

ANSWER MAZE



THE DISTANCE AND MIDPOINT FORMULAS

Distance and Midpoint: How Long and Where?

Both questions on the same points · exact answers · one page · nothing to prepare

FREE

5 How far apart are $P(-4, 7)$ and $Q(2, 4)$?

Distance = 45 → go to box 3

Distance = $3\sqrt{5}$ → go to box 2

Hint: Square across and up, add, and then take the square root of the sum.

2 What is the midpoint of the segment from $P(-4, 7)$ to $Q(2, 4)$?

Midpoint = $(-1, 5.5)$ → go to box 7

Midpoint = $(3, -1.5)$ → go to box 6

Hint: A midpoint lies between the two ends. Check each coordinate against the ends.

1. **Hand out page 3**, one per student, and scrap paper. No calculator is needed.
2. **Say this once:** *“Start at box 5. Read what each box asks: how far, or the midpoint. A distance is a length, exact, like $3\sqrt{3}$. A midpoint is a pair. Write every box number in the row at the bottom as you go.”*
3. **Check a sheet quickly.** A student with no mistakes writes **5 2 7 4 1 8**: six boxes, then out.

Student sheet	page 3, one per student, and scrap paper for working.
Answers	page 4.

The route uses three pairs of points, and asks both questions of each pair. First it asks how far apart the points are, then where the midpoint is. The two questions use the same four numbers, and students mix them up. The distance subtracts, squares, adds and takes the root, and gives a length. The midpoint adds and halves, and gives a pair.

Every wrong answer comes from a common mistake. For a distance: leaving out the root, subtracting each point's own x and y , losing the minus sign of a negative coordinate, or adding across and up. These wrong answers send the student to box 3. For a midpoint: subtracting and halving, adding without halving, or averaging an x with a y . These wrong answers send the student to box 6. Boxes 3 and 6 ask the same kind of question again, and both of their answers lead back to the route.

The row at the bottom is the check. A clean run is six numbers. Each wrong answer adds at least one more. Guessing does not get a student out: every simple guessing rule, such as always taking the smaller number, goes wrong within the first four boxes.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.

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Answer Maze — how long, and where?

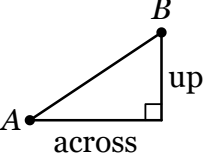
Start at box 5

Name _____

Period _____

Date _____

Start at box 5. Read what the box asks. Find it, pick one answer, and go to the box it names. Write each box number in the row at the bottom as you go.



across = the difference of the two x -coordinates. **up** = the difference of the two y -coordinates. Subtract in the same order both times.

Distance = $\sqrt{(\text{across}^2 + \text{up}^2)}$: a length. Leave every length exact, in simplest radical form: $\sqrt{27} = \sqrt{9 \times 3} = 3\sqrt{3}$. Do not use a decimal.

Midpoint = $((x_1 + x_2) \div 2, (y_1 + y_2) \div 2)$. A midpoint is a pair, in parentheses. Write halves as decimals, like $(-2, 3.5)$.

1 How far apart are P(-3, -1) and Q(5, 4)? Distance = $\sqrt{89}$ → go to box 8 Distance = $\sqrt{13}$ → go to box 3 <i>Hint: Look at the signs. Subtracting a negative number means adding it.</i>	2 What is the midpoint of the segment from P(-4, 7) to Q(2, 4)? Midpoint = $(-1, 5.5)$ → go to box 7 Midpoint = $(3, -1.5)$ → go to box 6 <i>Hint: A midpoint lies between the two ends. Check each coordinate against the ends.</i>
3 How far apart are P(-5, -8) and Q(-8, 4)? Distance = 15 → go to box 5 Distance = $3\sqrt{17}$ → go to box 2 <i>Hint: Write across and up on their own line. A distance is shorter than across plus up.</i>	4 What is the midpoint of the segment from P(2, 8) to Q(-5, -3)? Midpoint = $(-3, 5)$ → go to box 6 Midpoint = $(-1.5, 2.5)$ → go to box 1 <i>Hint: Add the two x-coordinates and halve the sum. Then repeat for the y-coordinates.</i>
5 How far apart are P(-4, 7) and Q(2, 4)? Distance = 45 → go to box 3 Distance = $3\sqrt{5}$ → go to box 2 <i>Hint: Square across and up, add, and then take the square root of the sum.</i>	6 What is the midpoint of the segment from P(-8, -7) to Q(-1, -1)? Midpoint = $(-4.5, -4)$ → go to box 7 Midpoint = $(3.5, 3)$ → go to box 2 <i>Hint: Add the two ends, then halve. Each coordinate lies between those of the ends.</i>
7 How far apart are P(2, 8) and Q(-5, -3)? Distance = $\sqrt{170}$ → go to box 4 Distance = $2\sqrt{10}$ → go to box 3 <i>Hint: Across uses the two x-coordinates. Up uses the two y-coordinates.</i>	8 What is the midpoint of the segment from P(-3, -1) to Q(5, 4)? Midpoint = $(0.5, 2)$ → go to box 6 Midpoint = $(1, 1.5)$ → you are out <i>Hint: The first coordinate of the midpoint comes from the two x-coordinates only.</i>

Write every box number here, in order.

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The route, in order. Boxes 3 and 6 are not on it. A student reaches them only by a wrong answer. They are the last two rows of the table. Across and up are found by subtracting P from Q; the other order gives the same distance.

5 → 2 → 7 → 4 → 1 → 8 → out

	The box's question	Right answer, and why	Wrong answer, and why a student picks it
1	Box 5 How far apart are P(-4, 7) and Q(2, 4)?	3√5. across = $2 - (-4) = 6$, up = $4 - 7 = -3$. Distance = $\sqrt{6^2 + (-3)^2} = \sqrt{45} = 3\sqrt{5}$.	"45" goes to box 3. The root is left out: 45 is the square of the distance. It is more than across + up = 9, so it cannot be a distance.
2	Box 2 What is the midpoint of the segment from P(-4, 7) to Q(2, 4)?	(-1, 5.5). x: $(-4 + 2) \div 2 = -1$. y: $(7 + 4) \div 2 = 5.5$. The midpoint is (-1, 5.5).	"(3, -1.5)" goes to box 6. The coordinates are subtracted and halved, which gives (3, -1.5). That point is not between the two ends, so it cannot be the midpoint.
3	Box 7 How far apart are P(2, 8) and Q(-5, -3)?	√170. across = $-5 - 2 = -7$, up = $-3 - 8 = -11$. Distance = $\sqrt{(-7)^2 + (-11)^2} = \sqrt{170}$.	"2√10" goes to box 3. Each point's own x and y are subtracted: $2 - 8$ and $-5 - (-3)$ give $\sqrt{40} = 2\sqrt{10}$. Across must use the two x-coordinates.
4	Box 4 What is the midpoint of the segment from P(2, 8) to Q(-5, -3)?	(-1.5, 2.5). x: $(2 + (-5)) \div 2 = -1.5$. y: $(8 + (-3)) \div 2 = 2.5$. The midpoint is (-1.5, 2.5).	"(-3, 5)" goes to box 6. The coordinates are added but not halved, which gives (-3, 5). That point is not between the two ends.
5	Box 1 How far apart are P(-3, -1) and Q(5, 4)?	√89. across = $5 - (-3) = 8$, up = $4 - (-1) = 5$. Distance = $\sqrt{8^2 + 5^2} = \sqrt{89}$.	"√13" goes to box 3. Both minus signs of P are lost: $5 - (-3)$ is worked as $5 - 3 = 2$, and $4 - (-1)$ as $4 - 1 = 3$. That gives $\sqrt{2^2 + 3^2} = \sqrt{13}$. Subtracting a negative number means adding it.
6	Box 8 What is the midpoint of the segment from P(-3, -1) to Q(5, 4)?	(1, 1.5). x: $(-3 + 5) \div 2 = 1$. y: $(-1 + 4) \div 2 = 1.5$. The midpoint is (1, 1.5).	"(0.5, 2)" goes to box 6. An x-coordinate is averaged with a y-coordinate, which gives (0.5, 2). The first number of the midpoint must come from the two x-coordinates only.
	Box 3 How far apart are P(-5, -8) and Q(-8, 4)?	3√17. across = $-8 - (-5) = -3$, up = $4 - (-8) = 12$. Distance = $\sqrt{(-3)^2 + 12^2} = \sqrt{153} = 3\sqrt{17}$.	"15" goes to box 5. Across and up are added, $3 + 12 = 15$. That is the walk along the grid lines, not the straight distance, which is shorter.
	Box 6 What is the midpoint of the segment from P(-8, -7) to Q(-1, -1)?	(-4.5, -4). x: $(-8 + (-1)) \div 2 = -4.5$. y: $(-7 + (-1)) \div 2 = -4$. The midpoint is (-4.5, -4).	"(3.5, 3)" goes to box 2. The coordinates are subtracted and halved, which gives (3.5, 3). That point is not between the two ends, so it cannot be the midpoint.

How to check any box. A distance is a length: it is longer than across and longer than up, and shorter than across + up. A midpoint is a pair: each of its coordinates lies between the matching coordinates of P and Q.

A student can find the last four boxes of the route by following the arrows backward from "you are out." So ask a student with a clean row to explain one box.