

MYSTERY PICTURE



INVERSE TRIG RATIOS: FINDING AN ANGLE

Read the Table Backward

Inverse trig ratios · 25 squares · no calculator · a picture appears

FREE

1 The angle whose sine is 0.75 is between 40° and 45°.	2 $\tan^{-1}(2.00)$ is between 60° and 65°.	3 The angle whose cosine is 0.60 is between 50° and 55°.	4 $\cos^{-1}(0.5000)$ is exactly 60°.	5 The angle whose tangent is 0.30 is between 15° and 20°.
6 The angle whose cosine is 0.80 is between 50° and 55°.	7 $\sin^{-1}(1.30)$ is between 50° and 55°.	8 The angle whose tangent is 2.00 is between 85° and 90°.	9 $\sin^{-1}(0.95)$ is between 70° and 75°.	10 The angle whose sine is 0.30 is between 70° and 75°.
11 $\cos^{-1}(0.70)$ is between 40° and 45°.	12 The angle whose tangent is 0.50 is between 20° and 25°.	13 The angle whose tangent is 1.30 is between 50° and 55°.	14 The angle whose sine is 0.90 is between 65° and 70°.	15 $\tan^{-1}(0.80)$ is between 50° and 55°.
16 The angle whose cosine is 1.20 is between 50° and 55°.	17 The angle whose cosine is 0.20 is between 75° and 80°.	18 $\sin^{-1}(0.5000)$ is exactly 60°.	19 The angle whose tangent is 0.10 is between 10° and 15°.	20 $\cos^{-1}(0.35)$ is between 20° and 25°.
21 The angle whose sine is 0.60 is between 35° and 40°.	22 $\sin^{-1}(0.40)$ is between 20° and 25°.	23 The angle whose tangent is 3.00 is between 70° and 75°.	24 $\cos^{-1}(0.90)$ is between 25° and 30°.	25 The angle whose sine is 0.80 is between 50° and 55°.

1. **Give each student page 3** and a pencil. No calculator is needed.
2. **Say this once:** “ $\sin^{-1}(0.6)$ means the angle whose sine is 0.6. Find 0.6 in the sine column of the table. Read the two rows it falls between. If the square is true, fill it 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. The table of ratios is printed beside the squares.
Answers pages 4–5, for you.

Every square is read from the table. The student finds the number in the column the square names, then reads the two angles on either side. The sine and tangent columns grow down the table. The cosine column shrinks, so a bigger cosine means a smaller angle. This is the lesson’s first step before the calculator.

This sheet writes $\sin^{-1}$, $\cos^{-1}$ and $\tan^{-1}$, as on the calculator, and also says “the angle whose sine is ...” in words. Some textbooks write arcsin, arccos and arctan instead. Some textbooks use other definitions, so tell the class which ones this sheet uses.

Each white square tests a common mistake. In five the rows come from the wrong column. In five they are the rows next to the right ones. In two a sine or cosine is above 1, which no acute angle has. In one the tangent is doubled, and the angle is taken as doubled too. Twelve squares are filled.

If part of a student’s picture looks wrong, the mistake is in that square. Ask: “Which column does the square name? Which two rows is the number between?” Guessing does not work. Every simple guessing rule, such as filling every sine square, 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 — read the table backward

Inverse trig ratios

Name _____

Period _____

Date _____

$\sin^{-1}(0.6)$ means the angle whose sine is 0.6. Find 0.6 in the sine column of the table. Read the two rows it falls between. $\cos^{-1}$ and $\tan^{-1}$ work the same way. A sine or cosine is never more than 1. **If a square is true, fill it with slanted lines. If not, leave it white.** A picture appears. If part of it is missing, or one square does not fit, check that square again.

Angle	sine	cosine	tangent
5°	0.0872	0.9962	0.0875
10°	0.1736	0.9848	0.1763
15°	0.2588	0.9659	0.2679
20°	0.3420	0.9397	0.3640
25°	0.4226	0.9063	0.4663
30°	0.5000	0.8660	0.5774
35°	0.5736	0.8192	0.7002
40°	0.6428	0.7660	0.8391
45°	0.7071	0.7071	1.0000
50°	0.7660	0.6428	1.1918
55°	0.8192	0.5736	1.4281
60°	0.8660	0.5000	1.7321
65°	0.9063	0.4226	2.1445
70°	0.9397	0.3420	2.7475
75°	0.9659	0.2588	3.7321
80°	0.9848	0.1736	5.6713
85°	0.9962	0.0872	11.4301

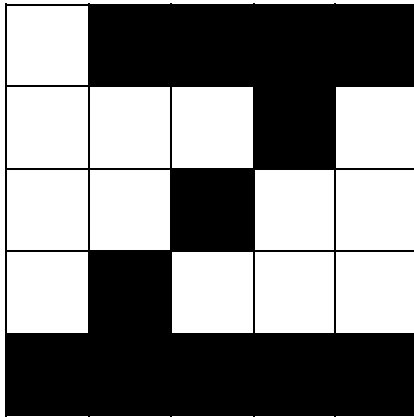
1 The angle whose sine is 0.75 is between 40° and 45°.	2 $\tan^{-1}(2.00)$ is between 60° and 65°.	3 The angle whose cosine is 0.60 is between 50° and 55°.	4 $\cos^{-1}(0.5000)$ is exactly 60°.	5 The angle whose tangent is 0.30 is between 15° and 20°.
6 The angle whose cosine is 0.80 is between 50° and 55°.	7 $\sin^{-1}(1.30)$ is between 50° and 55°.	8 The angle whose tangent is 2.00 is between 85° and 90°.	9 $\sin^{-1}(0.95)$ is between 70° and 75°.	10 The angle whose sine is 0.30 is between 70° and 75°.
11 $\cos^{-1}(0.70)$ is between 40° and 45°.	12 The angle whose tangent is 0.50 is between 20° and 25°.	13 The angle whose tangent is 1.30 is between 50° and 55°.	14 The angle whose sine is 0.90 is between 65° and 70°.	15 $\tan^{-1}(0.80)$ is between 50° and 55°.
16 The angle whose cosine is 1.20 is between 50° and 55°.	17 The angle whose cosine is 0.20 is between 75° and 80°.	18 $\sin^{-1}(0.5000)$ is exactly 60°.	19 The angle whose tangent is 0.10 is between 10° and 15°.	20 $\cos^{-1}(0.35)$ is between 20° and 25°.
21 The angle whose sine is 0.60 is between 35° and 40°.	22 $\sin^{-1}(0.40)$ is between 20° and 25°.	23 The angle whose tangent is 3.00 is between 70° and 75°.	24 $\cos^{-1}(0.90)$ is between 25° and 30°.	25 The angle whose sine is 0.80 is between 50° and 55°.



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Mystery Picture — answers

For the teacher



The finished picture is **the letter Z**. Twelve squares are filled.

To check a square, find its number in the column it names. The sine and tangent grow down the table, and the cosine shrinks. The table gives the reason for every square. It goes on over the page.

	The square	Answer	Why
1	The angle whose sine is 0.75 is between 40° and 45°.	white	In the sine column, 0.75 falls between the sines of 45° and 50°. So the angle is between 45° and 50°. The square names the rows next to them.
2	$\tan^{-1}(2.00)$ is between 60° and 65°.	fill	In the tangent column, 2.00 falls between the tangents of 60° and 65°. So the angle is between 60° and 65°.
3	The angle whose cosine is 0.60 is between 50° and 55°.	fill	In the cosine column, 0.60 falls between the cosines of 50° and 55°. So the angle is between 50° and 55°.
4	$\cos^{-1}(0.5000)$ is exactly 60°.	fill	In the cosine column, the cosine of 60° is exactly 0.5000. So the angle is 60°.
5	The angle whose tangent is 0.30 is between 15° and 20°.	fill	In the tangent column, 0.30 falls between the tangents of 15° and 20°. So the angle is between 15° and 20°.
6	The angle whose cosine is 0.80 is between 50° and 55°.	white	In the cosine column, 0.80 falls between the cosines of 35° and 40°. So the angle is between 35° and 40°. The square's rows come from the sine column.
7	$\sin^{-1}(1.30)$ is between 50° and 55°.	white	In the sine column, no acute angle has a sine of 1.30. A sine is never more than 1. The tangent column holds 1.30.
8	The angle whose tangent is 2.00 is between 85° and 90°.	white	In the tangent column, 2.00 falls between the tangents of 60° and 65°. So the angle is between 60° and 65°. The tangent of 45° is 1, but doubling the tangent does not double the angle.
9	$\sin^{-1}(0.95)$ is between 70° and 75°.	fill	In the sine column, 0.95 falls between the sines of 70° and 75°. So the angle is between 70° and 75°.
10	The angle whose sine is 0.30 is between 70° and 75°.	white	In the sine column, 0.30 falls between the sines of 15° and 20°. So the angle is between 15° and 20°. The square's rows come from the cosine column.
11	$\cos^{-1}(0.70)$ is between 40° and 45°.	white	In the cosine column, 0.70 falls between the cosines of 45° and 50°. So the angle is between 45° and 50°. The square names the rows next to them.
12	The angle whose tangent is 0.50 is between 20° and 25°.	white	In the tangent column, 0.50 falls between the tangents of 25° and 30°. So the angle is between 25° and 30°. The square names the rows next to them.

Mystery Picture — answers, squares 13 to 25

For the teacher

	The square	Answer	Why
13	The angle whose tangent is 1.30 is between 50° and 55° .	fill	In the tangent column, 1.30 falls between the tangents of 50° and 55° . So the angle is between 50° and 55° .
14	The angle whose sine is 0.90 is between 65° and 70° .	white	In the sine column, 0.90 falls between the sines of 60° and 65° . So the angle is between 60° and 65° . The square names the rows next to them.
15	$\tan^{-1}(0.80)$ is between 50° and 55° .	white	In the tangent column, 0.80 falls between the tangents of 35° and 40° . So the angle is between 35° and 40° . The square's rows come from the sine column.
16	The angle whose cosine is 1.20 is between 50° and 55° .	white	In the cosine column, no acute angle has a cosine of 1.20. A cosine is never more than 1. The tangent column holds 1.20.
17	The angle whose cosine is 0.20 is between 75° and 80° .	fill	In the cosine column, 0.20 falls between the cosines of 75° and 80° . So the angle is between 75° and 80° .
18	$\sin^{-1}(0.5000)$ is exactly 60° .	white	In the sine column, the sine of 30° is exactly 0.5000. So the angle is 30° . The square's rows come from the cosine column.
19	The angle whose tangent is 0.10 is between 10° and 15° .	white	In the tangent column, 0.10 falls between the tangents of 5° and 10° . So the angle is between 5° and 10° . The square names the rows next to them.
20	$\cos^{-1}(0.35)$ is between 20° and 25° .	white	In the cosine column, 0.35 falls between the cosines of 65° and 70° . So the angle is between 65° and 70° . The square's rows come from the sine column.
21	The angle whose sine is 0.60 is between 35° and 40° .	fill	In the sine column, 0.60 falls between the sines of 35° and 40° . So the angle is between 35° and 40° .
22	$\sin^{-1}(0.40)$ is between 20° and 25° .	fill	In the sine column, 0.40 falls between the sines of 20° and 25° . So the angle is between 20° and 25° .
23	The angle whose tangent is 3.00 is between 70° and 75° .	fill	In the tangent column, 3.00 falls between the tangents of 70° and 75° . So the angle is between 70° and 75° .
24	$\cos^{-1}(0.90)$ is between 25° and 30° .	fill	In the cosine column, 0.90 falls between the cosines of 25° and 30° . So the angle is between 25° and 30° .
25	The angle whose sine is 0.80 is between 50° and 55° .	fill	In the sine column, 0.80 falls between the sines of 50° and 55° . So the angle is between 50° and 55° .