

MYSTERY PICTURE



USING TRIG RATIOS TO FIND A SIDE

Trig Ratios: Is the Equation Right?

Finding a side · 25 triangles · which ratio, multiply or divide · a picture appears

FREE

1 $x = 20 \div \sin 34^\circ$	2 $x = 18 \times \sin 40^\circ$	3 $x = 12 \div \cos 35^\circ$	4 $x = 15 \times \tan 50^\circ$	5 $x = 10 \div \sin 28^\circ$
6 $x = 22 \times \cos 63^\circ$	7 $x = 13 \div \cos 52^\circ$	8 $x = 11 \times \sin 42^\circ$	9 $x = 19 \times \cos 59^\circ$	10 $x = 24 \times \sin 38^\circ$
11 $x = 14 \div \tan 37^\circ$	12 $x = 16 \times \tan 61^\circ$	13 $x = 14 \times \cos 64^\circ$	14 $x = 8 \times \sin 47^\circ$	15 $x = 23 \times \tan 29^\circ$
16 $x = 25 \times \sin 57^\circ$	17 $x = 15 \div \sin 33^\circ$	18 $x = 26 \div \cos 41^\circ$	19 $x = 12 \times \tan 55^\circ$	20 $x = 18 \div \cos 36^\circ$
21 $x = 13 \div \tan 32^\circ$	22 $x = 16 \times \cos 31^\circ$	23 $x = 9 \times \tan 56^\circ$	24 $x = 21 \div \sin 54^\circ$	25 $x = 27 \times \sin 53^\circ$

1. **Give each student page 3** and a pencil. No calculator is needed.
2. **Say this once:** *“Name the sides from the given angle. Pick the ratio. Is x on top or underneath? If the equation under the triangle is right, fill the square with slanted lines. If not, leave it white.”*
3. **Let them work.** The picture shows when they are right. Nothing else is needed.

Student sheet	page 3, one per student. A strip at the top names the three sides on a triangle and gives the three ratios.
Answers	pages 4–5, for you.

Each square shows a right triangle drawn to scale and one finished equation for x . The student does not compute anything. To judge the equation, the student names the two sides from the marked angle, picks the ratio that uses them ($\sin = \text{opposite} \div \text{hypotenuse}$, $\cos = \text{adjacent} \div \text{hypotenuse}$, $\tan = \text{opposite} \div \text{adjacent}$), and checks where x stands: on top of the fraction means $x = \text{number} \times \text{ratio}$, underneath means $x = \text{number} \div \text{ratio}$. Ten squares are filled.

Each white square holds one common mistake. In six squares the ratio is right but the equation multiplies where it should divide, or divides where it should multiply. In six squares opposite and adjacent are mixed up, so $\cos$ stands where $\sin$ belongs or $\sin$ where $\cos$ belongs. In three squares the ratio does not use the two sides of the triangle at all.

If part of a student’s picture looks wrong, the mistake is in that square. Ask: *“Which side is across from the angle? Which ratio uses the number and x ? Is x on top?”* Guessing does not work. Every simple guessing rule, such as filling every square that multiplies, gets at least ten squares wrong.



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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Mystery Picture — is the equation right?

Trig ratios: find a side

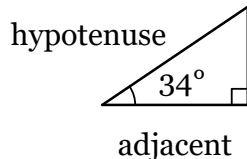
Name _____

Period _____

Date _____

Each square has a triangle and an equation for x . Do not compute. Pick the ratio and check where x stands. **If the equation is right, fill the square with slanted lines. If not, leave it white.** A picture appears. If part of it is missing, check that square again. The box at the bottom helps.

1 $x = 20 \div \sin 34^\circ$	2 $x = 18 \times \sin 40^\circ$	3 $x = 12 \div \cos 35^\circ$	4 $x = 15 \times \tan 50^\circ$	5 $x = 10 \div \sin 28^\circ$
6 $x = 22 \times \cos 63^\circ$	7 $x = 13 \div \cos 52^\circ$	8 $x = 11 \times \sin 42^\circ$	9 $x = 19 \times \cos 59^\circ$	10 $x = 24 \times \sin 38^\circ$
11 $x = 14 \div \tan 37^\circ$	12 $x = 16 \times \tan 61^\circ$	13 $x = 14 \times \cos 64^\circ$	14 $x = 8 \times \sin 47^\circ$	15 $x = 23 \times \tan 29^\circ$
16 $x = 25 \times \sin 57^\circ$	17 $x = 15 \div \sin 33^\circ$	18 $x = 26 \div \cos 41^\circ$	19 $x = 12 \times \tan 55^\circ$	20 $x = 18 \div \cos 36^\circ$
21 $x = 13 \div \tan 32^\circ$	22 $x = 16 \times \cos 31^\circ$	23 $x = 9 \times \tan 56^\circ$	24 $x = 21 \div \sin 54^\circ$	25 $x = 27 \times \sin 53^\circ$



opposite

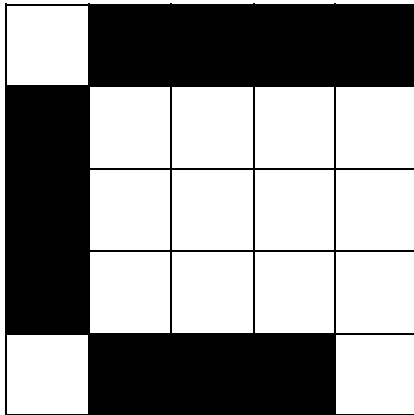
Name the sides from the given angle.
 $\sin = \text{opposite} \div \text{hypotenuse}$ · $\cos = \text{adjacent} \div \text{hypotenuse}$ · $\tan = \text{opposite} \div \text{adjacent}$
 x on top of the fraction: multiply. x underneath: divide. The hypotenuse is the longest side.



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Mystery Picture — answers

For the teacher



The finished picture is **the letter C**. Ten squares are filled.

To check a square, name the two sides from the marked angle and pick the ratio that uses them. Then x on top of the fraction means multiply, and x underneath means divide. The table gives the reason for every square. It goes on over the page.

	The square	Answer	Why
1	A 34° angle. The hypotenuse is 20. x is the leg across from the 34° angle. The square says $x = 20 \div \sin 34^\circ$.	white	The 20 is the hypotenuse and x is the opposite leg. The ratio sin is right: $\sin 34^\circ = x \div 20$. But x is on top, so the last step multiplies. The right equation is $x = 20 \times \sin 34^\circ$.
2	A 40° angle. The hypotenuse is 18. x is the leg across from the 40° angle. The square says $x = 18 \times \sin 40^\circ$.	fill	The 18 is across from the right angle, so it is the hypotenuse. x is across from the 40° angle, so it is the opposite leg. $\sin = \text{opposite} \div \text{hypotenuse}$, so $\sin 40^\circ = x \div 18$. x is on top, so multiply: $18 \times 0.6428 = 11.6$.
3	A 35° angle. The leg that touches the 35° angle is 12. x is the hypotenuse. The square says $x = 12 \div \cos 35^\circ$.	fill	The 12 touches the 35° angle and is not the hypotenuse, so it is the adjacent leg. x is across from the right angle, so it is the hypotenuse. $\cos = \text{adjacent} \div \text{hypotenuse}$, so $\cos 35^\circ = 12 \div x$. x is underneath, so divide: $12 \div 0.8192 = 14.6$.
4	A 50° angle. The leg that touches the 50° angle is 15. x is the leg across from the 50° angle. The square says $x = 15 \times \tan 50^\circ$.	fill	The 15 touches the 50° angle and is not the hypotenuse, so it is the adjacent leg. x is across from the 50° angle, so it is the opposite leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 50^\circ = x \div 15$. x is on top, so multiply: $15 \times 1.1918 = 17.9$.
5	A 28° angle. The leg across from the 28° angle is 10. x is the hypotenuse. The square says $x = 10 \div \sin 28^\circ$.	fill	The 10 is across from the 28° angle, so it is the opposite leg. x is across from the right angle, so it is the hypotenuse. $\sin = \text{opposite} \div \text{hypotenuse}$, so $\sin 28^\circ = 10 \div x$. x is underneath, so divide: $10 \div 0.4695 = 21.3$.
6	A 63° angle. The hypotenuse is 22. x is the leg that touches the 63° angle. The square says $x = 22 \times \cos 63^\circ$.	fill	The 22 is across from the right angle, so it is the hypotenuse. x touches the 63° angle and is not the hypotenuse, so it is the adjacent leg. $\cos = \text{adjacent} \div \text{hypotenuse}$, so $\cos 63^\circ = x \div 22$. x is on top, so multiply: $22 \times 0.4540 = 10.0$.
7	A 52° angle. The leg across from the 52° angle is 13. x is the hypotenuse. The square says $x = 13 \div \cos 52^\circ$.	white	The 13 is the opposite leg and x is the hypotenuse. Opposite leg and hypotenuse go with sin, not cos. Opposite and adjacent are mixed up. The right equation is $x = 13 \div \sin 52^\circ$.
8	A 42° angle. The leg that touches the 42° angle is 11. x is the leg across from the 42° angle. The square says $x = 11 \times \sin 42^\circ$.	white	The 11 is the adjacent leg and x is the opposite leg. sin does not use these two sides. They go with tan. The right equation is $x = 11 \times \tan 42^\circ$.
9	A 59° angle. The leg that touches the 59° angle is 19. x is the hypotenuse. The square says $x = 19 \times \cos 59^\circ$.	white	The 19 is the adjacent leg and x is the hypotenuse. The ratio cos is right: $\cos 59^\circ = 19 \div x$. But x is underneath, so the last step divides. The right equation is $x = 19 \div \cos 59^\circ$.
10	A 38° angle. The hypotenuse is 24. x is the leg that touches the 38° angle. The square says $x = 24 \times \sin 38^\circ$.	white	The 24 is the hypotenuse and x is the adjacent leg. Adjacent leg and hypotenuse go with cos, not sin. Opposite and adjacent are mixed up. The right equation is $x = 24 \times \cos 38^\circ$.
11	A 37° angle. The leg across from the 37° angle is 14. x is the leg that touches the 37° angle. The square says $x = 14 \div \tan 37^\circ$.	fill	The 14 is across from the 37° angle, so it is the opposite leg. x touches the 37° angle and is not the hypotenuse, so it is the adjacent leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 37^\circ = 14 \div x$. x is underneath, so divide: $14 \div 0.7536 = 18.6$.

Mystery Picture — answers, squares 12 to 25

For the teacher

	The square	Answer	Why
12	A 61° angle. The leg across from the 61° angle is 16. x is the leg that touches the 61° angle. The square says $x = 16 \times \tan 61^\circ$.	white	The 16 is the opposite leg and x is the adjacent leg. The ratio tan is right: $\tan 61^\circ = 16 \div x$. But x is underneath, so the last step divides. The right equation is $x = 16 \div \tan 61^\circ$.
13	A 64° angle. The hypotenuse is 14. x is the leg across from the 64° angle. The square says $x = 14 \times \cos 64^\circ$.	white	The 14 is the hypotenuse and x is the opposite leg. Opposite leg and hypotenuse go with sin, not cos. Opposite and adjacent are mixed up. The right equation is $x = 14 \times \sin 64^\circ$.
14	A 47° angle. The leg across from the 47° angle is 8. x is the hypotenuse. The square says $x = 8 \times \sin 47^\circ$.	white	The 8 is the opposite leg and x is the hypotenuse. The ratio sin is right: $\sin 47^\circ = 8 \div x$. But x is underneath, so the last step divides. The right equation is $x = 8 \div \sin 47^\circ$.
15	A 29° angle. The hypotenuse is 23. x is the leg across from the 29° angle. The square says $x = 23 \times \tan 29^\circ$.	white	The 23 is the hypotenuse and x is the opposite leg. tan does not use these two sides. They go with sin. The right equation is $x = 23 \times \sin 29^\circ$.
16	A 57° angle. The hypotenuse is 25. x is the leg across from the 57° angle. The square says $x = 25 \times \sin 57^\circ$.	fill	The 25 is across from the right angle, so it is the hypotenuse. x is across from the 57° angle, so it is the opposite leg. $\sin = \text{opposite} \div \text{hypotenuse}$, so $\sin 57^\circ = x \div 25$. x is on top, so multiply: $25 \times 0.8387 = 21.0$.
17	A 33° angle. The leg that touches the 33° angle is 15. x is the hypotenuse. The square says $x = 15 \div \sin 33^\circ$.	white	The 15 is the adjacent leg and x is the hypotenuse. Adjacent leg and hypotenuse go with cos, not sin. Opposite and adjacent are mixed up. The right equation is $x = 15 \div \cos 33^\circ$.
18	A 41° angle. The hypotenuse is 26. x is the leg that touches the 41° angle. The square says $x = 26 \div \cos 41^\circ$.	white	The 26 is the hypotenuse and x is the adjacent leg. The ratio cos is right: $\cos 41^\circ = x \div 26$. But x is on top, so the last step multiplies. The right equation is $x = 26 \times \cos 41^\circ$.
19	A 55° angle. The hypotenuse is 12. x is the leg that touches the 55° angle. The square says $x = 12 \times \tan 55^\circ$.	white	The 12 is the hypotenuse and x is the adjacent leg. tan does not use these two sides. They go with cos. The right equation is $x = 12 \times \cos 55^\circ$.
20	A 36° angle. The leg across from the 36° angle is 18. x is the hypotenuse. The square says $x = 18 \div \cos 36^\circ$.	white	The 18 is the opposite leg and x is the hypotenuse. Opposite leg and hypotenuse go with sin, not cos. Opposite and adjacent are mixed up. The right equation is $x = 18 \div \sin 36^\circ$.
21	A 32° angle. The leg that touches the 32° angle is 13. x is the leg across from the 32° angle. The square says $x = 13 \div \tan 32^\circ$.	white	The 13 is the adjacent leg and x is the opposite leg. The ratio tan is right: $\tan 32^\circ = x \div 13$. But x is on top, so the last step multiplies. The right equation is $x = 13 \times \tan 32^\circ$.
22	A 31° angle. The hypotenuse is 16. x is the leg that touches the 31° angle. The square says $x = 16 \times \cos 31^\circ$.	fill	The 16 is across from the right angle, so it is the hypotenuse. x touches the 31° angle and is not the hypotenuse, so it is the adjacent leg. $\cos = \text{adjacent} \div \text{hypotenuse}$, so $\cos 31^\circ = x \div 16$. x is on top, so multiply: $16 \times 0.8572 = 13.7$.
23	A 56° angle. The leg that touches the 56° angle is 9. x is the leg across from the 56° angle. The square says $x = 9 \times \tan 56^\circ$.	fill	The 9 touches the 56° angle and is not the hypotenuse, so it is the adjacent leg. x is across from the 56° angle, so it is the opposite leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 56^\circ = x \div 9$. x is on top, so multiply: $9 \times 1.4826 = 13.3$.
24	A 54° angle. The leg across from the 54° angle is 21. x is the hypotenuse. The square says $x = 21 \div \sin 54^\circ$.	fill	The 21 is across from the 54° angle, so it is the opposite leg. x is across from the right angle, so it is the hypotenuse. $\sin = \text{opposite} \div \text{hypotenuse}$, so $\sin 54^\circ = 21 \div x$. x is underneath, so divide: $21 \div 0.8090 = 26.0$.
25	A 53° angle. The hypotenuse is 27. x is the leg that touches the 53° angle. The square says $x = 27 \times \sin 53^\circ$.	white	The 27 is the hypotenuse and x is the adjacent leg. Adjacent leg and hypotenuse go with cos, not sin. Opposite and adjacent are mixed up. The right equation is $x = 27 \times \cos 53^\circ$.