
Frequency Modulation

Chapter

6

Trigonometric Functions

GOALS

You will be able to

- Understand radian measure and its relationship to degree measure
- Use radian measure with trigonometric functions
- Make connections between trigonometric ratios and the graphs of the primary and reciprocal trigonometric functions
- Pose, model, and solve problems that involve trigonometric functions
- Solve problems that involve rates of change in trigonometric functions

? FM radio stations and many other wireless technologies (such as the sound portion of a television signal, cordless phones, and cell phones) transmit information using sine waves. The equations that are used to model these sine waves, however, do not use angles that are measured in degrees. What is an alternative way to measure angles, and how does this affect the graphs of trigonometric functions?

6 Getting Started

Study *Aid*

- For help, see the Review of Essential Skills found at the Nelson Advanced Functions website.

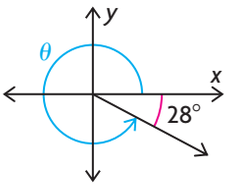
Question	Appendix
1, 2, 3, 4	R-10
5	R-11
6, 7	R-12

SKILLS AND CONCEPTS You Need

1. For angle θ, determine

a) the size of the **related acute angle**

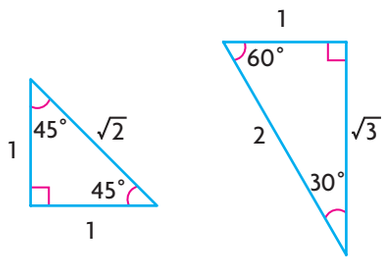
b) the size of the **principal angle**



2. Point $P(3, -4)$ lies on the terminal arm of an angle in standard position.

a) Sketch the angle, and determine the values of the primary and reciprocal ratios.

b) Determine the measure of the principal angle, to the nearest degree.



3. Draw each angle in standard position. Then, using the **special triangles** as required, determine the exact value of the trigonometric ratio.

a) $\sin 60°$ **c)** $\sin 120°$ **e)** $\sec 135°$

b) $\tan 180°$ **d)** $\cos 300°$ **f)** $\csc 270°$

4. Determine the value(s) of θ, if $0° \leq \theta \leq 360°$.

a) $\cos\theta = \frac{1}{2}$ **c)** $\tan\theta = 1$ **e)** $\cot\theta = -1$

b) $\tan\theta = \frac{1}{\sqrt{3}}$ **d)** $\cos\theta = -1$ **f)** $\sin\theta = 1$

5. For each of the following, state the **period**, **amplitude**, **equation of the axis**, and range of the function. Then sketch its graph.

a) $y = \sin\theta$, where $-360° \leq \theta \leq 360°$.

b) $y = \cos\theta$, where $-360° \leq \theta \leq 360°$.

6. State the period, equation of the axis, horizontal shift, and amplitude of each function. Then sketch one cycle.

a) $y = 2\sin(3(x + 45°))$ **b)** $y = -\sin\left(\frac{1}{2}(x - 60°)\right) - 1$

7. Identify the transformation that is associated with each of the parameters (a, k, d, and c) in the graphs defined by $y = a\sin(k(x - d)) + c$ and $y = a\cos(k(x - d)) + c$. Discuss which graphical feature (period, amplitude, equation of the axis, or horizontal shift) is associated with each parameter.

APPLYING What You Know

Using a Sinusoidal Model

A Ferris wheel has a diameter of 20 m, and its axle is located 15 m above the ground. Once the riders are loaded, the Ferris wheel accelerates to a steady speed and rotates 10 times in 4 min. The height, h metres, of a rider above the ground during a ride on this Ferris wheel can be modelled by a sinusoidal function of the form $h(t) = a \sin (k(t - d)) + c$, where t is the time in seconds.

The height of a rider begins to be tracked when the rider is level with the axis of the Ferris wheel on the first rotation.

YOU WILL NEED

- graph paper

? What does the graph of the rider's height versus time, for three complete revolutions, look like? What equation can be used to describe this graph?

A. Determine the maximum and minimum heights of a rider above the ground during the ride.

B. How many seconds does one complete revolution take? What part of the graph represents this?

C. On graph paper, sketch a graph of the rider's height above the ground versus time for three revolutions of the Ferris wheel.

D. What type of curve does your graph resemble?

E. Is this function a periodic function? Explain.

F. What is the amplitude of this function?

G. What is the period of this function?

H. What is the equation of the axis of this function?

I. Assign appropriate values to each parameter in $h(t)$ for this situation.

J. Write the equation of a sine function that describes the graph you sketched in part C.