

ANSWER MAZE



EQUATIONS OF PARALLEL AND PERPENDICULAR LINES

Equations of Parallel and Perpendicular Lines

Line through a point · $y = mx + b$ · one page · 10–15 minutes · nothing to prepare

FREE

3 Find the line through $(3, -1)$ that is perpendicular to $y = \frac{1}{3}x + 4$.

$y = -3x - 2 \rightarrow$ **go to box 4**

$y = -3x + 8 \rightarrow$ **go to box 7**

Hint: Find b with the new slope. Then put the point the new line goes through into each answer.

7 Find the line through $(-3, -5)$ that is parallel to $2x - 3y = -15$.

$y = \frac{2}{3}x - 3 \rightarrow$ **go to box 1**

$y = \frac{2}{3}x - 7 \rightarrow$ **go to box 6**

Hint: Put the point the new line goes through into each equation. Check both sides.

1. **Hand out page 3**, one per student. No calculator is needed.
2. **Say this once:** *“Start at box 3. Find the slope of the given line. Write down the new slope first. Then find b with the new slope. Write every box number in the row at the bottom as you go.”*
3. **Check a sheet quickly.** A student with no mistakes writes **3 7 1 5 8 2**: six boxes, then out.

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

Every box asks for the line through a point, parallel or perpendicular to a given line. The given line is written as $y = mx + b$, as an equation not solved for y , in point-slope form, or as two points. Both answers in every box are written as $y = mx + b$, with fractions in lowest terms. A line has only one equation in this form, so the two answers are always two different lines.

Every wrong answer comes from one of two kinds of mistake. The first kind is a slope mistake: finding b with the old slope after writing the new one, turning the fraction over without changing the sign, or keeping the old slope for a perpendicular. These send the student to box 4. The second kind happens while finding b : a sign slip, the point's x and y swapped, or the given line's b copied. These send the student to box 6. Boxes 4 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 larger b , goes wrong within the first three 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 — parallel and perpendicular lines

Start at box 3

Name _____

Period _____

Date _____

Start at box 3. Find the line. Pick one answer and go to the box it names. Write each box number in the row at the bottom as you go. Write every equation as $y = mx + b$. Write the slope and b as whole numbers or as fractions in lowest terms.

Step 1. Find the slope of the given line. If its equation is not solved for y , solve it for y first.

Step 2. Write the slope of the new line on its own. **Parallel:** the same slope. **Perpendicular:** the opposite reciprocal. Turn the fraction over *and* change its sign.

Step 3. Put the NEW slope, and the x and y of the point the NEW line goes through, into $y = mx + b$. Solve for b .

Check. Put that point into your finished equation. Both sides must come out the same.

- 1 Find the line through $(4, -3)$ that is perpendicular to the line through $(-3, 5)$ and $(6, -1)$.

$$y = -\frac{3}{2}x + 3 \rightarrow \text{go to box 4}$$

$$y = \frac{3}{2}x - 9 \rightarrow \text{go to box 5}$$

Hint: A perpendicular slope takes two changes: the fraction turns over, and the sign changes.

- 2 Find the line through $(-1, -3)$ that is parallel to $y = 4x - 5$.

$$y = 4x + 1 \rightarrow \text{you are out}$$

$$y = 4x - 5 \rightarrow \text{go to box 6}$$

Hint: The new line passes through the point. Its b comes from the point, never from the given line.

- 3 Find the line through $(3, -1)$ that is perpendicular to $y = \frac{1}{3}x + 4$.

$$y = -3x - 2 \rightarrow \text{go to box 4}$$

$$y = -3x + 8 \rightarrow \text{go to box 7}$$

Hint: Find b with the new slope. Then put the point the new line goes through into each answer.

- 4 Find the line through $(4, -1)$ that is perpendicular to $y = -\frac{1}{2}x + 3$.

$$y = \frac{1}{2}x - 3 \rightarrow \text{go to box 3}$$

$$y = 2x - 9 \rightarrow \text{go to box 7}$$

Hint: Turn the fraction over and change its sign. A perpendicular slope takes both moves.

- 5 Find the line through $(-5, 2)$ that is perpendicular to $y - 1 = \frac{1}{2}(x - 6)$.

$$y = -2x - 8 \rightarrow \text{go to box 8}$$

$$y = -2x - 1 \rightarrow \text{go to box 6}$$

Hint: In a point, x comes first and y comes after it. Put each number in its place.

- 6 Find the line through $(-2, 2)$ that is parallel to the line through $(1, -1)$ and $(2, -5)$.

$$y = -4x - 6 \rightarrow \text{go to box 1}$$

$$y = -4x + 6 \rightarrow \text{go to box 7}$$

Hint: Which number is x ? Put the point the new line goes through into each equation.

- 7 Find the line through $(-3, -5)$ that is parallel to $2x - 3y = -15$.

$$y = \frac{2}{3}x - 3 \rightarrow \text{go to box 1}$$

$$y = \frac{2}{3}x - 7 \rightarrow \text{go to box 6}$$

Hint: Put the point the new line goes through into each equation. Check both sides.

- 8 Find the line through $(2, 4)$ that is perpendicular to $2x - y = -5$.

$$y = 2x \rightarrow \text{go to box 4}$$

$$y = -\frac{1}{2}x + 5 \rightarrow \text{go to box 2}$$

Hint: Perpendicular lines meet at a right angle. Their slopes are opposite reciprocals.

Write every box number here, in order.

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Answer Maze — answers

For the teacher

The route, in order. Boxes 4 and 6 are not on it. A student reaches them only by a wrong answer. They are the last two rows of the table.

3 → 7 → 1 → 5 → 8 → 2 → out

	The box's question	Right answer, and why	Wrong answer, and why a student picks it
1	Box 3 Find the line through (3, -1) that is perpendicular to $y = \frac{1}{3}x + 4$.	$y = -3x + 8$. The given line $y = \frac{1}{3}x + 4$ has slope $\frac{1}{3}$. Perpendicular, so the new slope is the opposite reciprocal, -3. Put the point in: $-1 = -3(3) + b$, so $b = 8$.	" $y = -3x - 2$ " goes to box 4. The new slope is written, but b is found with the given slope: $-1 = \frac{1}{3}(3) + b$ gives $b = -2$. The point does not fit: $-3(3) - 2 = -11$, not -1.
2	Box 7 Find the line through (-3, -5) that is parallel to $2x - 3y = -15$.	$y = \frac{2}{3}x - 3$. Solve $2x - 3y = -15$ for y : $y = \frac{2}{3}x + 5$. The slope is $\frac{2}{3}$. Parallel, so the new slope is the same, $\frac{2}{3}$. Put the point in: $-5 = \frac{2}{3}(-3) + b$, so $b = -3$.	" $y = \frac{2}{3}x - 7$ " goes to box 6. A sign slip: $b = -5 + -2$ in place of $-5 - (-2)$, so $b = -7$. The point does not fit: $\frac{2}{3}(-3) - 7 = -9$, not -5.
3	Box 1 Find the line through (4, -3) that is perpendicular to the line through (-3, 5) and (6, -1).	$y = \frac{3}{2}x - 9$. From (-3, 5) to (6, -1): rise -6 over run 9, so the slope is $-\frac{2}{3}$. Perpendicular, so the new slope is the opposite reciprocal, $\frac{3}{2}$. Put the point in: $-3 = \frac{3}{2}(4) + b$, so $b = -9$.	" $y = -\frac{3}{2}x + 3$ " goes to box 4. Only the fraction is turned over, giving slope $-\frac{3}{2}$. The opposite reciprocal also changes the sign: $\frac{3}{2}$.
4	Box 5 Find the line through (-5, 2) that is perpendicular to $y - 1 = \frac{1}{2}(x - 6)$.	$y = -2x - 8$. The given line $y - 1 = \frac{1}{2}(x - 6)$ has slope $\frac{1}{2}$. Perpendicular, so the new slope is the opposite reciprocal, -2. Put the point in: $2 = -2(-5) + b$, so $b = -8$.	" $y = -2x - 1$ " goes to box 6. The point's x and y are swapped: $-5 = -2(2) + b$ gives $b = -1$. The point does not fit: $-2(-5) - 1 = 9$, not 2.
5	Box 8 Find the line through (2, 4) that is perpendicular to $2x - y = -5$.	$y = -\frac{1}{2}x + 5$. Solve $2x - y = -5$ for y : $y = 2x + 5$. The slope is 2. Perpendicular, so the new slope is the opposite reciprocal, $-\frac{1}{2}$. Put the point in: $4 = -\frac{1}{2}(2) + b$, so $b = 5$.	" $y = 2x$ " goes to box 4. The given slope 2 is kept. That line goes through the point, but it is parallel to the given line, not perpendicular.
6	Box 2 Find the line through (-1, -3) that is parallel to $y = 4x - 5$.	$y = 4x + 1$. The given line $y = 4x - 5$ has slope 4. Parallel, so the new slope is the same, 4. Put the point in: $-3 = 4(-1) + b$, so $b = 1$.	" $y = 4x - 5$ " goes to box 6. The given line's b , -5, is copied, so this is the given line itself. The point does not fit: $4(-1) - 5 = -9$, not -3.
	Box 4 Find the line through (4, -1) that is perpendicular to $y = -\frac{1}{2}x + 3$.	$y = 2x - 9$. The given line $y = -\frac{1}{2}x + 3$ has slope $-\frac{1}{2}$. Perpendicular, so the new slope is the opposite reciprocal, 2. Put the point in: $-1 = 2(4) + b$, so $b = -9$.	" $y = \frac{1}{2}x - 3$ " goes to box 3. Only the sign is changed, giving slope $\frac{1}{2}$. The opposite reciprocal also turns the fraction over: 2.
	Box 6 Find the line through (-2, 2) that is parallel to the line through (1, -1) and (2, -5).	$y = -4x - 6$. From (1, -1) to (2, -5): rise -4 over run 1, so the slope is -4. Parallel, so the new slope is the same, -4. Put the point in: $2 = -4(-2) + b$, so $b = -6$.	" $y = -4x + 6$ " goes to box 7. The point's x and y are swapped: $-2 = -4(2) + b$ gives $b = 6$. The point does not fit: $-4(-2) + 6 = 14$, not 2.

How to check any box. Put the point into the answer: both sides must come out the same. Then read the slope of the answer: for a parallel line it is the slope of the given line, and for a perpendicular line it is the opposite reciprocal. An answer that passes both checks is the line.

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.