

SCAVENGER HUNT



SINE AND COSINE OF COMPLEMENTARY ANGLES

Add to 90 or Set Equal?

Sine and cosine of complementary angles · whole-number answers · the cards check the answers

FREE

ANSWER

26

In a right triangle, the acute angles are A and B . The cosine of A is $\frac{2x-1}{17}$. The sine of B is $\frac{x+7}{17}$.

What is x ?

A sine or a cosine of an acute angle is less than 1. Check the value.

F

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1. **Tape the 16 cards around the room**, in any order. Each card has a large letter in its bottom left corner. Start each group at a *different* one of these eight cards: *N F A K M J R E*.
2. **Say this once:** “*First ask: is x inside the angles, or in the values? If x is inside the angles, the two angles add to 90° . If x is in the values, the two values are equal. Some cards ask for an angle, not for x . Then walk to the card with your answer at the top.*”
3. **Each group writes one line per card.** Eight right answers bring the group back to its first card.

16 cards	pages 3–10, one copy. There are two cards on each sheet. Cut the whole stack once.
Record sheet	page 11, one per student. It shows why $\sin A = \cos B$ as a small drawing.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card is a sine equal to a cosine, with an unknown x . Some cards write it in symbols and some in words. All angles are in degrees, and every answer is a whole number. On the ring, three cards have x inside the two angles: the two angles add to 90° . Two cards have x in the values of $\sin A$ and $\cos B$: A and B add to 90° , so the two values are equal. Three cards ask for the larger or the smaller angle, so the group must put x back in.

Eight of the sixteen cards make the ring. A group reaches the other eight only by a wrong answer, but all the cards look the same. A group that sets the two angles equal, or adds the two values to 90, or stops at x when the card asks for an angle, gets the number at the top of another card. That card asks the question the group answered just before, and its answer sends the group back to the card it got wrong.

The check is the length of the group’s list. A clean run is **eight lines**. Each wrong answer adds two. Every card has a line in small type under the question. It tells a group that arrived by a wrong answer what to check. A group that arrived by a right answer skips it. If a group keeps coming back to the same cards, ask: “*Where is x ? Put your x back in. Do the two angles add to 90° ?*” No single rule, such as always adding to 90, gets a group more than six of the sixteen cards right.



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

8

$$\cos(4x - 10) = \sin(2x + 4)$$

Find the larger of the two angles.

Finding x is only the first step. Which angle does the card want?

A

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ANSWER

6

$$\sin(3x - 7) = \cos(2x + 2)$$

Find the smaller of the two angles.

Is x inside an angle or inside a value? Here it sits in an angle.

B

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ANSWER

1

The cosine of $(4x - 10)^\circ$ is equal to the sine of $(2x + 4)^\circ$.

How large is the larger of the two angles?

Check that the two angles at your x add to exactly 90° .

C

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ANSWER

16

A and B are the two acute angles of a right triangle.

$$\cos A = \frac{2x - 1}{17} \quad \text{and} \quad \sin B = \frac{x + 7}{17}$$

Find x .

Two angles come from one x . Is the answer the larger or the smaller?

D

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ANSWER

12

The sine of $(3x - 7)^\circ$ is equal to the cosine of $(2x + 2)^\circ$.

How large is the smaller of the two angles?

The answer is an angle, not x . Each angle is between 0° and 90° .

E

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ANSWER

26

In a right triangle, the acute angles are A and B . The cosine of A is $\frac{2x - 1}{17}$. The sine of B is $\frac{x + 7}{17}$.

What is x ?

A sine or a cosine of an acute angle is less than 1. Check the value.

F

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ANSWER

28

The cosine of $(2x + 3)^\circ$ is equal to the sine of $(x + 9)^\circ$.

What is x ?

Put your x into each value. Is each one less than 1?

G

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ANSWER

19

The cosine of $(6x - 7)^\circ$ is equal to the sine of $(2x + 1)^\circ$.

What is x ?

Find x , then both angles. Do the two angles add to 90° ?

H

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ANSWER

49

A and B are the two acute angles of a right triangle.

$$\sin A = \frac{6x - 6}{25} \quad \text{and} \quad \cos B = \frac{x + 19}{25}$$

Find x .

When x sits in the two values, the values are one number.

J

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ANSWER

54

The sine of $(5x - 8)^\circ$ is equal to the cosine of $(3x - 6)^\circ$.

What is x ?

Put your x into both angles. Do the two angles add to 90° ?

K

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ANSWER

2

In a right triangle, the acute angles are A and B . The sine of A is $\frac{6x - 6}{25}$. The cosine of B is $\frac{x + 19}{25}$.

What is x ?

The angles add to 90° . Setting them equal is a different rule.

L

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ANSWER

13

The sine of $(2x + 5)^\circ$ is equal to the cosine of $(3x - 5)^\circ$.

How large is the larger of the two angles?

Put your x into both angles. Then pick the one the card wants.

M

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ANSWER

40

$$\cos(2x + 3) = \sin(x + 9)$$

Find x .

When x sits inside the two angles, the angles add to 90° .

N

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ANSWER

18

$$\sin(5x - 8) = \cos(3x - 6)$$

Find x .

Does the answer name an angle? Here x alone is not an angle.

P

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ANSWER

11

$$\sin(2x + 5) = \cos(3x - 5)$$

Find the larger of the two angles.

$\sin A$ and $\cos B$ use the same side over the same hypotenuse.

Q

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ANSWER

5

$$\cos(6x - 7) = \sin(2x + 1)$$

Find x .

A sine and a cosine are equal when their angles add to 90° .

R

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Scavenger Hunt — where I went

sine and cosine

Name _____

Period _____

Date _____

Answer the card. All angles are in degrees, and every answer is a whole number. Then find the card with your answer at the top. A clean run is eight lines. Each card has a line in small type under the question.

If you are on a card because you went wrong, its line says what to check. If you were right, skip it.

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.

Card letter	My work	My answer
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Why do $\sin A$ and $\cos B$ always agree?

Every number stands for a letter. Write the letter for each answer in the box above its number. Read the boxes you filled, left to right. **If they do not spell the answer, one of your answers is wrong.**

1 = D 2 = I 5 = S 6 = S 8 = A 11 = E 12 = M 13 = E 16 = A 18 = S 19 = E 26 = S 28 = M 40 = I 49 = D 54 = E

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

1 2 5 6 8 11 12 13 16 18 19 26 28 40 49 54



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Scavenger Hunt — answers

For the teacher

The ring in order, with the answer found on each card. A group may begin anywhere on it. Wherever it begins, eight right answers bring it back to that card.

N (26) → F (8) → A (54) → K (13) → M (49) → J (5) → R (12) → E (40) → N

Why do sin A and cos B always agree? The answer is *SAME SIDE!* (they use the same side over the same hypotenuse). It is read along the boxes of the record sheet, which run from the smallest number to the largest.

	Card	The question on the card	Answer, and why	The wrong answer that leads to a card off the ring	Letter of its top
1	N	$\cos(2x + 3) = \sin(x + 9)$ Find x .	26. A sine equals a cosine when the two angles add to 90° : $(2x + 3) + (x + 9) = 90$, so $3x + 12 = 90$ and $x = 26$. Check: $55^\circ + 35^\circ = 90^\circ$.	6. The student sets the two angles equal: $2x + 3 = x + 9$. Then the angles are 15° and 15° , which do not add to 90° .	I
2	F	In a right triangle, the acute angles are A and B . The cosine of A is $\frac{2x-1}{17}$. The sine of B is $\frac{x+7}{17}$. What is x ?	8. A and B add to 90° , so $\cos A = \sin B$: the two values are one number. $2x - 1 = x + 7$, so $x = 8$. Both values are $15/17$.	28. The student adds $2x - 1$ and $x + 7$ to make 90. Then $\cos A$ would be $55/17$, more than 1, which no sine or cosine can be.	S
3	A	$\cos(4x - 10) = \sin(2x + 4)$ Find the larger of the two angles.	54. The two angles add to 90° : $(4x - 10) + (2x + 4) = 90$, so $6x - 6 = 90$ and $x = 16$. The angles are 54° and 36° , so the larger is 54° .	16. The student finds x and stops. The card asks for an angle.	A
4	K	The sine of $(5x - 8)^\circ$ is equal to the cosine of $(3x - 6)^\circ$. What is x ?	13. A sine equals a cosine when the two angles add to 90° : $(5x - 8) + (3x - 6) = 90$, so $8x - 14 = 90$ and $x = 13$. Check: $57^\circ + 33^\circ = 90^\circ$.	1. The student sets the two angles equal: $5x - 8 = 3x - 6$. Then the angles are -3° and -3° , which do not add to 90° .	E
5	M	The sine of $(2x + 5)^\circ$ is equal to the cosine of $(3x - 5)^\circ$. How large is the larger of the two angles?	49. The two angles add to 90° : $(2x + 5) + (3x - 5) = 90$, so $5x = 90$ and $x = 18$. The angles are 41° and 49° , so the larger is 49° .	18. The student finds x and stops. The card asks for an angle.	E
6	J	A and B are the two acute angles of a right triangle. $\sin A = \frac{6x-6}{25}$ and $\cos B = \frac{x+19}{25}$ Find x .	5. A and B add to 90° , so $\sin A = \cos B$: the two values are one number. $6x - 6 = x + 19$, so $x = 5$. Both values are $24/25$.	11. The student adds $6x - 6$ and $x + 19$ to make 90. Then $\sin A$ would be $60/25$, more than 1, which no sine or cosine can be.	D
7	R	$\cos(6x - 7) = \sin(2x + 1)$ Find x .	12. A sine equals a cosine when the two angles add to 90° : $(6x - 7) + (2x + 1) = 90$, so $8x - 6 = 90$ and $x = 12$. Check: $65^\circ + 25^\circ = 90^\circ$.	2. The student sets the two angles equal: $6x - 7 = 2x + 1$. Then the angles are 5° and 5° , which do not add to 90° .	S
8	E	The sine of $(3x - 7)^\circ$ is equal to the cosine of $(2x + 2)^\circ$. How large is the smaller of the two angles?	40. The two angles add to 90° : $(3x - 7) + (2x + 2) = 90$, so $5x - 5 = 90$ and $x = 19$. The angles are 50° and 40° , so the smaller is 40° .	19. The student finds x and stops. The card asks for an angle.	M

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The number at the top of each one is the wrong answer from one ring card. The card asks the question the group answered just before, in other words. Its right answer is the number at the top of the card the group got wrong, so the group goes there and tries it again. If the group makes the same mistake here, it goes to another card off the ring. So a second wrong answer never moves a group forward.

Card	The question on the card	Answer, and why	The wrong answer that leads to a card off the ring	Letter of its top
B	$\sin(3x - 7) = \cos(2x + 2)$ Find the smaller of the two angles.	40. The two angles add to 90° : $(3x - 7) + (2x + 2) = 90$, so $5x - 5 = 90$ and $x = 19$. The angles are 50° and 40° , so the smaller is 40° .	19. The student finds x and stops. The card asks for an angle.	S
G	The cosine of $(2x + 3)^\circ$ is equal to the sine of $(x + 9)^\circ$. What is x ?	26. A sine equals a cosine when the two angles add to 90° : $(2x + 3) + (x + 9) = 90$, so $3x + 12 = 90$ and $x = 26$. Check: $55^\circ + 35^\circ = 90^\circ$.	6. The student sets the two angles equal: $2x + 3 = x + 9$. Then the angles are 15° and 15° , which do not add to 90° .	M
D	A and B are the two acute angles of a right triangle. $\cos A = \frac{2x-1}{17}$ and $\sin B = \frac{x+7}{17}$ Find x .	8. A and B add to 90° , so $\cos A = \sin B$: the two values are one number. $2x - 1 = x + 7$, so $x = 8$. Both values are $15/17$.	28. The student adds $2x - 1$ and $x + 7$ to make 90. Then $\cos A$ would be $55/17$, more than 1, which no sine or cosine can be.	A
C	The cosine of $(4x - 10)^\circ$ is equal to the sine of $(2x + 4)^\circ$. How large is the larger of the two angles?	54. The two angles add to 90° : $(4x - 10) + (2x + 4) = 90$, so $6x - 6 = 90$ and $x = 16$. The angles are 54° and 36° , so the larger is 54° .	16. The student finds x and stops. The card asks for an angle.	D
P	$\sin(5x - 8) = \cos(3x - 6)$ Find x .	13. A sine equals a cosine when the two angles add to 90° : $(5x - 8) + (3x - 6) = 90$, so $8x - 14 = 90$ and $x = 13$. Check: $57^\circ + 33^\circ = 90^\circ$.	1. The student sets the two angles equal: $5x - 8 = 3x - 6$. Then the angles are -3° and -3° , which do not add to 90° .	S
Q	$\sin(2x + 5) = \cos(3x - 5)$ Find the larger of the two angles.	49. The two angles add to 90° : $(2x + 5) + (3x - 5) = 90$, so $5x = 90$ and $x = 18$. The angles are 41° and 49° , so the larger is 49° .	18. The student finds x and stops. The card asks for an angle.	E
L	In a right triangle, the acute angles are A and B . The sine of A is $\frac{6x-6}{25}$. The cosine of B is $\frac{x+19}{25}$. What is x ?	5. A and B add to 90° , so $\sin A = \cos B$: the two values are one number. $6x - 6 = x + 19$, so $x = 5$. Both values are $24/25$.	11. The student adds $6x - 6$ and $x + 19$ to make 90. Then $\sin A$ would be $60/25$, more than 1, which no sine or cosine can be.	I
H	The cosine of $(6x - 7)^\circ$ is equal to the sine of $(2x + 1)^\circ$. What is x ?	12. A sine equals a cosine when the two angles add to 90° : $(6x - 7) + (2x + 1) = 90$, so $8x - 6 = 90$ and $x = 12$. Check: $65^\circ + 25^\circ = 90^\circ$.	2. The student sets the two angles equal: $6x - 7 = 2x + 1$. Then the angles are 5° and 5° , which do not add to 90° .	E

Other mistakes lead to no card. A group might add the two angles to 180 instead of 90, give the other angle when the card asks for the larger or the smaller, or set the angles equal on a card that asks for an angle. Its answer is then not the number at the top of any card.