

# MS 113 In-class Problems

April 3, 2025

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## Chapter 5 Section 1

360 is divisible by many numbers:

1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24,  
30, 36, 40, 45, 60, 72, 90, 120, 180, 360

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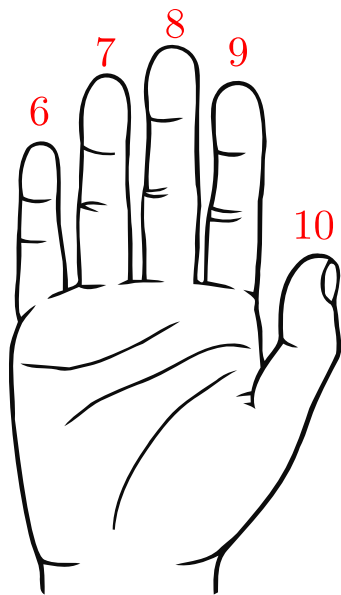
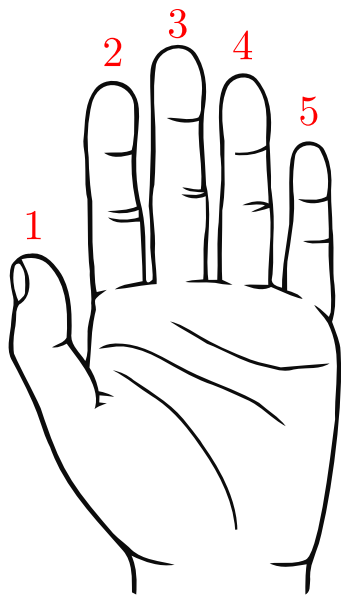
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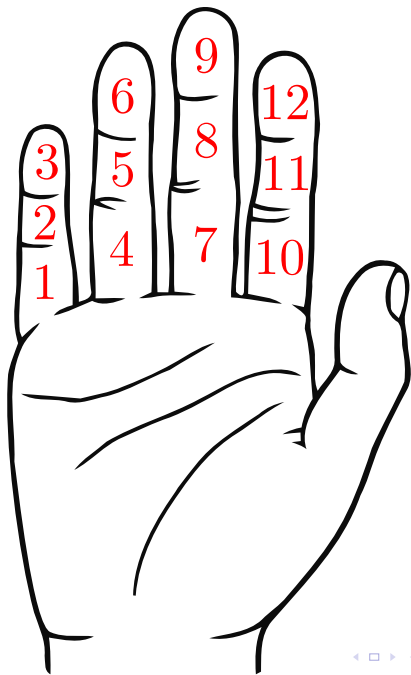
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𐎶 1	𐎶𐎵 11	𐎶𐎵𐎶 21	𐎶𐎵𐎶𐎵 31	𐎶𐎵𐎶𐎵𐎶 41	𐎶𐎵𐎶𐎵𐎶𐎵 51
𐎶𐎶 2	𐎶𐎶𐎵 12	𐎶𐎶𐎵𐎶 22	𐎶𐎶𐎵𐎶𐎵 32	𐎶𐎶𐎵𐎶𐎵𐎶 42	𐎶𐎶𐎵𐎶𐎵𐎶𐎵 52
𐎶𐎶𐎶 3	𐎶𐎶𐎶𐎵 13	𐎶𐎶𐎶𐎵𐎶 23	𐎶𐎶𐎶𐎵𐎶𐎵 33	𐎶𐎶𐎶𐎵𐎶𐎵𐎶 43	𐎶𐎶𐎶𐎵𐎶𐎵𐎶𐎵 53
𐎶𐎶𐎶𐎶 4	𐎶𐎶𐎶𐎶𐎵 14	𐎶𐎶𐎶𐎶𐎵𐎶 24	𐎶𐎶𐎶𐎶𐎵𐎶𐎵 34	𐎶𐎶𐎶𐎶𐎵𐎶𐎵𐎶 44	𐎶𐎶𐎶𐎶𐎵𐎶𐎵𐎶𐎵 54
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So

$$1^\circ \equiv 60'$$

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$$1^\circ \equiv 3600''$$

Minute < **Middle French** *minute* < **post-classical Latin** *minuta* or *minutum*.

Second < **French** *seconde* < **medieval Latin** *secunda*.

“St Augustine refers to *minuta* and to *minutae minutarum* ‘minutes of minutes’, i.e. seconds ... as terms in use by *mathematici*.”

“... used elliptically for *secunda minuta*, lit. ‘second minute’, i.e. the result of the second operation of sexagesimal division; the result of the first such operation (now called ‘minute’ simply) being the ‘first’ or ‘prime minute’ or ‘prime’”

Oxford English Dictionary, s.v. “minute (n.1),” March 2024,  
<https://doi.org/10.1093/OED/1094508711>.

Oxford English Dictionary, s.v. “second (n.1),” December 2023,  
<https://doi.org/10.1093/OED/7821975804>.

Convert 6 ft to inches.

Convert 3 min to seconds.

Convert  $3\frac{\text{ft}}{\text{min}}$  to  $\frac{\text{in}}{\text{s}}$ .



Convert  $2^\circ$  to minutes.

Convert 3' to seconds.

# Etymology of angle adjectives

- right** Seems to be influenced from classical Latin *rect* meaning to be  $90^\circ$ .
- acute** From Latin *acūtus* meaning sharp.
- obtuse** From classical Latin *obtūsus* meaning blunt, dull, stupid. So most likely dull in comparison with acute's meaning of sharp.
- reflex** Not sure, but one meaning of classical Latin *reflexus* is curved back. So maybe this?

# Gradian

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# Gradian

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Mostly used in surveying and lasers in USA.



Find the gradian measure of the angle with the given degree measure.

$$135^{\circ}$$

Find the gradian measure of the angle with the given degree measure.

$$180^\circ$$

Find the degree measure of the angle with the given gradian measure.

300 grad

Find the degree measure of the angle with the given gradian measure.

50 grad

## Dimensional Analysis - a little bit

Suppose you have a rectangle with length  $l = 2$  in and width  $w = 5$  in.

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$$A = w$$

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Why not?

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Can the following be the formula for the area of the rectangle?

$$A = w$$

Why not?

---

What about

$$A = lwh?$$

Why or why not?



Find the radian measure of the angle with the given degree measure.

$$45^\circ$$

Find the radian measure of the angle with the given degree measure.

$$-30^\circ$$

Find the radian measure of the angle with the given degree measure.

$$60^\circ$$

Find the radian measure of the angle with the given degree measure.

$$90^\circ$$

Find the radian measure of the angle with the given degree measure.

$$180^\circ$$

Find the radian measure of the angle with the given degree measure.

$$270^\circ$$

Find the radian measure of the angle with the given degree measure.

$$360^\circ$$

Find the degree measure of the angle with the given radian measure.

$$\frac{7\pi}{4}$$



Find the degree measure of the angle with the given radian measure.

$$\frac{5\pi}{6}$$

Find the degree measure of the angle with the given radian measure.

$$-\frac{\pi}{2}$$

Find the degree measure of the angle with the given radian measure.  
(Round your answer to one decimal place.)

6

Find the degree measure of the angle with the given radian measure.  
(Round your answer to one decimal place.)

1

Find the degree measure of the angle with the given radian measure.  
(Round your answer to one decimal place.)

$$-2.3$$

Danger



When writing an angle if you do not write the degree symbol it is interpreted as a radian!



So 2 is 2 rad and  $2^\circ$  is 2 deg.

Starting at  $\frac{\pi}{2}$  count to  $2\pi$  beyond it by  $\frac{\pi}{2}$ ths.

Starting at  $\frac{\pi}{3}$  count to  $2\pi$  beyond it by  $\frac{\pi}{2}$ ths.



Starting at  $\frac{\pi}{6}$  count to  $2\pi$  beyond it by  $\frac{\pi}{6}$ ths.

The measure of an angle in standard position is given. Find two positive angles and two negative angles that are coterminal with the given angle.

$$45^\circ$$

The measure of an angle in standard position is given. Find two positive angles and two negative angles that are coterminal with the given angle.

$$-30^\circ$$

The measure of an angle in standard position is given. Find two positive angles and two negative angles that are coterminal with the given angle.

$$400^\circ$$

The measure of an angle in standard position is given. Find two positive angles and two negative angles that are coterminal with the given angle.

$$\frac{3\pi}{4}$$

The measure of an angle in standard position is given. Find two positive angles and two negative angles that are coterminal with the given angle.

5

The measures of two angles in standard position are given. Determine whether the angles are coterminal.

$$70^\circ, 430^\circ$$

The measures of two angles in standard position are given. Determine whether the angles are coterminal.

$$\frac{5\pi}{6}, \frac{19\pi}{6}$$



Find an angle between  $0^\circ$  and  $360^\circ$  that is coterminal with the given angle.

$$-1190^\circ$$

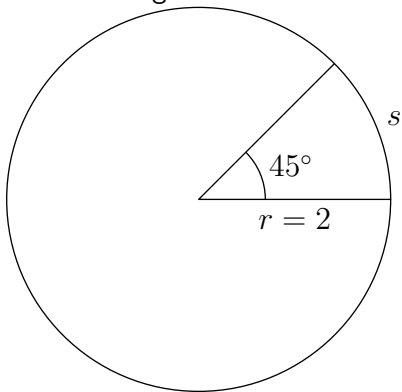
Find an angle between 0 and  $2\pi$  that is coterminal with the given angle.

$$\frac{21\pi}{4}$$

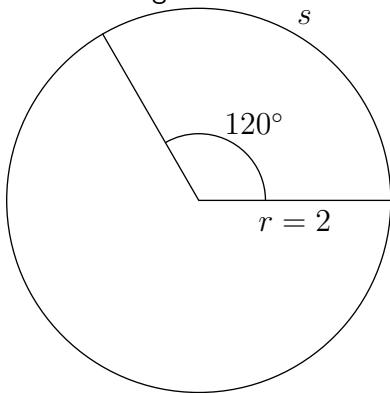
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7

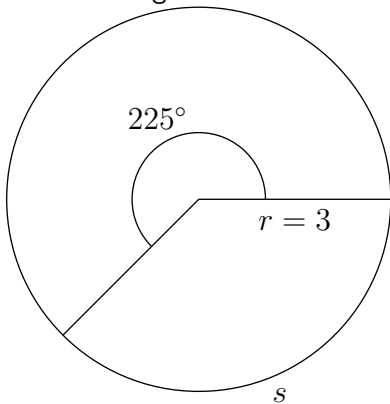
Find the length  $s$  of the circular arc.



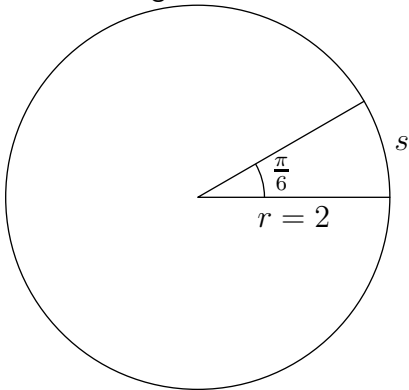
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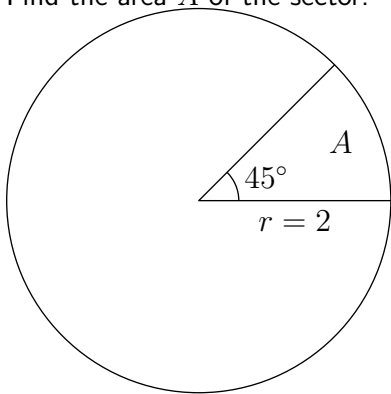
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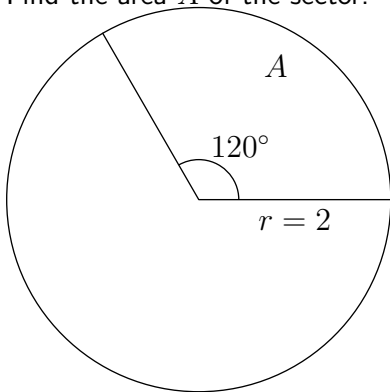


Find the area  $A$  of the sector.

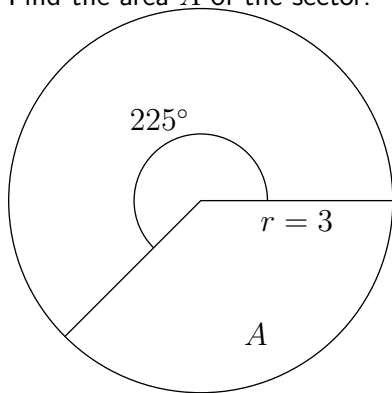




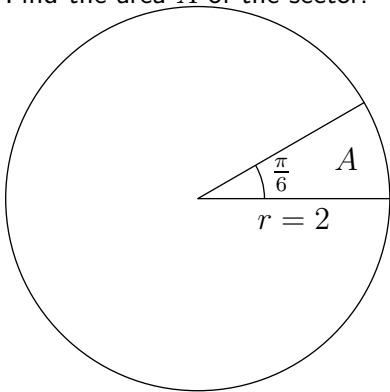
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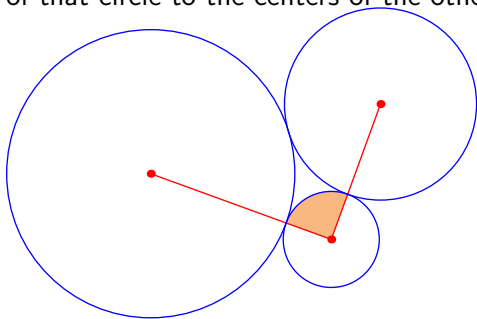


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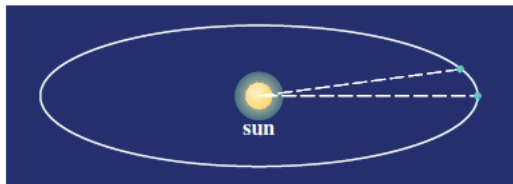


- ▶ If the central angle is  $\theta = \frac{\pi}{2}$  and the arc length is  $s = 3$ , find the radius  $r$ .
- ▶ If the radius is  $r = 5$  and the arc length is  $s = 10$ , find the central angle  $\theta$ .
- ▶ If the central angle is  $\theta = \pi$  and the sector area is  $A = 6\pi$ , find the radius  $r$ .

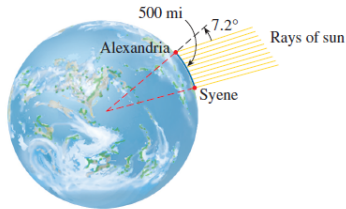
**5.1.071** Three circles with radii 1, 2, and 3 ft are externally tangent to one another, as shown in the figure. Find the area of the sector of the circle of radius 1 that is cut off by the line segments joining the center of that circle to the centers of the other two circles.



**5.1.079** Find the distance that the earth travels in two days in its path around the sun. Assume that a year has 365 days and that the path of the earth around the sun is a circle of radius 93 million miles.



**5.1.080** The Greek mathematician Eratosthenes (ca. 276–195 B.C.) measured the circumference of the earth from the following observations. He noticed that on a certain day the sun shone directly down a deep well in Syene (modern Aswan). At the same time in Alexandria, 500 mi north (on the same meridian), the rays of the sun shone at an angle of  $7.2^\circ$  to the zenith.



1. Find the radius of the earth. (Round to nearest ten miles.)
2. Find the circumference of the earth.

## Chapter 5 Section 2



## Definition 1 (Trigonometry)

[from: modern Latin (1595) < Greek (triangle) + (-metry)]

You are doing trigonometry if

1. you can find a standard quantitative measure of the inclination of one line to another.
2. you have a capacity for calculating the lengths of line segments.

from THE MATHEMATICS OF THE HEAVENS AND THE EARTH,  
Glen van Brummelen

What is the equation for a circle centered at the origin  $(h, k)$  and a radius of  $r$ ?

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Given a circle with center  $C(0, 0)$  and radius  $r = 5$ :  
What is the equation?

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Given a circle with center  $C(0, 0)$  and radius  $r = 5$ :  
What is the equation?

$$x^2 + y^2 = 25$$

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Given a circle with center  $C(0, 0)$  and radius  $r = 5$ :  
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Is the point  $(3, 4)$  on the circle?

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Given a circle with center  $C(0, 0)$  and radius  $r = 13$ :

$$x^2 + y^2 = 169$$

If  $y = 12$ , find  $x$ .

# Things you should know

- ▶ Pythagorean theorem

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- ▶ Sum of the interior angles of a triangle

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- ▶ Pythagorean theorem
- ▶ Similar triangles
- ▶ Sum of the interior angles of a triangle
- ▶ Leg length/angle size correspondence

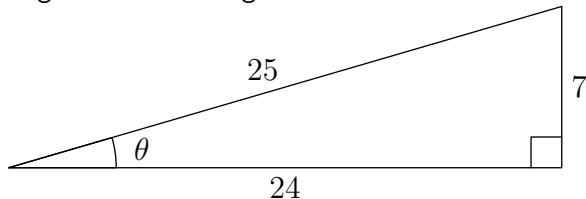
## -fixes and stems

trigonometry triangle + -metry (measure)

isosceles iso- (same) + sceles (leg)

equilateral equi- (equal) + lateral (side)

**5.2.004** Find the exact values of the six trigonometric ratios of the angle  $\theta$  in the triangle.



a)  $\sin \theta =$

b)  $\cos \theta =$

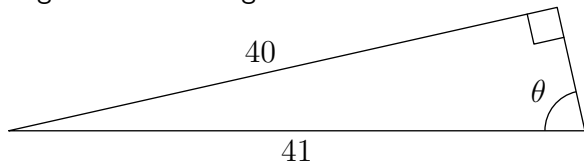
c)  $\tan \theta =$

d)  $\csc \theta =$

e)  $\sec \theta =$

f)  $\cot \theta =$

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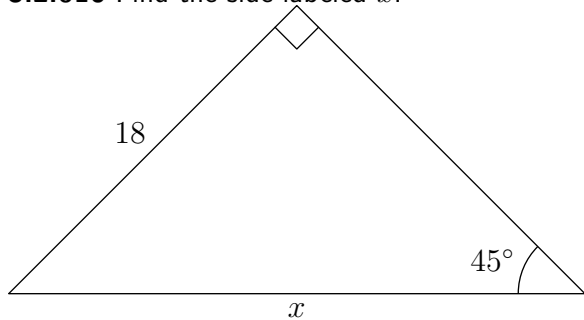
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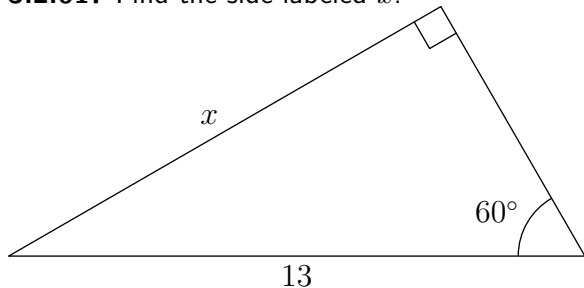
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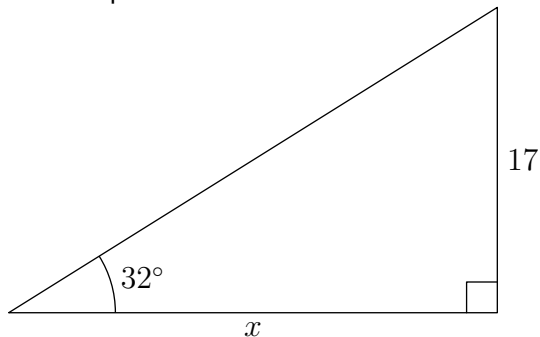
**5.2.016** Find the side labeled  $x$ .



**5.2.017** Find the side labeled  $x$ .

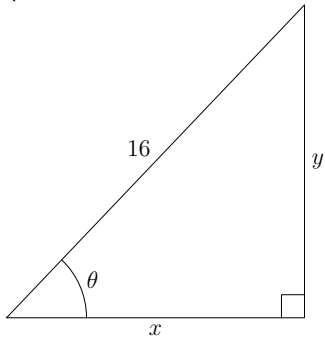


**5.2.019** Find the side labeled  $x$ . State your answer rounded to 5 decimal places.





**5.2.021** Express  $x$  and  $y$  in terms of trigonometric ratios of  $\theta$ .  
(Express your answer in terms of  $\theta$  only.)



**5.2.023** Sketch a triangle that has acute angle  $\theta$ .

$$\tan(\theta) = \frac{4}{7}$$

Then find

a)  $\sin \theta =$

b)  $\cos \theta =$

**5.2.026** Sketch a triangle that has acute angle  $\theta$ .

$$\tan(\theta) = \sqrt{3}$$

Then find

a)  $\sin \theta =$

b)  $\cos \theta =$

**5.2.029** Evaluate the expression without using a calculator.

$$\sin\left(\frac{\pi}{3}\right) + \cos\left(\frac{\pi}{3}\right)$$

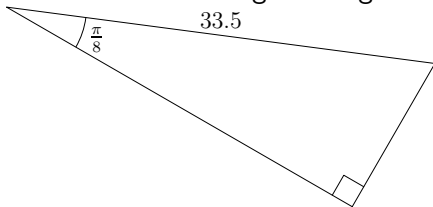
**5.2.032** Evaluate the expression without using a calculator.

$$(\sin(30^\circ))^2 + (\cos(30^\circ))^2$$

**5.2.035** Evaluate the expression without using a calculator.

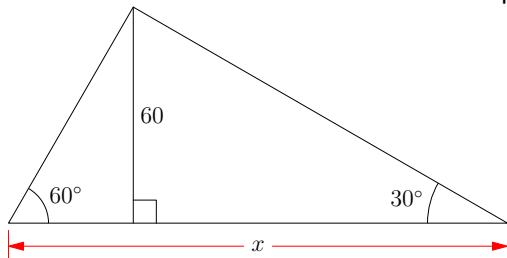
$$\left(\cos\left(\frac{\pi}{4}\right) + \sin\left(\frac{\pi}{6}\right)\right)^2$$

**5.2.041** Solve the right triangle.



1. Find the length of the side opposite to the given angle. (Round your answer to two decimal places.)
2. Find the length of the side adjacent to the given angle. (Round your answer to two decimal places.)
3. Find the other acute angle.

**5.2.047** Find  $x$  rounded to one decimal place.





**YO DAWG I HEARD YOU LOVE TRIANGLES**

**SO WE PUT A TRIANGLE IN YOUR TRIANGLE SO YOU  
CAN LOVE TRIANGLES WHILE YOU LOVE TRIANGLES**

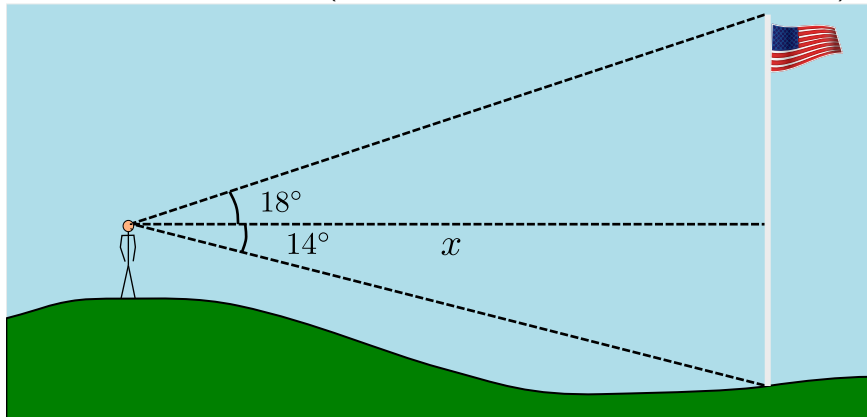
quickmeme.com

**5.2.053** The angle of elevation to the top of a very tall Building is found to be  $7^\circ$  from the ground at a distance of 1 mi from the base of the building. Using this information, find the height of the building. (Round your answer to the nearest foot.)

**5.2.056** From the top of a 170 ft lighthouse, the angle of depression to a ship in the ocean is  $27^\circ$ . How far is the ship from the base of the lighthouse? (Round your answer to the nearest foot.)

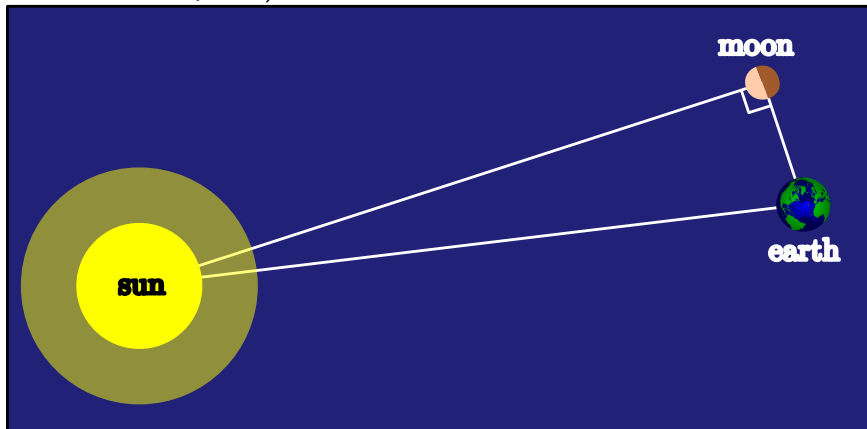
**5.2.058** A 450 ft guy wire is attached to the top of a communications tower. If the wire makes an angle of  $70^\circ$  with the ground, how tall is the communications tower? (Round your answer to the nearest foot.)

**5.2.060** A woman standing on a hill sees a flagpole that she knows is 35 ft tall. The angle of depression to the bottom of the pole is  $14^\circ$ , and the angle of elevation to the top of the pole is  $18^\circ$ . Find her distance  $x$  from the pole. (Round your answer to one decimal place.)



**5.2.062** An airplane is flying at an elevation of 5150 ft, directly above a straight highway. Two motorists are driving cars on the highway on opposite sides of the plane. The angle of depression to one car is  $32^\circ$ , and that to the other is  $57^\circ$ . How far apart are the cars? (Round your answer to the nearest foot.)

**5.2.067** When the moon is exactly half full, the earth, moon, and sun form a right angle (see the figure). At that time the angle formed by the sun, earth, and moon (using the earth as its vertex) is measured to be  $89.85^\circ$ . If the distance from the earth to the moon is 240,000 mi, estimate the distance from the earth to the sun. (Round your answer to one decimal place.)



## Chapter 5 Section 3



**5.3.039** Find the quadrant in which  $\theta$  lies from the information given.

$$\sec(\theta) > 0 \text{ and } \tan(\theta) < 0$$

**5.3.047** Find the values of the trigonometric functions of  $\theta$  from the information given.

$$\sin \theta = -\frac{15}{17}, \quad \theta \text{ in Quadrant IV}$$

1.  $\cos \theta =$

2.  $\tan \theta =$

3.  $\csc \theta =$

4.  $\sec \theta =$

5.  $\cot \theta =$

**5.3.052** Find the values of the trigonometric functions of  $\theta$  from the information given.

$$\cot \theta = \frac{1}{2}, \quad \sin \theta < 0$$

1.  $\sin \theta =$

2.  $\cos \theta =$

3.  $\tan \theta =$

4.  $\csc \theta =$

5.  $\sec \theta =$

**5.3.005** Find the reference angle for the given angle.

1.  $100^\circ =$

2.  $220^\circ =$

3.  $280^\circ =$

**5.3.007** Find the reference angle for the given angle.

1.  $215^\circ =$

2.  $460^\circ =$

3.  $-95^\circ =$

**5.3.009** Find the reference angle for the given angle.

1.  $\frac{7\pi}{10} =$

2.  $\frac{11\pi}{8} =$

3.  $\frac{10\pi}{3} =$

**5.3.014** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

1.  $\sin 240^\circ =$

2.  $\cos 240^\circ =$

3.  $\tan 240^\circ =$

**5.3.026** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

$$\cos \frac{4\pi}{3} =$$



**5.3.029** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

$$\csc\left(-\frac{\pi}{6}\right) =$$

**5.3.023** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

1.  $\tan 840^\circ =$

2.  $\sin 840^\circ =$

3.  $\cos 840^\circ =$

**5.3.031** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

$$\sec\left(\frac{17\pi}{4}\right) =$$

1.  $\sin\left(\frac{17\pi}{4}\right) =$

2.  $\cos\left(\frac{17\pi}{4}\right) =$

3.  $\tan\left(\frac{17\pi}{4}\right) =$

**5.3.055** If  $\theta = \frac{\pi}{3}$ , find the value of each expression.

1.  $\sin(2\theta) =$

2.  $2 \sin(\theta) =$

**5.3.056** If  $\theta = \frac{\pi}{3}$ , find the value of each expression.

1.  $\sin^2(\theta) =$

2.  $\sin(\theta^2) =$

## Chapter 6 Section 1

## 6.1.001

1. The unit circle is the circle centered at what point and with what radius?
  
  
  
  
  
  
  
  
  
  
2. The equation of the unit circle is?
  
  
  
  
  
  
  
  
  
  
3. Suppose the point  $P(x, y)$  is on the unit circle. Find the missing coordinate.
  - 3.1  $P(1, \underline{\hspace{1cm}})$
  - 3.2  $P(\underline{\hspace{1cm}}, 1)$
  - 3.3  $P(-1, \underline{\hspace{1cm}})$
  - 3.4  $P(\underline{\hspace{1cm}}, -1)$

## 6.1.002

1. If we mark off a distance  $t$  along the unit circle, starting at  $(1, 0)$  and moving in a counterclockwise direction, we arrive at the reference, quadrant, terminal point determined by  $t$ .
2. What are the terminal points determined by  $\frac{\pi}{2}, \pi, \frac{-\pi}{2}, 2\pi$ ?

$$\frac{\pi}{2}: (x, y) = (\_, \_)$$

$$\pi: (x, y) = (\_, \_)$$

$$-\frac{\pi}{2}: (x, y) = (\_, \_)$$

$$\pi: (x, y) = (\_, \_)$$



**6.1.004** Show that the point is on the unit circle.

$$\left(-\frac{7}{25}, -\frac{24}{25}\right)$$

**6.1.010** Find the missing coordinate of  $P$ , using the fact that  $P$  lies on the unit circle in the given quadrant.

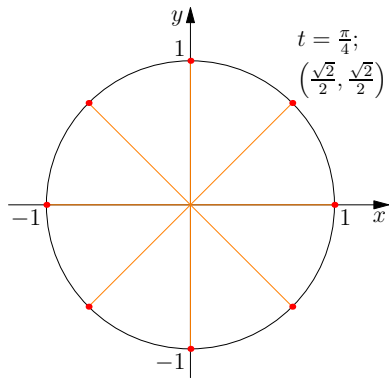
Coordinates	Quadrant
$P \left( \underline{\hspace{1cm}}, -\frac{15}{17} \right)$	$IV$

**6.1.016** The point  $P$  is on the unit circle. Find  $P(x, y)$  from the given information.

The  $y$ -coordinate of  $P$  is  $-\frac{3}{5}$ , and the  $x$ -coordinate is positive.

$$P(x, y) = \left( \underline{\hspace{1cm}}, \underline{\hspace{1cm}} \right)$$

# 6.1.021



$t$	Terminal Point
0	$\left(\underline{\hspace{1cm}}, \underline{\hspace{1cm}}\right)$
$\frac{\pi}{4}$	$\left(\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}\right)$
	$\left(\underline{\hspace{1cm}}, \underline{\hspace{1cm}}\right)$
	$\left(\underline{\hspace{1cm}}, \underline{\hspace{1cm}}\right)$
	$\left(\underline{\hspace{1cm}}, \underline{\hspace{1cm}}\right)$
$\vdots$	$\vdots$
$2\pi$	$\left(\underline{\hspace{1cm}}, \underline{\hspace{1cm}}\right)$

**6.1.024** Find the terminal point  $P(x, y)$  on the unit circle determined by the given value of  $t$ .

$$t = -3\pi$$

$$P(x, y) = \left( \underline{\hspace{1cm}}, \underline{\hspace{1cm}} \right)$$

**6.1.028** Find the terminal point  $P(x, y)$  on the unit circle determined by the given value of  $t$ .

$$t = \frac{5\pi}{6}$$

$$P(x, y) = \left( \underline{\hspace{1cm}}, \underline{\hspace{1cm}} \right)$$

**6.1.033** Find the terminal point  $P(x, y)$  on the unit circle determined by the given value of  $t$ .

$$t = -\frac{5\pi}{4}$$

$$P(x, y) = \left( \underline{\hspace{1cm}}, \underline{\hspace{1cm}} \right)$$

## Chapter 5 Section 3 Part Deux and Chapter 6 Section 2



### 5.3.003

1. If  $\theta$  is in standard position, then the reference angle  $\bar{\theta}$  is the acute angle formed by the terminal side of  $\theta$  and the  $x$ -axis,  $y$ -axis. So the reference angle for  $\theta = 100^\circ$  is  $\bar{\theta} = \underline{\hspace{2cm}}^\circ$ , and that for  $\theta = 210^\circ$  is  $\bar{\theta} = \underline{\hspace{2cm}}^\circ$ .
  
2. If  $\theta$  is any angle, the value of a trigonometric function of  $\theta$  is the same, except possibly for sign, as the value of the trigonometric function of  $\bar{\theta}$ . So  $\sin(100^\circ) = \sin(\underline{\hspace{2cm}}^\circ)$ , and  $\sin(210^\circ) = -\sin(\underline{\hspace{2cm}}^\circ)$ .

**5.3.025** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

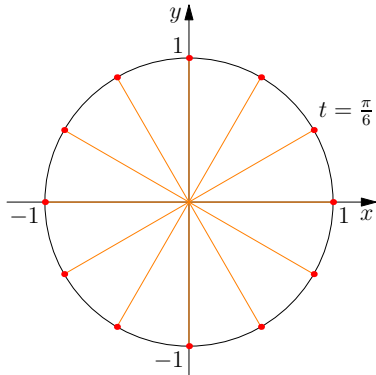
$$\sin\left(\frac{3\pi}{2}\right)$$

**5.3.035** Find the exact value of the trigonometric function. (If an answer is undefined, enter UNDEFINED.)

$$\tan\left(\frac{5\pi}{2}\right)$$

**6.2.004** Find  $\sin(t)$  and  $\cos(t)$  for the values of  $t$  whose terminal points are shown on the unit circle in the figure.  $t$  increases in increments of  $\frac{\pi}{6}$ .

$t$	$\sin(t)$	$\cos(t)$
0		
$\frac{\pi}{6}$		
$\frac{\pi}{3}$		
$\frac{\pi}{2}$		
$\frac{2\pi}{3}$		
$\frac{5\pi}{6}$		
$\vdots$	$\vdots$	$\vdots$
$2\pi$		



**6.2.006** Find the exact value of the trigonometric function at the given **real number**.

1.  $\sin\left(\frac{5\pi}{3}\right) =$

2.  $\cos\left(\frac{11\pi}{3}\right) =$

3.  $\tan\left(\frac{5\pi}{3}\right) =$

**6.2.023** Find the value of each of the six trigonometric functions (if it is defined) at the given real number  $t$ . Use your answers to complete the table. (If an answer is undefined, enter UNDEFINED.)

$$t = 0$$

$t$	$\sin t$	$\cos t$	$\tan t$	$\csc t$	$\sec t$	$\cot t$
0						

**6.2.028** The terminal point  $P(x, y)$  determined by a real number  $t$  is given. Find  $\sin(t)$ ,  $\cos(t)$ , and  $\tan(t)$ .

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

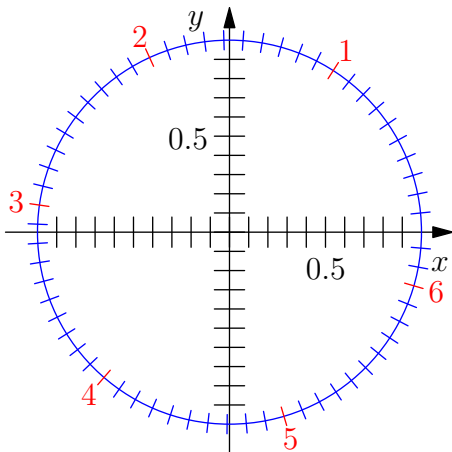
1.  $\sin(t) =$

2.  $\cos(t) =$

3.  $\tan(t) =$

**6.2.037** Find an approximate value of the given trigonometric function by using the figure and a calculator.

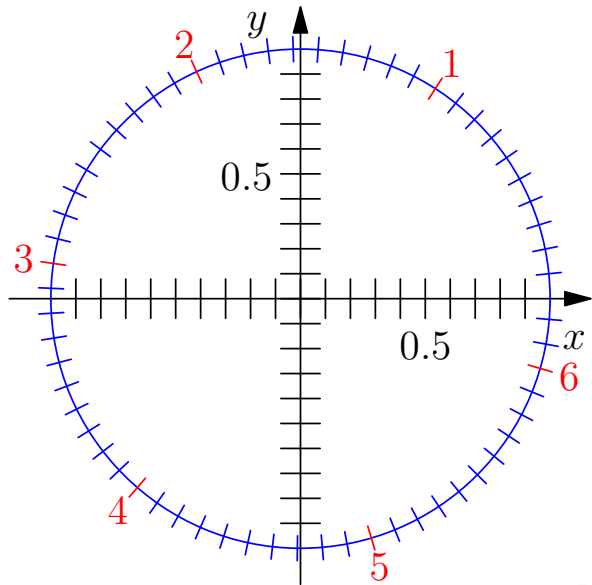
$$\sin(1)$$



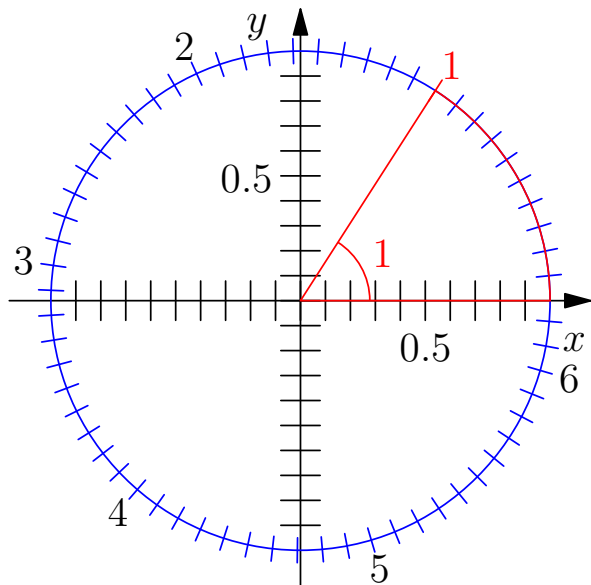
1. the figure (Round your answer to one decimal place.)
2. a calculator (Round your answer to four decimal places.)



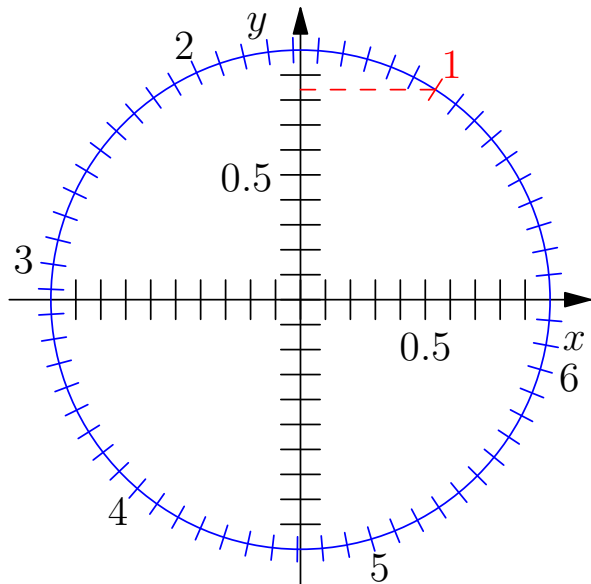
**6.2.037 b** Find  $\sin(1)$ :



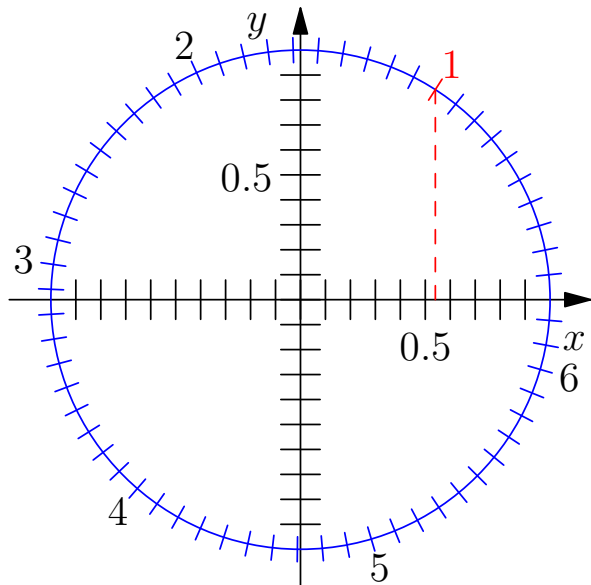
**6.2.037 c** Find  $\sin(1)$ :  $\theta = 1$



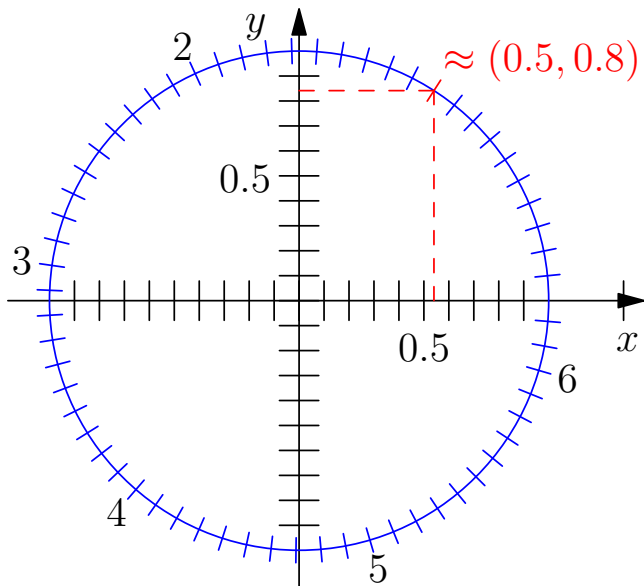
**6.2.037 d** Find  $\sin(1) =$



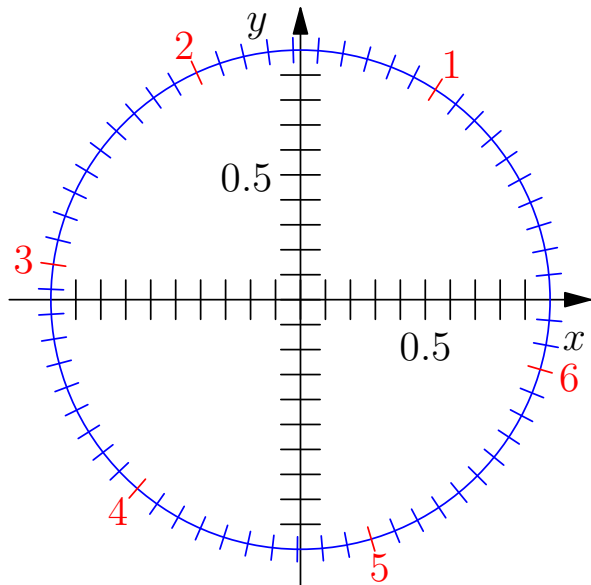
**6.2.037 e** Find  $\cos(1) =$



**6.2.037 f** Find  $(\cos(1), \sin(1)) \approx (0.5, 0.8)$ :



**6.2.038** Find  $\cos(0.3)$ :



**5.3.041** Write the first trigonometric function in terms of the second for  $\theta$  in the given quadrant.

$$\tan(\theta), \cos(\theta); \quad \theta \text{ in Quadrant II}$$

$$\tan(\theta) =$$

**5.3.043** Write the first trigonometric function in terms of the second for  $\theta$  in the given quadrant.

$$\cos(\theta), \sin(\theta); \quad \theta \text{ in Quadrant II}$$

$$\cos(\theta) =$$



**5.3.044** Write the first trigonometric function in terms of the second for  $\theta$  in the given quadrant.

$$\sec(\theta), \sin(\theta); \quad \theta \text{ in Quadrant I}$$

$$\sec(\theta) =$$

**6.2.045** Find the sign of the expression if the terminal point determined by  $t$  is in the given quadrant.

$$\sin(t) \cos(t), \quad \text{Quadrant II}$$

► positive

► negative

**5.3.004** The area  $\mathcal{A}$  of a triangle with sides of lengths  $a$  and  $b$  and with included angle  $\theta$  is given by the formula

$$\mathcal{A} =$$

So the area of the triangle with sides 4 and 7 and included angle  $\theta = 30^\circ$  is

**5.3.057** Find the area of a triangle with the given description. (Round your answer to one decimal place.)

a triangle with sides of length 7 and 8 and included angle  $76^\circ$

**5.3.059** Find the area of a triangle with the given description. (Round your answer to one decimal place.)

an equilateral triangle with side of length 10

**6.1.059** Suppose that the terminal point determined by  $t$  is the point

$$\left(\frac{4}{5}, \frac{3}{5}\right)$$

on the unit circle. Find the terminal point determined by each of the following.

a)  $\pi - t$

$$(x, y) = (\underline{\hspace{1cm}}, \underline{\hspace{1cm}})$$

b)  $-t$

$$(x, y) = (\underline{\hspace{1cm}}, \underline{\hspace{1cm}})$$

c)  $\pi + t$

$$(x, y) = (\underline{\hspace{1cm}}, \underline{\hspace{1cm}})$$

d)  $2\pi + t$

$$(x, y) = (\underline{\hspace{1cm}}, \underline{\hspace{1cm}})$$

## Chapter 6 Section 3 Unshifted

Graph  $y = \sin t$



Graph  $y = \sin 2t$

Graph  $y = -2 \sin t$

Graph  $x = \cos t$

Graph  $x = 3 \cos \left( \frac{1}{2}t \right)$

## Test 1 Spring 2025

## Chapter 5 Section 4

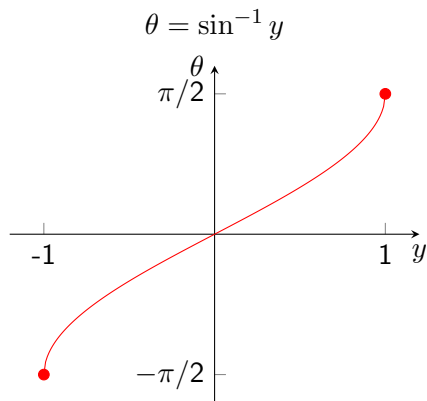
## Calculator Buttons

The inverse trigonometric functions are labeled in one of three possible ways on your calculator<sup>1</sup>:

Function	Group 1	Group 2	Group 3
$\sin^{-1} \theta$	asin	arcsin	$\sin^{-1}$
$\cos^{-1} \theta$	acos	arccos	$\cos^{-1}$
$\tan^{-1} \theta$	atan	arctan	$\tan^{-1}$

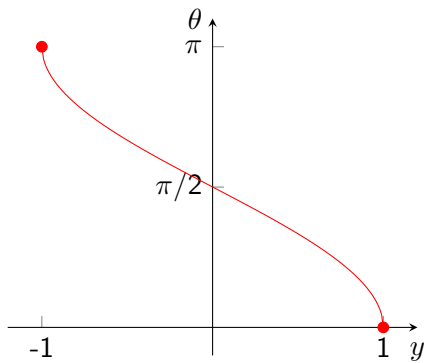
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<sup>1</sup>These are the only labels that I've ever seen.

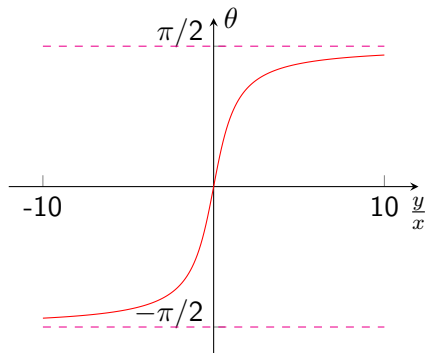




$$\theta = \cos^{-1} x$$



$$\theta = \tan^{-1} \frac{y}{x}$$



**5.4.006** Find the exact value of each expression, if it is defined. Express your answer in radians. (If an answer is undefined, enter UNDEFINED.)

1.  $\sin^{-1}(0)$

2.  $\cos^{-1}(-1)$

3.  $\tan^{-1}(0)$

**5.4.008** Find the exact value of each expression, if it is defined. Express your answer in radians. (If an answer is undefined, enter UNDEFINED.)

1.  $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

2.  $\cos^{-1}\left(-\frac{1}{2}\right)$

3.  $\tan^{-1}(-\sqrt{3})$

**5.4.011** Use a calculator to find an approximate value (in radians) of the expression rounded to five decimal places, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\cos^{-1}\left(\frac{1}{8}\right)$$

**5.4.024'** Use a calculator to find an approximate value (in radians) of the expression rounded to five decimal places, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\cos^{-1}\left(\frac{3}{8}\right)$$

**5.4.028'** Use a calculator to find an approximate value (in radians) of the expression rounded to five decimal places, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\sin^{-1}\left(\frac{2}{9}\right)$$

**5.4.030** Find the exact value of the expression.

$$\cos \left( \tan^{-1} \left( \frac{12}{5} \right) \right)$$



**5.4.032** Find the exact value of the expression.

$$\csc \left( \cos^{-1} \left( \frac{3}{5} \right) \right)$$

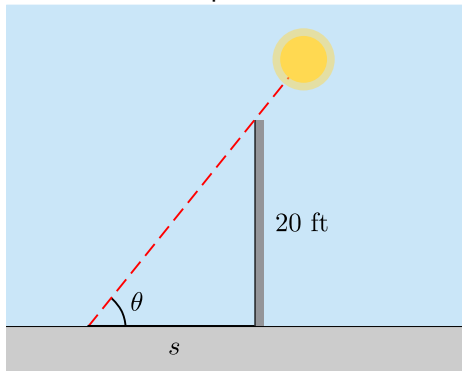
**5.4.033** Find the exact value of the expression.

$$\tan \left( \sin^{-1} \left( \frac{12}{13} \right) \right)$$

**5.4.035** Rewrite the expression as an algebraic expression in  $x$ .

$$\cos(\sin^{-1}(x))$$

**5.4.042** A 20 ft pole casts a shadow as shown in the figure.



1. Express the angle of elevation  $\theta$  of the sun as a function of the length  $s$  of the shadow.

$\theta =$

2. Find the angle  $\theta$  of elevation of the sun when the shadow is 35 ft long. (Round your answer to one decimal place.)

$\theta =$

## Chapter 6 Section 5

**6.5.003** Find the exact value of each expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

1.  $\sin^{-1}(1) =$

2.  $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right) =$

3.  $\sin^{-1}(2) =$

**6.5.006** Find the exact value of each expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

1.  $\cos^{-1}\left(\frac{\sqrt{2}}{2}\right) = \cos^{-1}\left(\frac{1}{\sqrt{2}}\right) =$

2.  $\cos^{-1}(1) =$

3.  $\cos^{-1}\left(-\frac{\sqrt{2}}{2}\right) =$

**6.5.008** Find the exact value of each expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

1.  $\tan^{-1}(0) =$

2.  $\tan^{-1}(-\sqrt{3}) =$

3.  $\tan^{-1}\left(-\frac{\sqrt{3}}{3}\right) = \tan^{-1}\left(-\frac{1}{\sqrt{3}}\right) =$



**6.5.014** Use a calculator (in radian mode) to find an approximate value of the expression correct to five decimal places, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\cos^{-1}\left(\frac{2}{9}\right)$$

**6.5.027** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\sin \left( \sin^{-1} \left( \frac{8}{3} \right) \right)$$

**6.5.028** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\tan \left( \tan^{-1} \left( \frac{7}{2} \right) \right)$$

**6.5.030** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\sin \left( \sin^{-1} \left( -\frac{1}{8} \right) \right)$$

**6.5.032** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\cos^{-1} \left( \cos \left( \frac{\pi}{3} \right) \right)$$

**6.5.033** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\sin^{-1} \left( \sin \left( \frac{3\pi}{4} \right) \right)$$

**6.5.042** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\sin^{-1} \left( \sin \left( \frac{11\pi}{4} \right) \right)$$

**6.5.045** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\cos \left( \sin^{-1} \left( \frac{1}{2} \right) \right)$$



**6.5.A** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\cos^{-1} \left( \cos \left( \frac{7\pi}{6} \right) \right)$$

**6.5.B** Find the exact value of the expression, if it is defined. (If an answer is undefined, enter UNDEFINED.)

$$\tan^{-1} \left( \tan \left( \frac{7\pi}{4} \right) \right)$$

## Chapter Ch 7.4

**7.4.006** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\sin(\theta) = -\frac{1}{2}$$

**7.4.017** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\cos \theta = -\frac{\sqrt{2}}{2}$$

1.  $\theta =$

2. List six specific solutions.

**7.4.021** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\cos \theta = 0.76$$

1.  $\theta =$

2. List six specific solutions.

**7.4.016** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\tan \theta = \frac{-1}{3}$$

1.  $\theta =$

2. List six specific solutions.

**7.4.025** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\cos \theta + 1 = 0$$



**7.4.027** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\sqrt{2} \sin \theta + 1 = 0$$

**7.4.031** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\tan^2 \theta - 3 = 0$$

**7.4.033** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$4 \cos^2 \theta - 1 = 0$$

**7.4.038** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$3 \csc^2 \theta - 4 = 0$$

**7.4.041** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$4 \cos^2 \theta - 4 \cos \theta + 1 = 0$$

**7.4.046** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\sin^2 \theta - 3 \sin \theta - 4 = 0$$

**7.4.047** Solve the given equation. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to two decimal places where appropriate.)

$$\cos^2 \theta - \cos \theta - 6 = 0$$

## Chapter Ch 7.5 Basic



**7.5.017** An equation is given. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to three decimal places where appropriate. If there is no solution, enter NO SOLUTION.)

$$2 \cos(3\theta) = 1$$

1. Find all solutions of the equation.
2. Find the solutions in the interval  $[0, 2\pi)$ .

**7.5.020** An equation is given. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to three decimal places where appropriate. If there is no solution, enter NO SOLUTION.)

$$2 \cos(2\theta) - 1 = 0$$

1. Find all solutions of the equation.
2. Find the solutions in the interval  $[0, 2\pi)$ .

**7.5.023** An equation is given. (Enter your answers as a comma-separated list. Let  $k$  be any integer. Round terms to three decimal places where appropriate. If there is no solution, enter NO SOLUTION.)

$$\sin\left(\frac{\theta}{2}\right) - 1 = 0$$

1. Find all solutions of the equation.
2. Find the solutions in the interval  $[0, 2\pi)$ .

## Chapter 7.1

# Fundamental Identities

$\csc \theta = \frac{1}{\sin \theta}$ $\sec \theta = \frac{1}{\cos \theta}$ $\cot \theta = \frac{1}{\tan \theta}$	$\tan \theta = \frac{\sin \theta}{\cos \theta}$ $\tan \theta = \frac{\sec \theta}{\csc \theta}$ $\cot \theta = \frac{\cos \theta}{\sin \theta}$	$\sin^2 \theta + \cos^2 \theta = 1$ $\tan^2 \theta + 1 = \sec^2 \theta$ $1 + \cot^2 \theta = \csc^2 \theta$
$\sin(-\theta) = -\sin \theta$	$\cos(-\theta) = \cos \theta$	$\tan(-\theta) = -\tan \theta$
$\sin\left(\frac{\pi}{2} - \theta\right) = \cos \theta$	$\sec\left(\frac{\pi}{2} - \theta\right) = \csc \theta$	$\tan\left(\frac{\pi}{2} - \theta\right) = \cot \theta$

**Ex 1** Write the trigonometric expression in terms of sine and cosine, and then simplify.

$$7 \cos(t) \tan(t)$$

**Ex 2** Write the trigonometric expression in terms of sine and cosine, and then simplify.

$$\csc(\theta) \tan(\theta)$$

**Ex 3** Write the trigonometric expression in terms of sine and cosine, and then simplify.

$$\sec^2(x) - \tan^2(x)$$



**Ex 4** Write the trigonometric expression in terms of sine and cosine, and then simplify.

$$\frac{\tan \theta}{\sec \theta - \cos \theta}$$

**Ex 5** Write the trigonometric expression in terms of sine and cosine, and then simplify.

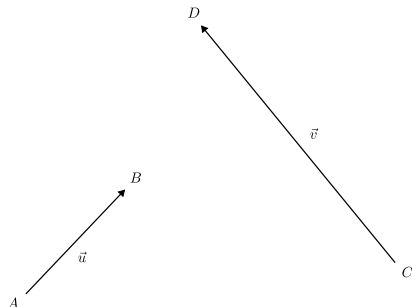
$$\cos^3(x) + \sin^2(x) \cos^2(x)$$

**Ex 6** Write the trigonometric expression in terms of sine and cosine, and then simplify.

$$\sin^4(\alpha) - \cos^4(\alpha) + \cos^2(\alpha)$$

## Chapter 9 Section 1

## 9.1.001 (a)



A vector in the plane is a line segment with an assigned direction.

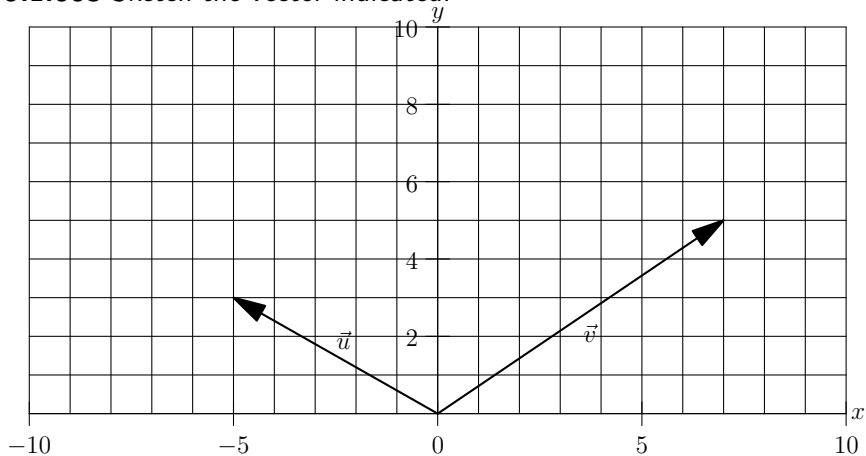
The vector  $\vec{u}$  has initial point \_\_\_\_ and terminal point \_\_\_\_.

Sketch the vectors  $\vec{u}$  and  $\vec{u} + \vec{v}$ .

## Definition 2 (Coordinate system)

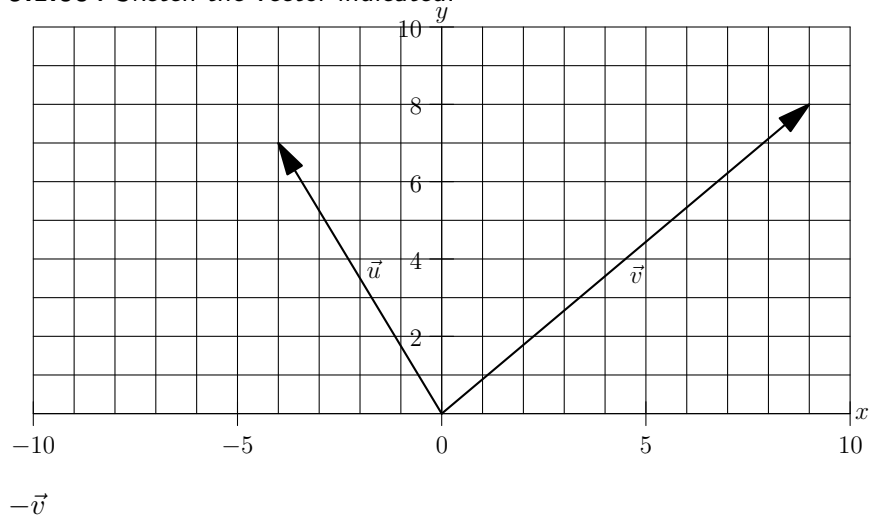
A coordinate system is a system that uses one or more numbers, or coordinates, to uniquely determine the position of the points or other geometric elements on a manifold.

9.1.003 Sketch the vector indicated.



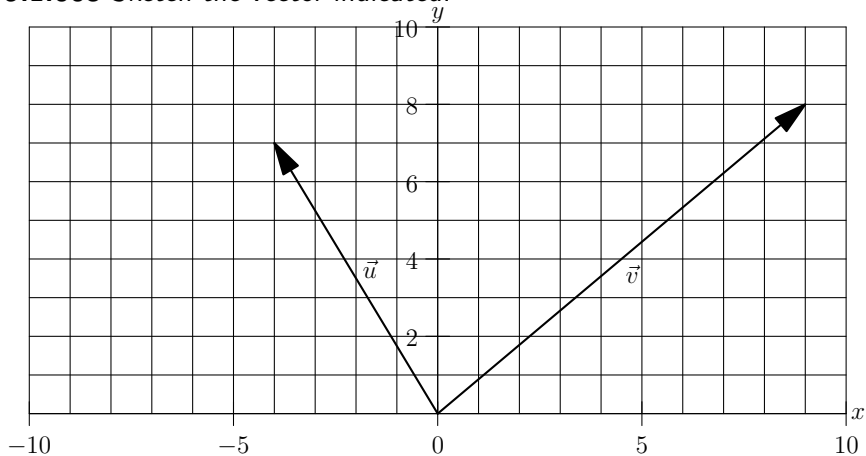
$2\vec{u}$

9.1.004 Sketch the vector indicated.



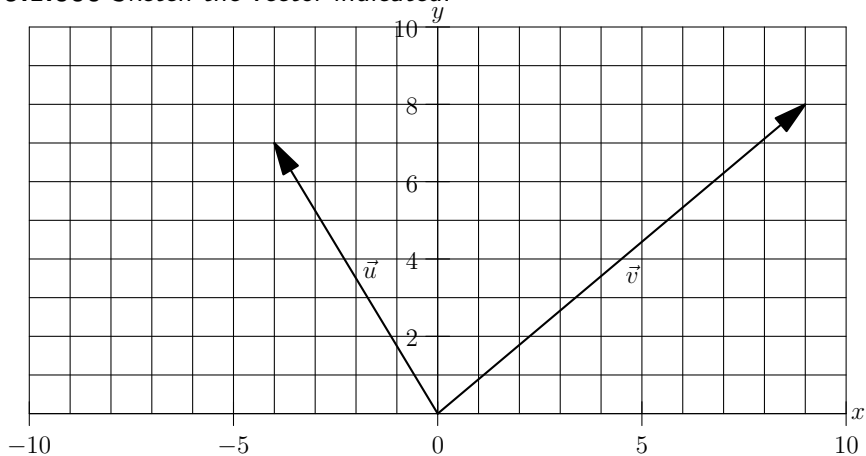


9.1.005 Sketch the vector indicated.



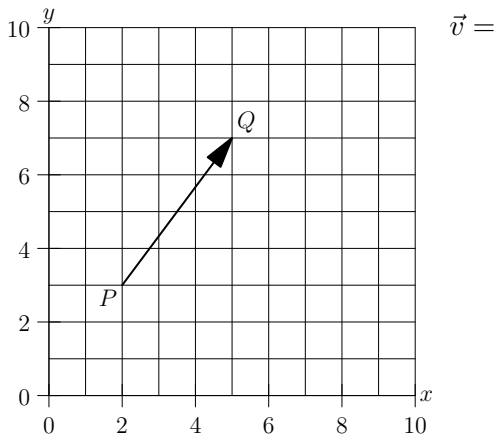
$$\vec{u} + \vec{v}$$

**9.1.006** Sketch the vector indicated.



$$\vec{u} - \vec{v}$$

**9.1.009** Express the vector  $\vec{v}$  with initial point  $P$  and terminal point  $Q$  in component form. (Assume that each point lies on the gridlines.)



**9.1.013** Express the vector  $\vec{v}$  with initial point  $P$  and terminal point  $Q$  in component form.

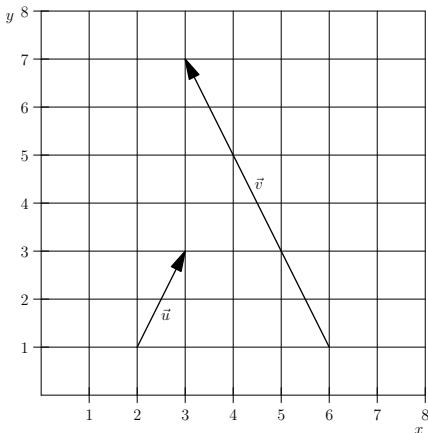
$$P(6, 3), \quad Q(8, 9)$$

**9.1.019** Sketch the given vector with initial point  $(4, 6)$ .

$$\vec{u} = \langle 3, 2 \rangle$$

And find the terminal point.

## 9.1.001 (b)



A vector in a coordinate plane is expressed by using components. The vector  $\vec{u}$  has initial point  $(x, y) = (\underline{\hspace{1cm}}, \underline{\hspace{1cm}})$  and terminal point  $(x, y) = (\underline{\hspace{1cm}}, \underline{\hspace{1cm}})$ . In component form we write  $\vec{u} = \underline{\hspace{1cm}}$  and  $\vec{v} = \underline{\hspace{1cm}}$ . Then  $2\vec{u} = \underline{\hspace{1cm}}$  and  $\vec{u} + \vec{v} = \underline{\hspace{1cm}}$ .

**9.1.023** Sketch representations of the given vector with initial points  $(0, 0)$ ,  $(2, 3)$ , and  $(-3, 5)$ .

$$\vec{u} = \langle 3, 4 \rangle$$

**9.1.027** Write the given vector in terms of  $\hat{i}$  and  $\hat{j}$ .

$$\vec{u} = \langle 1, 3 \rangle$$



**9.1.031** For the given vectors  $\vec{u}$  and  $\vec{v}$ . Find (Simplify your answers completely.)

$$\vec{u} = \langle 3, 7 \rangle, \quad \vec{v} = \langle 2, 5 \rangle$$

$$2\vec{u} =$$

$$-3\vec{v} =$$

$$\vec{u} + \vec{v} =$$

$$3\vec{u} - 4\vec{v} =$$

**9.1.033** For the given vectors  $\vec{u}$  and  $\vec{v}$ . Find (Simplify your answers completely.)

$$\vec{u} = \langle 0, -7 \rangle, \quad \vec{v} = \langle -3, 0 \rangle$$

$$2\vec{u} =$$

$$-3\vec{v} =$$

$$\vec{u} + \vec{v} =$$

$$3\vec{u} - 4\vec{v} =$$

**9.1.037** For the given vectors  $\vec{u}$  and  $\vec{v}$ . Find (Simplify your answers completely.)

$$\vec{u} = 3\hat{i} + \hat{j}, \quad \vec{v} = 4\hat{i} - 2\hat{j}$$

$$|\vec{v}| =$$

$$|2\vec{u}| =$$

$$|\vec{u} - \vec{v}| =$$

$$|\vec{u}| - |\vec{v}| =$$

**9.1.041** Find the horizontal and vertical components of the vector with the given length and direction, and write the vector in terms of the vectors  $\hat{i}$  and  $\hat{j}$ .

$$|\vec{v}| = 22, \quad \theta = 30^\circ$$

**9.1.047** Find the magnitude and direction (in degrees) of the vector.  
(Assume  $0^\circ \leq \theta < 360^\circ$ . Round the direction to two decimal places.)

$$v = \langle 3, 4 \rangle$$

**9.1.052** Find the magnitude and direction (in degrees) of the vector.  
(Assume  $0^\circ \leq \theta < 360^\circ$ . Round the direction to two decimal places.)

$$v = 3\hat{i} + 3\hat{j}$$

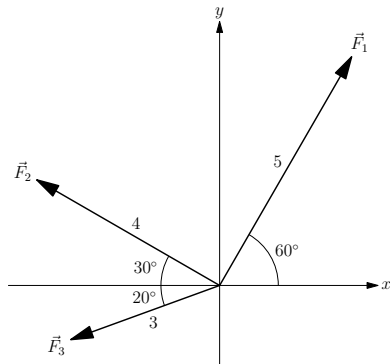
**9.1.056** A river flows due south at 1.6 mile/hour and a swimmer attempts to cross the river from the west side to the east side. In what direction should the swimmer head, at a velocity of 2 mile/hour, in order to arrive at a landing point due east of his starting point? (Round your answer to one decimal place.)

**9.1.067** The forces  $\vec{F}_1, \vec{F}_2, \dots, \vec{F}_n$  acting at the same point  $P$  are said to be in equilibrium if the resultant force is zero, that is, if  $\vec{F}_1 + \vec{F}_2 + \dots + \vec{F}_n = 0$ .

$$\vec{F}_1 = \langle 3, 4 \rangle, \quad \vec{F}_2 = \langle 4, -7 \rangle$$

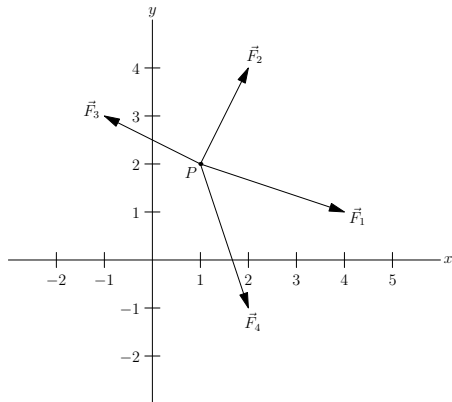


**9.1.071** The forces  $\vec{F}_1, \vec{F}_2, \dots, \vec{F}_n$  acting at the same point  $P$  are said to be in equilibrium if the resultant force is zero, that is, if  $\vec{F}_1 + \vec{F}_2 + \dots + \vec{F}_n = 0$ . (Round your answers to two decimal places.)



1. Find the resultant force acting at  $P$ .
2. Find the additional force required (if any) for the forces to be in equilibrium.

**9.1.072** The forces  $\vec{F}_1, \vec{F}_2, \dots, \vec{F}_n$  acting at the same point  $P$  are said to be in equilibrium if the resultant force is zero, that is, if  $\vec{F}_1 + \vec{F}_2 + \dots + \vec{F}_n = 0$ . (Round your answers to two decimal places.)



1. Find the resultant force acting at  $P$ .
2. Find the additional force required (if any) for the forces to be in equilibrium.

## Chapter 8 Section 1

**1** Plot the point that has the given polar coordinates.

$$\left(3, \frac{\pi}{3}\right)$$

2 Plot the point that has the given polar coordinates.

$$\left(1, \frac{\pi}{2}\right)$$

**3** Plot the point that has the given polar coordinates.

$$\left(2, -\frac{5\pi}{6}\right)$$

4 Plot the point that has the given polar coordinates.

$$\left(-3, \frac{7\pi}{6}\right)$$

**5** Plot the point that has the given polar coordinates.

$$\left(-2, -\frac{\pi}{6}\right)$$



6 For

$$\left(5, \frac{3\pi}{2}\right)$$

1. Plot the point that has the given polar coordinates.
2. Give two other polar coordinate representations of the point, one with  $r < 0$  and one with  $r > 0$ .

7 For

$$\left(1, -\frac{5\pi}{4}\right)$$

1. Plot the point that has the given polar coordinates.
2. Give two other polar coordinate representations of the point, one with  $r < 0$  and one with  $r > 0$ .

8 For

$$\left(-2, \frac{7\pi}{4}\right)$$

1. Plot the point that has the given polar coordinates.
2. Give two other polar coordinate representations of the point, one with  $r < 0$  and one with  $r > 0$ .

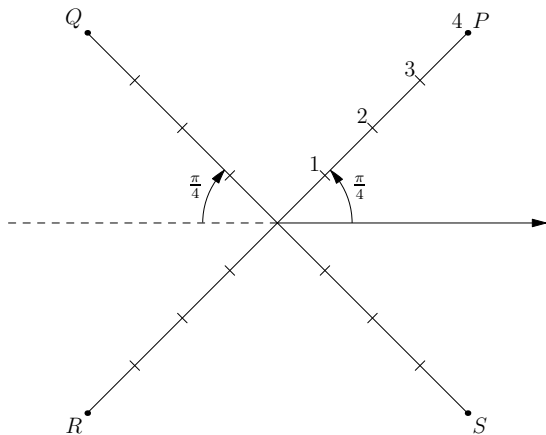
9 For

$$\left(-3, -\frac{2\pi}{3}\right)$$

1. Plot the point that has the given polar coordinates.
2. Give two other polar coordinate representations of the point, one with  $r < 0$  and one with  $r > 0$ .

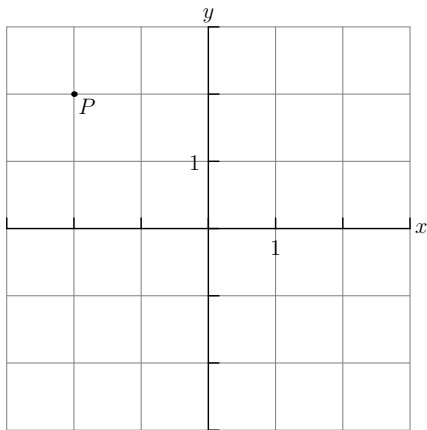
**8.1.018.MI** Determine which point in the figure,  $P$ ,  $Q$ ,  $R$ , or  $S$ , has the given polar coordinates.

$$\left(4, -\frac{3\pi}{4}\right)$$



**8.1.025** A point is graphed in rectangular form. Find polar coordinates for the point, with  $r > 0$  and  $0 \leq \theta < 2\pi$ .

$$(r, \theta) =$$



**10** Find the rectangular coordinates for the point whose polar coordinates are given.

$$\left(8, \frac{\pi}{4}\right)$$

**11** Find the rectangular coordinates for the point whose polar coordinates are given.

$$\left(7, \frac{5\pi}{3}\right)$$



**12** Find the rectangular coordinates for the point whose polar coordinates are given.

$$\left(17, \frac{25\pi}{6}\right)$$

**13** Find the rectangular coordinates for the point whose polar coordinates are given.

$$(3, 3\pi)$$

**14** Find the rectangular coordinates for the point whose polar coordinates are given.

$$(2, 5)$$

**15** Convert the rectangular coordinates to polar coordinates with  $r > 0$  and  $0 \leq \theta < 2\pi$ .

$$(\sqrt{3}, 1)$$

**16** Convert the rectangular coordinates to polar coordinates with  $r > 0$  and  $0 \leq \theta < 2\pi$ .

$$(5\sqrt{2}, 5\sqrt{2})$$

**17** Convert the rectangular coordinates to polar coordinates with  $r > 0$  and  $0 \leq \theta < 2\pi$ .

$$(0, -3)$$

**18** Convert the rectangular coordinates to polar coordinates with  $r > 0$  and  $0 \leq \theta < 2\pi$ .

$$(-\sqrt{5}, \sqrt{15})$$

**19** Convert the rectangular coordinates to polar coordinates with  $r > 0$  and  $0 \leq \theta < 2\pi$ .

$$(5, 12)$$



## Chapter 6 Section 3 Shifted

# 1

(a) Graph  $y = x^2$

(b) Graph  $y = (x - 1)^2$

**2** Graph  $y = \sin\left(t - \frac{\pi}{4}\right)$

**3** Graph  $y = 5 \sin \left( 2t - \frac{\pi}{3} \right)$

**4** Graph  $x = 2 \cos \left( \frac{1}{2}t - \frac{5\pi}{6} \right)$

## 5 Graph $y = \sin\left(t + \frac{\pi}{2}\right)$

**6** Graph  $x = \cos\left(\pi t + \frac{\pi}{4}\right)$

**7** Find the period and phase shift of

$$y = 5 \sin \left( 2t - \frac{\pi}{3} \right)$$



Let  $k > 0$ :

	$y = A \sin(B\theta + C)$	$y = a \sin[k(\theta - b)]$
Period	$B\theta + C = 0 \quad B\theta + C = 2\pi$ $\theta_0 = -\frac{C}{B} \quad \theta_{2\pi} = \frac{2\pi - C}{B}$ $\theta_{2\pi} - \theta_0$ $= \frac{2\pi}{B} - \frac{C}{B} - \frac{C}{B}$ $= \frac{2\pi}{B}$	$= \frac{2\pi}{k}$
Phase shift	$-\frac{C}{B}$	$b$

## Chapter 6 Section 4

# 1 Graph $\frac{y}{x} = \tan \theta$

(a) Graph  $y = \csc t$

(b) Graph  $y = \sec t$

## Chapter Ch 7.3

Formulas for sine:

Formulas for sine:

$$\sin 2x = 2 \sin x \cos x$$

Formulas for sine:

$$\sin 2x = 2 \sin x \cos x$$

Formulas for cosine:



Formulas for sine:

$$\sin 2x = 2 \sin x \cos x$$

Formulas for cosine:

$$\cos 2x = \cos^2 x - \sin^2 x$$

Formulas for sine:

$$\sin 2x = 2 \sin x \cos x$$

Formulas for cosine:

$$\cos 2x = \cos^2 x - \sin^2 x$$

Formulas for tangent:

Formulas for sine:

$$\sin 2x = 2 \sin x \cos x$$

Formulas for cosine:

$$\cos 2x = \cos^2 x - \sin^2 x$$

Formulas for tangent:

No one cares!

Ex Find  $\sin(2x)$ ,  $\cos(2x)$ , and  $\tan(2x)$  from the given information.

$$\sin(x) = \frac{5}{13}, \quad x \in QI$$

Ex Find  $\sin(2x)$  and  $\cos(2x)$  from the given information.

$$\tan(x) = -\frac{4}{3}, \quad x \in QII$$

Ex Find  $\sin(2x)$  and  $\cos(2x)$  from the given information.

$$\tan(x) = -\frac{1}{2}, \quad \cos(x) > 0$$

## Half-Angle Formulas

## Half-Angle Formulas

$$\sin \frac{u}{2} = \pm \sqrt{\frac{1 - \cos u}{2}} \qquad \cos \frac{u}{2} = \pm \sqrt{\frac{1 + \cos u}{2}}$$



Ex Use an appropriate Half-Angle Formula to find the exact value of the expression.

$$\cos(22.5^\circ)$$

Ex Use an appropriate Half-Angle Formula to find the exact value of the expression.

$$\sin(75^\circ)$$

Ex Use an appropriate Half-Angle Formula to find the exact value of the expression.

$$\cos(105^\circ)$$

Ex Use an appropriate Half-Angle Formula to find the exact value of the expression.

$$\sin\left(\frac{5\pi}{12}\right)$$

Ex Use an appropriate Half-Angle Formula to find the exact value of the expression.

$$\cos\left(\frac{9\pi}{8}\right)$$

Ex Use an appropriate Half-Angle Formula to find the exact value of the expression.

$$\sin\left(\frac{13\pi}{12}\right)$$

Ex Simplify the expression by using a Double-Angle Formula or a Half-Angle Formula.

1.  $2 \sin(18^\circ) \cos(18^\circ)$

2.  $2 \sin(4\theta) \cos(4\theta)$

Ex Simplify the expression by using a Double-Angle Formula or a Half-Angle Formula.

1.  $\cos^2(32^\circ) - \sin^2(32^\circ)$

2.  $\cos^2(8\theta) - \sin^2(8\theta)$



Ex Find  $\sin\left(\frac{x}{2}\right)$  and  $\cos\left(\frac{x}{2}\right)$  from the given information.

$$\sin x = \frac{5}{13}, \quad 0^\circ < x < 90^\circ$$

Ex Find  $\sin\left(\frac{x}{2}\right)$  and  $\cos\left(\frac{x}{2}\right)$  from the given information.

$$\cos x = -\frac{4}{5}, \quad 180^\circ < x < 270^\circ$$

Ex Find  $\sin\left(\frac{x}{2}\right)$  and  $\cos\left(\frac{x}{2}\right)$  from the given information.

$$\sec x = \frac{3}{2}, \quad 270^\circ < x < 360^\circ$$

## Chapter Ch 7.2

**7.2.003** Use an Addition or Subtraction Formula to find the exact value of the expression, as demonstrated in Example 1.

$$\sin(75^\circ)$$

**7.2.005** Use an Addition or Subtraction Formula to find the exact value of the expression, as demonstrated in Example 1.

$$\cos(195^\circ)$$

**7.2.009** Use an Addition or Subtraction Formula to find the exact value of the expression, as demonstrated in Example 1.

$$\sin\left(\frac{43\pi}{12}\right)$$

**7.2.010** Use an Addition or Subtraction Formula to find the exact value of the expression, as demonstrated in Example 1.

$$\cos\left(\frac{29\pi}{12}\right)$$



**7.2.015** Use an Addition or Subtraction Formula to write the expression as a trigonometric function of one number.

$$\sin(17^\circ) \cos(28^\circ) + \cos(17^\circ) \sin(28^\circ)$$

Find its exact value.

**7.2.051** Find the exact value of the expression.

$$\sin \left( \cos^{-1} \left( \frac{1}{2} \right) + \tan^{-1}(1) \right)$$

**7.2.054** Find the exact value of the expression.

$$\sin \left( \cos^{-1} \left( \frac{2}{3} \right) - \tan^{-1} \left( \frac{1}{4} \right) \right)$$

## Chapter Ch 9.4 and 9.2

**9.4.003** Find the vector  $\vec{v}$  with initial point  $P$  and terminal point  $Q$ .

$$P(7, -1, 0), \quad Q(0, -2, 3)$$

**9.4.007** If the vector  $\vec{v}$  has initial point  $P$ , what is its terminal point?

$$\vec{v} = \langle 5, 6, -2 \rangle, \quad P(2, 0, 1)$$

**9.4.011** Find the magnitude of the given vector.

$$\langle -6, 2, 3 \rangle$$

### 9.4.015 Given

$$\vec{u} = \langle 2, -5, 4 \rangle, \vec{v} = \langle 0, 4, -1 \rangle$$

$$\vec{u} + \vec{v} =$$

$$\vec{u} - \vec{v} =$$

$$3\vec{u} - \frac{1}{2}\vec{v} =$$



**9.4.019** Express the given vector in terms of the unit vectors  $\hat{i}$ ,  $\hat{j}$ , and  $\hat{k}$ .

$$\langle 11, 0, 6 \rangle$$

**9.2.005** Consider the following.

$$\vec{u} = \langle 3, 0 \rangle, \quad \vec{v} = \langle 7, 1 \rangle$$

1. Find  $\vec{u} \cdot \vec{v} =$

2. Find the angle between  $\vec{u}$  and  $\vec{v}$  to the nearest degree.  
 $\theta =$

**9.2.006** Consider the following.

$$\vec{u} = \hat{i} + \sqrt{2}\hat{j}, \quad \vec{v} = -\sqrt{2}\hat{i} + \hat{j}$$

1. Find  $\vec{u} \cdot \vec{v} =$

2. Find the angle between  $\vec{u}$  and  $\vec{v}$  to the nearest degree.  
 $\theta =$

**9.2.015** Determine whether the given vectors are perpendicular.

$$\vec{u} = \langle 2, 4 \rangle, \quad \vec{v} = \langle -6, 3 \rangle$$

**9.2.018** Determine whether the given vectors are perpendicular.

$$\vec{u} = 4\hat{i}, \quad \vec{v} = -7\hat{j}$$

**9.4.025** Two vectors  $\vec{u}$  and  $\vec{v}$  are given. Find their dot product  $\vec{u} \cdot \vec{v}$ .

$$\vec{u} = \langle 2, 7, 0 \rangle, \quad \vec{v} = \left\langle \frac{1}{2}, -1, 10 \right\rangle$$

**9.4.027** Two vectors  $\vec{u}$  and  $\vec{v}$  are given. Find their dot product  $\vec{u} \cdot \vec{v}$ .

$$\vec{u} = 6\hat{i} - 6\hat{j} - 5\hat{k}, \quad \vec{v} = \frac{5}{6}\hat{i} + \frac{3}{2}\hat{j} - \hat{k}$$

**9.2.035** Find the work done by the force  $\vec{F}$  in moving an object from  $P$  to  $Q$ .

$$\vec{F} = 3\hat{i} - 2\hat{j}, \quad P(0, 0), \quad Q(3, 7)$$



**9.2.047** A lawn mower is pushed a distance of 100 ft along a horizontal path by a constant force of 55 lb. The handle of the lawn mower is held at an angle of  $30^\circ$  from the horizontal. Find the work done. (Round your answer to the nearest whole number.)

## Test 2 Spring 2025