 0), B(6, 0) and C(6, 8). The squared distances AB^2, BC^2 and AC^2 are 36, 64 and 100.

Since 36 + 64 = 100, the right angle lies opposite AC, at B. Using AB as base gives area 24 square units.



Which diagonals split a rhombus into right triangles?

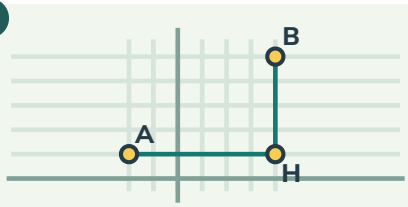
The diagonals meet at right angles and bisect one another.

ILLUSTRATED PROBLEM SHEET

Build the right triangle between two points

The horizontal and vertical displacements are perpendicular. Their squares add to the squared direct distance.

1

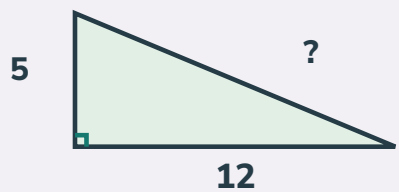


A (-2, 1)
H (4, 1)
B (4, 5)

Find the direct distance from A(−2, 1) to B(4, 5).

The legs are 6 and 4. AB = $\sqrt{52} = 2\sqrt{13}$. The broken route via H is 10 units.

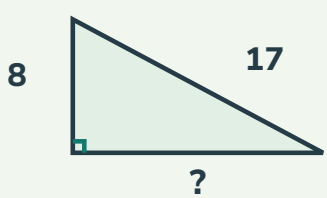
2



A right triangle has legs 5 and 12. How long is its hypotenuse?

$5^2 + 12^2 = 169$, so the longest side is 13.

3



The hypotenuse is 17 and one leg is 8. Recover the other leg.

Subtract squares: 289 − 64 = 225. The missing positive length is 15.

4

$$7^2 + 24^2$$
$$\downarrow$$
$$49 + 576 = 625$$
$$\downarrow$$
$$25^2$$

Can sides 7, 24 and 25 make a right triangle?

Yes. The converse places the right angle opposite the longest side, 25.

Coordinate changes (0,7)
distance 7.

Coordinate changes (−3,4)
distance 5.

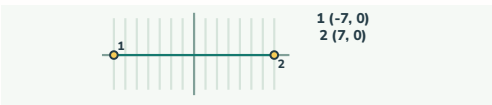
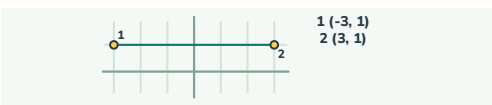
CHAPTER PROBLEM

A rectangle has vertices A(0,0), B(5,0), C(5,6) and D(0,6). Find AC^2.

61. Taking A, B, C and D in the listed order, diagonal AC has coordinate changes 5 and 6. Its squared length is $5^2 + 6^2 = 61$.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Does swapping AP:PB from 1:2 to 2:1 keep P fixed?	Only an equal division would stay fixed on reversal. On the segment from (0,0) to (9,6) the new point is (6,4).
02 Is a route 3 units east and 4 north 7 units from its start?	The route length is 7. The straight-line distance is 5.
03 A=(−7,0),B=(7,0). Find midpoint x. 	0 Symmetric endpoints average to zero.
04 P on the x-axis divides A(2,−3),B(8,6) internally. Find AP/PB.	0.5 The y-displacement is 9; reaching 0 takes 3, so the ratio is 1:2.
05 A quadrilateral has all four sides equal. What follows without more information? A) It must be a square. B) It is a rhombus. C) It has right angles. D) Its diagonals are equal.	It is a rhombus. Equal sides alone give a rhombus; right angles need separate evidence.
06 Find the distance from (−3,1) to (3,1). 	6 The coordinate changes are 6 and 0. Their squares add to 36. Taking the positive square root gives the distance.

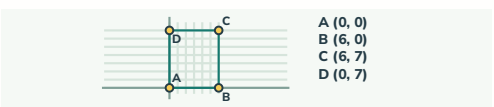


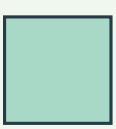
How many mirror axes does a non-square rectangle have?

Two, through the midpoints of opposite sides. Its diagonals are not mirror axes.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
07 Explain how midpoint calculations can establish that a quadrilateral is a parallelogram.	Compute the midpoint of each diagonal using opposite vertices. If they match, the diagonals bisect each other, so the quadrilateral is a parallelogram.
08 Can a drawing that looks like a square replace distance or angle evidence?	No; a sketch may be distorted or not to scale. State a sufficient criterion and verify its required properties from the coordinates.
09 For A=(0,0), B=(5,0), C=(5,6), D=(0,6), find AB^2.	25 A and B share y = 0, so AB is horizontal and five units long. Its square is 25 square units.
10 A rectangle has vertices A(0,0), B(6,0), C(6,7) and D(0,7). Find AC^2. 	85 Apply the squared distance formula.
11 For A=(0,0), B=(7,0), C=(7,8), D=(0,8), find AB^2.	49 AB runs horizontally from x = 0 to x = 7 at y = 0. Its length is 7 and its squared length is 49.



4 mirrors

What additional symmetries does a square have?

Both diagonal mirrors also work. A quarter-turn about its centre maps it onto itself.

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