

Trigonometric Functions and the Unit Circle: math practice, Grade 11 – download the PDF

22 problems graded by difficulty (★ easy, ★★ medium, ★★★ hard). Try first, without looking at the solutions!

1 Degrees to radians



Convert each angle to radians. Give exact answers in terms of π .

- a. 45°
- b. 120°
- c. 270°
- d. 150°

2 Radians to degrees



Convert each angle to degrees.

- a. $\frac{5\pi}{6}$
- b. $\frac{7\pi}{4}$
- c. $\frac{\pi}{9}$
- d. $\frac{11\pi}{6}$

3 Length of a sprinkler arc



A lawn sprinkler sprays water 8 inches from its center through a central angle of $\frac{3\pi}{4}$ radians. Find the length of the arc swept by the water at that distance, first in inches (to the nearest hundredth), then in centimeters. (1 inch = 2.54 cm.)

4 Special values on the unit circle



Give the exact value of each expression.

- a. $\sin \frac{\pi}{6}$
- b. $\cos \frac{\pi}{3}$
- c. $\sin \frac{\pi}{4}$
- d. $\cos \frac{\pi}{2}$
- e. $\tan \frac{\pi}{4}$

5 Quadrants and signs



For each angle, name the quadrant of its terminal side and tell whether sine and cosine are positive or negative.

- a. 200°
- b. $\frac{5\pi}{6}$
- c. 300°
- d. $-\frac{\pi}{4}$

6 Amplitude and period



Give the amplitude and the period of each function.

a. $y = 4 \sin x$

b. $y = \sin 3x$

c. $y = -2 \cos \frac{x}{2}$

7 True or false?



Decide whether each statement is true or false and justify your answer.

a. $\cos \pi = -1$.

b. $\tan \frac{\pi}{2} = 0$.

c. A straight angle measures 2π radians.

d. $\sin^2 20^\circ + \cos^2 20^\circ = 1$.

8 Exact values with reference angles



Find the exact value of each expression. Show the quadrant and the reference angle.

a. $\sin 150^\circ$

b. $\cos 225^\circ$

c. $\tan 300^\circ$

d. $\sin \frac{4\pi}{3}$

9 Cosine known, quadrant IV



The angle θ lies in quadrant IV and $\cos \theta = \frac{3}{5}$. Find $\sin \theta$ and $\tan \theta$.

10 Sine known, quadrant II



The angle θ lies in quadrant II and $\sin \theta = \frac{5}{13}$. Find $\cos \theta$ and $\tan \theta$.

11 Key points of a reflected cosine



Consider $y = -3 \cos(2x) + 1$.

- Give the amplitude, the period and the midline.
- Give the maximum and the minimum values.
- Complete the table of key points for $x = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi$.

12 A sine equation



Solve $2 \sin x - 1 = 0$ on the interval $[0, 2\pi)$.

13 A cosine equation

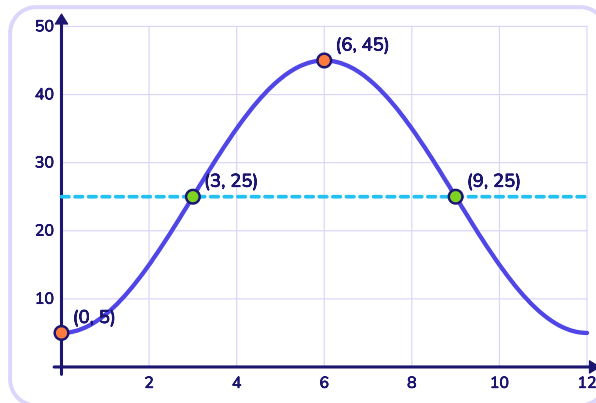


Solve $2 \cos x + \sqrt{2} = 0$ on $[0, 2\pi)$.

14 The Ferris wheel



The height in feet of a seat on a Ferris wheel is $h(t) = 25 - 20 \cos \frac{\pi t}{6}$, where t is the time in minutes after the seat leaves the boarding platform. The graph of one turn is shown below.



- Find the lowest height, the highest height and the time for one turn. Give the highest height in meters too (1 ft = 0.3048 m).
- Find the height after 2 minutes.
- At what times during the first turn is the seat at 35 feet?

15 Harbor tide



In a simplified model, the water depth at the end of a pier is $d(t) = 8 + 3 \sin \frac{\pi t}{6}$ feet, where t is the number of hours after midnight.

- Find the period, the maximum depth and the minimum depth. Give the maximum depth in meters (1 ft = 0.3048 m).
- Find the depth at 1 a.m.
- At what times between $t = 0$ and $t = 12$ is the depth exactly 9.5 feet?

16 A shifted sine wave

Consider $y = 2 \sin \left(x - \frac{\pi}{3} \right)$.

- Give the amplitude, the period, the phase shift and the range.
- Find the x-intercepts in $[0, 2\pi)$.
- Find where the maximum and the minimum occur in $[0, 2\pi)$.

17 One branch of a tangent

Consider $f(x) = \tan(2x)$.

- Find the period of f .
- Find the vertical asymptotes that border the branch containing the origin.
- Give the points of that branch where $f(x) = -1, 0$ and 1 .

18 Factoring a trigonometric equation

Solve $2 \cos^2 x - \cos x - 1 = 0$ on $[0, 2\pi)$.

19 Using the Pythagorean identity to solve

Solve $2 \sin^2 x + 3 \cos x = 3$ on $[0, 2\pi)$. (Hint: rewrite everything in terms of cosine.)

20 Writing an equation from features



A sinusoidal graph has a maximum value of 5 at $x = 0$, a minimum value of -3 , and a period of π .

- Find its amplitude and midline.
- Write an equation of the form $y = A \cos(Bx) + D$.
- Check your equation at $x = 0$ and at $x = \frac{\pi}{2}$.

21 Daily temperature



In a desert town the temperature in degrees Fahrenheit is modeled by

$T(t) = 62 - 14 \cos \frac{\pi(t - 4)}{12}$, where t is the number of hours after midnight ($0 \leq t < 24$).

- Find the lowest and highest temperatures and the times they occur.
- Find the temperature at 10 a.m. and at noon.
- At what times is the temperature 69°F ? Convert 69°F to Celsius to the nearest tenth.

22 Proving and checking an identity



- Show that $\frac{\sin^2 x}{1 - \cos x} = 1 + \cos x$ for every x with $\cos x \neq 1$.
- Check the identity numerically for $x = \frac{\pi}{3}$.



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