

ANSWER MAZE



SINE AND COSINE OF COMPLEMENTARY ANGLES

Add to 90 or Set Equal?

One page · 10–15 minutes · nothing to prepare

FREE

4

$\cos x = \sin 70$. Find x .

$x = 70 \rightarrow$ **go to box 3**

$x = 20 \rightarrow$ **go to box 7**

Hint: Look at the two angles in the statement. How are they linked in a triangle with a right angle?

7

$\sin(x + 5) = \cos 35$. Find x .

$x = 50 \rightarrow$ **go to box 2**

$x = 30 \rightarrow$ **go to box 3**

Hint: Find the two angles inside sin and cos. Where does x sit?

1. **Hand out page 3**, one per student. Nothing else is needed.
2. **Say this once:** *“Start at box 4. In every box, first ask: is x inside the angles, or in the values? Inside the angles: the two angles add to 90° . In the values: the two values are equal. Write every box number in the row at the bottom as you go.”*
3. **Check a sheet quickly.** A student with no mistakes writes **4 7 2 5 1 8**: six boxes, then out.

Student sheet page 3, one per student. A strip at the top shows why $\sin A = \cos B$ as a small drawing.
Answers page 4.

Every wrong answer comes from the wrong move. In four of the six boxes on the route, x is inside the two angles. The angles add to 90° . The common mistake is to set the two angles equal, because the statement has an equals sign in the middle. That answer sends the student to box 3. In the other two boxes, x is in the values of $\sin A$ and $\cos B$. Then the two values are equal, and the mistake is to add the two expressions to 90. That answer gives a value more than 1, and it sends 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 quick check. When x is inside the angles, put the answer into both angles: they must add to 90° . When x is in the values, put it into both fractions: they must be the same number, less than 1.

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 number, 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 — add to 90 or set equal?

Start at box 4

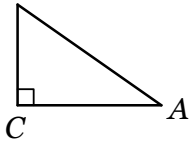
Name _____

Period _____

Date _____

Start at box 4. Find x . All angles are in degrees. Pick the answer you got and go to the box it names. Write each box number in the row at the bottom as you go.

B



C is the right angle. A and B are the two acute angles, so $A + B = 90^\circ$.

BC is opposite A and adjacent to B. So $\sin A = \frac{BC}{AB}$ and $\cos B = \frac{BC}{AB}$.

$\sin A = \cos B$ and $\cos A = \sin B$. The sine of one acute angle is the cosine of the other.

If x is inside the two angles, the angles add to 90° . If x is in the two values, the values are equal.

A and B are the acute angles of a right triangle. $\cos A = \frac{3x}{17}$ and $\sin B = \frac{x+10}{17}$.

Find x .

1

$x = 5 \rightarrow$ go to box 8

$x = 20 \rightarrow$ go to box 6

Hint: Look at the letters. A and B are the two acute angles of one triangle.

A and B are the acute angles of a right triangle. $\sin A = \frac{3x+1}{25}$ and $\cos B = \frac{x+5}{25}$.

Find x .

2

$x = 21 \rightarrow$ go to box 6

$x = 2 \rightarrow$ go to box 5

Hint: Look at where x sits: inside an angle, or inside a value?

$\sin(3x - 7) = \cos(x + 1)$. Find x .

$x = 24 \rightarrow$ go to box 7

$x = 4 \rightarrow$ go to box 4

Hint: Where does x sit? Look inside the brackets after sin and after cos.

$\cos x = \sin 70$. Find x .

$x = 70 \rightarrow$ go to box 3

$x = 20 \rightarrow$ go to box 7

Hint: Look at the two angles in the statement. How are they linked in a triangle with a right angle?

$\sin(x + 40) = \cos(3x + 10)$. Find x .

$x = 10 \rightarrow$ go to box 1

$x = 15 \rightarrow$ go to box 3

Hint: Read what stands inside the brackets after sin and after cos.

A and B are the acute angles of a right triangle. $\sin A = \frac{4x}{13}$ and $\cos B = \frac{2x+6}{13}$.

Find x .

6

$x = 14 \rightarrow$ go to box 2

$x = 3 \rightarrow$ go to box 5

Hint: Here x sits in a value. Look at the side each ratio uses.

$\sin(x + 5) = \cos 35$. Find x .

$x = 50 \rightarrow$ go to box 2

$x = 30 \rightarrow$ go to box 3

Hint: Find the two angles inside sin and cos. Where does x sit?

$\cos(3x - 4) = \sin(x + 10)$. Find x .

$x = 7 \rightarrow$ go to box 3

$x = 21 \rightarrow$ you are out

Hint: Put each answer into both angles, and look at the two angles.

Write every box number here, in order.

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Answer Maze — answers

For the teacher

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.

4 → 7 → 2 → 5 → 1 → 8 → out

	The box's question	Right answer, and why	Wrong answer, and why a student picks it
1	Box 4 $\cos x = \sin 70$. Find x .	$x = 20$. x is inside the angles. A sine equals a cosine when the two angles add to 90° : $x + 70 = 90$, so $x = 20$. Check: $20^\circ + 70^\circ = 90^\circ$.	" $x = 70$ " goes to box 3. A student who sets the two angles equal gets 70. Then the angles are 70° and 70° , which do not add to 90° .
2	Box 7 $\sin(x + 5) = \cos 35$. Find x .	$x = 50$. x is inside the angles. A sine equals a cosine when the two angles add to 90° : $(x + 5) + 35 = 90$, so $x = 50$. Check: $55^\circ + 35^\circ = 90^\circ$.	" $x = 30$ " goes to box 3. A student who sets the two angles equal gets 30. Then the angles are 35° and 35° , which do not add to 90° .
3	Box 2 A and B are the acute angles of a right triangle. $\sin A = \frac{3x+1}{25}$ and $\cos B = \frac{x+5}{25}$. Find x .	$x = 2$. x is in the values. A and B add to 90° , so $\sin A = \cos B$: $3x + 1 = x + 5$, so $x = 2$. Both values are $7/25$.	" $x = 21$ " goes to box 6. A student who adds $3x + 1$ and $x + 5$ to make 90 gets 21. Then $\sin A$ would be $64/25$, more than 1, which is impossible.
4	Box 5 $\sin(x + 40) = \cos(3x + 10)$. Find x .	$x = 10$. x is inside the angles. A sine equals a cosine when the two angles add to 90° : $(x + 40) + (3x + 10) = 90$, so $4x + 50 = 90$ and $x = 10$. Check: $50^\circ + 40^\circ = 90^\circ$.	" $x = 15$ " goes to box 3. A student who sets the two angles equal gets 15. Then the angles are 55° and 55° , which do not add to 90° .
5	Box 1 A and B are the acute angles of a right triangle. $\cos A = \frac{3x}{17}$ and $\sin B = \frac{x+10}{17}$. Find x .	$x = 5$. x is in the values. A and B add to 90° , so $\cos A = \sin B$: $3x = x + 10$, so $x = 5$. Both values are $15/17$.	" $x = 20$ " goes to box 6. A student who adds $3x$ and $x + 10$ to make 90 gets 20. Then $\cos A$ would be $60/17$, more than 1, which is impossible.
6	Box 8 $\cos(3x - 4) = \sin(x + 10)$. Find x .	$x = 21$. x is inside the angles. A sine equals a cosine when the two angles add to 90° : $(3x - 4) + (x + 10) = 90$, so $4x + 6 = 90$ and $x = 21$. Check: $59^\circ + 31^\circ = 90^\circ$.	" $x = 7$ " goes to box 3. A student who sets the two angles equal gets 7. Then the angles are 17° and 17° , which do not add to 90° .
	Box 3 $\sin(3x - 7) = \cos(x + 1)$. Find x .	$x = 24$. x is inside the angles. A sine equals a cosine when the two angles add to 90° : $(3x - 7) + (x + 1) = 90$, so $4x - 6 = 90$ and $x = 24$. Check: $65^\circ + 25^\circ = 90^\circ$.	" $x = 4$ " goes to box 4. A student who sets the two angles equal gets 4. Then the angles are 5° and 5° , which do not add to 90° .
	Box 6 A and B are the acute angles of a right triangle. $\sin A = \frac{4x}{13}$ and $\cos B = \frac{2x+6}{13}$. Find x .	$x = 3$. x is in the values. A and B add to 90° , so $\sin A = \cos B$: $4x = 2x + 6$, so $x = 3$. Both values are $12/13$.	" $x = 14$ " goes to box 2. A student who adds $4x$ and $2x + 6$ to make 90 gets 14. Then $\sin A$ would be $56/13$, more than 1, which is impossible.

How to check any box. In a right triangle the two acute angles add to 90° , and the side opposite one of them is the side adjacent to the other. So the sine of one acute angle is the cosine of the other. If x is inside the angles, make the angles add to 90° . If x is in the values of $\sin A$ and $\cos B$, make the two values equal. Never set the two angles equal, and never add two values to 90.

A student can find the last three 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.