LESSON MAKER PRO

Circle Pattern Power

Use unit-circle patterns to simplify trig values.

HIGH SCHOOL · AII-F.TF.4

AII-F.TF.4 "Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions."

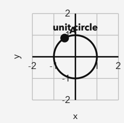
NAME ______________________________ DATE ______________

SYMMETRY AND REPEATS

On the unit circle, changing x to -x reflects a point across the x-axis. So sin(-x) = -sin(x), cos(-x) = cos(x), and tan(-x) = -tan(x). Sine and cosine repeat every 2pi, while tangent repeats every pi.

WORKED EXAMPLE

Use the unit circle diagram to find sin(-2pi/3).

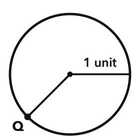


1. At 2pi/3, point A has y-coordinate sqrt(3)/2.
2. Changing 2pi/3 to -2pi/3 reflects the point across the x-axis.
3. The reflected point has y-coordinate -sqrt(3)/2, which is the sine value.

Answer: -sqrt(3)/2

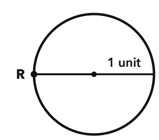
PRACTICE 6 problems

1 The point Q is shown on the unit circle. Use its vertical coordinate to find sin(5pi/4).



ANSWER ______________________

2 The point R is shown on the unit circle. Use its horizontal coordinate to find cos(pi).



ANSWER ______________________

3 Use odd symmetry to find tan(-pi/4).

ANSWER ______________________

4 If sin(x) = 2/5, find sin(-x).

ANSWER ______________________

5 If cos(x) = -4/9, find cos(x + 2pi).

ANSWER ______________________

6 Use periodicity to find sin(7pi/2).

ANSWER ______________________

APPLY IT Show your work

1 A music app models its left-right speaker balance with b(t) = cos(t). At t = pi/4, the balance is sqrt(2)/2. The app reverses the time input to t = -pi/4. What is b(-pi/4)?

WORK SPACE

ANSWER ____________________

2 A Ferris wheel rider's height is modeled by H(t) = 14 + 6cos(pi t/8), where H is in meters and t is in seconds. Find the rider's height at t = 8 and t = 24. Explain why the heights match.

WORK SPACE

ANSWER ____________________

CHALLENGE One step up

Let f(x) = sin(x) + cos(x). Is f even, odd, or neither? Show this by comparing f(-x) with f(x) and -f(x).

WORK SPACE AND ANSWER

ANSWER KEY **Circle Pattern Power** HIGH SCHOOL · AII-F.TF.4

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	The point Q is shown on the unit circle. Use its vertical coordinate to find sin(5pi/4).	**-sqrt(2)/2**
2	The point R is shown on the unit circle. Use its horizontal coordinate to find cos(pi).	**-1**
3	Use odd symmetry to find tan(-pi/4).	**-1**
4	If sin(x) = 2/5, find sin(-x).	**-2/5**
5	If cos(x) = -4/9, find cos(x + 2pi).	**-4/9**
6	Use periodicity to find sin(7pi/2).	**-1**

PART 2 · APPLY IT

1. **sqrt(2)/2** Cosine is even, so cos(-pi/4) = cos(pi/4). The balance remains sqrt(2)/2.
2. **H(8) = 8 meters and H(24) = 8 meters. The heights match because the cosine input changes by 2pi, one full period.** H(8) = 14 + 6cos(pi) = 8. H(24) = 14 + 6cos(3pi) = 8, and 3pi - pi = 2pi.

CHALLENGE

Neither. f(-x) = -sin(x) + cos(x), which is not equal to sin(x) + cos(x) or -sin(x) - cos(x).

Accept equivalent exact forms, such as -sqrt(2)/2 written as -sqrt(2)/2. For the challenge, students must show that f(-x) matches neither f(x) nor -f(x).