

## THE OTHER TRIGONOMETRIC FUNCTIONS

### ALGEBRA 2 WITH TRIGONOMETRY

There are four additional trigonometric functions that are of less importance than sine and cosine. Yet, these functions still find their applications in mathematics, science, and engineering. This and the next lesson will be devoted to some basic investigation on these four additional functions, each one of which is defined in terms of the basic sine and cosine functions.

#### THE OTHER FOUR TRIGONOMETRIC FUNCTIONS

**TANGENT:**  $\tan(\theta) = \frac{\sin(\theta)}{\cos(\theta)}$

**SECANT:**  $\sec(\theta) = \frac{1}{\cos(\theta)}$

**COTANGENT:**  $\cot(\theta) = \frac{\cos(\theta)}{\sin(\theta)}$

**COSECANT:**  $\csc(\theta) = \frac{1}{\sin(\theta)}$

The first skill that must be mastered with any new function is evaluating that function for a variety of inputs. The next few exercises will help with this skill.

**Exercise #1:** Considering your work with sine and cosine, evaluate each of the following. Express your answers in exact and simplest form.

(a)  $\tan(45^\circ)$

(b)  $\sec(60^\circ)$

(c)  $\cot(150^\circ)$

(d)  $\csc\left(\frac{3\pi}{4}\right)$

(e)  $\tan(\pi)$

(f)  $\cot\left(\frac{5\pi}{3}\right)$

**Exercise #2:** Which of the following is closest to the value of  $\sec(52^\circ)$ ?

(1) 0.62

(3) 0.36

(2) 1.62

(4) 2.48



Because each of these four trigonometric functions has a variable denominator, there will be angles at which these denominators are zero and hence the function is undefined.

**Exercise #3:** At which of the following values of  $\alpha$  is  $\tan(\alpha)$  undefined?

(1)  $\alpha = 0^\circ$                       (3)  $\alpha = 45^\circ$

(2)  $\alpha = 180^\circ$                       (4)  $\alpha = 90^\circ$                       \_\_\_\_\_

**Exercise #4:** Which of the following values of  $x$  is *not* in the domain of  $y = \csc(x)$ ?

(1)  $x = 180^\circ$                       (3)  $x = 90^\circ$

(2)  $x = 60^\circ$                       (4)  $x = 135^\circ$                       \_\_\_\_\_

Because each of these four functions is dependent on sine and/or cosine, it is possible to determine the **sign** (positive or negative nature) of each based on the quadrant of the input angle.

**Exercise #5:** Determine the sign of each of the following trigonometric functions in the quadrant specified.

(a)  $\tan(\beta)$  for  $\beta$  in quad. II

(b)  $\sec(\beta)$  for  $\beta$  in quad. IV

(c)  $\csc(\beta)$  for  $\beta$  in quad. III

**Exercise #6:** For an angle  $\alpha$  it is known that  $\tan(\alpha) > 0$  and  $\sin(\alpha) < 0$ . The terminal ray of  $\alpha$  when drawn in standard position must lie in quadrant

(1) I                                      (3) III

(2) II                                      (4) IV                                      \_\_\_\_\_

**Exercise #7:** If  $\cot(\theta) < 0$  and  $\sec(\theta) > 0$  then  $\theta$  could be which of the following angles?

(1)  $\theta = 48^\circ$                       (3)  $\theta = 122^\circ$

(2)  $\theta = 310^\circ$                       (4)  $\theta = 225^\circ$                       \_\_\_\_\_



Name: \_\_\_\_\_

Date: \_\_\_\_\_

**THE OTHER TRIGONOMETRIC FUNCTIONS**  
**ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK**

**SKILLS**

1. Determine the value of each of the following in exact and simplest form.

(a)  $\tan(135^\circ)$

(b)  $\csc(30^\circ)$

(c)  $\cot(90^\circ)$

(d)  $\sec\left(\frac{5\pi}{4}\right)$

(e)  $\tan\left(\frac{\pi}{3}\right)$

(f)  $\csc\left(\frac{3\pi}{2}\right)$

2. Use your calculator to determine the value of each of the following to the nearest *hundredth*.

(a)  $\cot(115^\circ)$

(b)  $\sec(312^\circ)$

(c)  $\csc(245^\circ)$

3. In simplest radical form,  $\sec(135^\circ)$  is equal to

(1)  $-\frac{\sqrt{2}}{3}$

(3)  $-\frac{\sqrt{2}}{2}$

(2)  $-\sqrt{2}$

(4)  $-\frac{\sqrt{3}}{2}$

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4. Which of the following is nearest to the value of  $\cot(220^\circ)$ ?

(1) 1.19

(3) -2.74

(2) 3.17

(4) -0.85

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5. For which of the following values of  $\alpha$  is  $\cot(\alpha)$  undefined?

- (1)  $60^\circ$                       (3)  $180^\circ$   
 (2)  $90^\circ$                       (4)  $135^\circ$

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6. For which angle,  $\beta$ , below will  $\sec(\beta)$  not exist?

- (1)  $30^\circ$                       (3)  $180^\circ$   
 (2)  $45^\circ$                       (4)  $90^\circ$

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7. Which of the following values of  $x$  is *not* in the domain of  $g(x) = \tan(2x)$ ? Hint – you will be multiplying each of these values by 2 before finding its tangent.

- (1)  $45^\circ$                       (3)  $180^\circ$   
 (2)  $0^\circ$                       (4)  $90^\circ$

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8. Determine whether each function in the tables below is positive, (+), or negative, (–), for angles whose terminal rays lie in the respective quadrants. Use the table in part (a) to help create the table in (b).

(a)

	I	II	III	IV
$\cos(\theta)$				
$\sin(\theta)$				

(b)

	I	II	III	IV
$\tan(\theta)$				
$\cot(\theta)$				
$\sec(\theta)$				
$\csc(\theta)$				

9. For an angle  $\alpha$  it is known that  $\tan(\alpha) < 0$  and  $\sin(\alpha) < 0$ . If drawn in standard position the terminal ray of  $\alpha$  would lie in which quadrant?

- (1) I                              (3) III  
 (2) II                             (4) IV

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10. For the angle  $\beta$  it is known that  $\csc(\beta) > 0$  and  $\sec(\beta) < 0$ . When drawn in standard position, the terminal ray of  $\beta$  lies in quadrant

- (1) I                              (3) III  
 (2) II                             (4) IV

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