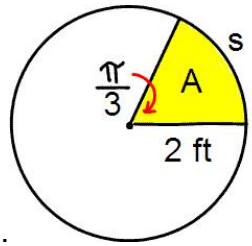
Angles and Their Measure		**Trig Worksheet 1**	
In problems 1-12, draw each angle.			
1. $30°$	2. $60°$	3. $135°$	4. $-120°$
5. $450°$	6. $540°$	7. $\frac{3\pi}{4}$	8. $\frac{4\pi}{3}$
9. $-\frac{\pi}{6}$	10. $-\frac{2\pi}{3}$	11. $\frac{16\pi}{3}$	12. $\frac{21\pi}{4}$
In problems 13-24, convert each angle in **degrees to radians**. Express your answer as a multiple of π.			
13. 30°	14. 120°	15. 240°	16. 330°
17. -60°	18. -30°	19. 180°	20. 270°
21. -135°	22. -225°	23. -90°	24. -180°
In problems 25-36, convert each angle in **radians to degrees**.			
25. $\frac{\pi}{3}$	26. $\frac{5\pi}{6}$	27. $-\frac{5\pi}{4}$	28. $-\frac{2\pi}{3}$
29. $\frac{\pi}{2}$	30. 4π	31. $\frac{\pi}{12}$	32. $\frac{5\pi}{12}$
33. $-\frac{\pi}{2}$	34. $-\pi$	35. $-\frac{\pi}{6}$	36. $-\frac{3\pi}{4}$
In Problems 37-44, **s** denotes the length of the arc of a circle of radius **r** subtended by the central angle **Θ**. Find the missing quantity. Round answers to three decimal places.			
37. r=10 meters, Θ=1/2 radian, s=?		38. r=6 feet, Θ=2 radians, s=?	
39. Θ=1/3 radian, s=2 feet, r=?		40. Θ=1/4 radian, s=6 cm, r=?	
41. r=5 miles, s=3 miles, Θ=?		42. r=6 meters, s=8 meters, Θ=?	
43. r=2 inches, Θ=30º, s=?		44. r=3 meters, Θ=120º, s=?	
In Problems 45-52, **A** denotes the area of a sector of a circle of radius **r** formed by the central angle **Θ**. Find the missing quantity. Round answers to three decimal places.			
45. r=10 meters, Θ=1/2 radian, A=?		46. r=6 feet, Θ=2 radians, A=?	
47. Θ=1/3 radian, A=2 sqft, r=?		48. Θ=1/4 radian, A=6 sqcm, r=?	
49. r=5 miles, A=3 sq miles, Θ=?		50. r=6 meters, A=8 sq meters, Θ=?	
51. r=2 inches, Θ=30º, A=?		52. r=3 meters, Θ=120º, A=?	

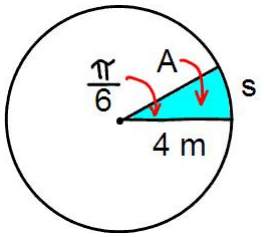
Angles and Their Measure	**Trig Worksheet 1**

In Problems 53-56, find the length **s** and area **A**. Round answers to 3 decimal places.

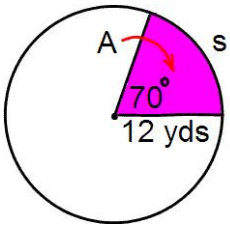
53.



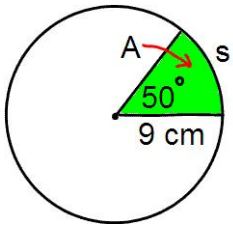
54.



55.



56.



In Problems 57-62, convert each angle in **degrees to radians**. Express your answer in decimal form, rounded to two decimal places.

57. 17º	58. 73º	59. -40º
60. -51º	61. 125º	62. 350º

In Problems 63-68, convert each angle in **radians to degrees**. Express your answer in decimal form, rounded to two decimal places.

63. 3.14	64. 0.75	65. 2
66. 3	67. 6.32	68. $\sqrt{2}$

In Problems 69-74, convert each angle to a **decimal in degrees**. Round your answer to two decimal places.

69. 4º 10’ 25”	70. 61º 42’ 21”	71. 1º 2’ 3”
72. 73º 40’ 40”	73. 9º 9’ 9”	74. 98º 22’ 45”

In Problems 75-80, convert each angle to **DºM’S”** form. Round your answer to the nearest second.

75. 40.32º	76. 61.24º	77. 18.255º
78. 29.411º	79. 19.99º	80. 44.01º

81. **Car Wheels**. The radius of each wheel of a car is 15 inches. If the wheels are turning at the rate of 3 revolutions per second, how fast is the car moving? Express your answer in inches per second and in miles per hour.

82. **Bicycle Wheels**. The diameter of each wheel of a bicycle is 26 inches. If you are traveling at a speed of 35 miles per hour on this bicycle, through how many revolutions per minute are the wheels turning?

83. **Watering a Lawn**. A water sprinkler sprays water over a distance of 30 feet while rotating through an angle of 135º. What area of lawn receives water?

84. **Movement of a pendulum**. A pendulum swings through an angle of 20º each second. If the pendulum is 40 inches long, how far does its tip move each second?

Unit Circle Approach		Trig Worksheet 2	
In problems 1-8, **t** is a real number and **P=(x,y)** is the point on the unit circle that corresponds to **t**. Find the exact values of the six trigonometric functions of **t**.			
1. $\frac{\sqrt{2}}{2}, \frac{1}{2}$	2. $\frac{1}{2}, -\frac{\sqrt{3}}{2}$	3. $-\frac{2}{5}, \frac{\sqrt{21}}{2}$	4. $-\frac{1}{5}, \frac{2\sqrt{6}}{5}$
5. $-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}$	6. $\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}$	7. $\frac{2\sqrt{2}}{3}, -\frac{1}{3}$	8. $-\frac{\sqrt{5}}{3}, -\frac{2}{3}$
In problems 9-18, find the exact value. Do not use a calculator.			
9. $\sin\frac{11\pi}{2}$	10. $\cos 7\pi$	11. $\tan 6\pi$	12. $\cot\frac{7\pi}{2}$
13. $\csc\frac{11\pi}{2}$	14. $\sec 8\pi$	15. $\sin\left(-\frac{3\pi}{2}\right)$	16. $\sin(-3\pi)$
17. $\sec(-\pi)$	18. $\tan(-3\pi)$		

In problems 19-38, find the exact values of each expression. Do not use a calculator.		
19. $\sin 45° + \cos 60°$	20. $\sin 30° - \cos 45°$	21. $\sin 90° + \tan 45°$
22. $\cos 180° + \sin 180°$	23. $\sin 45° \cos 60°$	24. $\tan 45° \cos 30°$
25. $5\cos 90° - 8\sin 270°$	26. $\sec 30° \cot 45°$	27. $4\sin 90° - 3\tan 180°$
28. $\sin 45° + \cos 60°$	29. $2\sin\frac{\pi}{3} - 3\tan\frac{\pi}{6}$	30. $2\sin\frac{\pi}{4} + 3\tan\frac{\pi}{4}$
31. $\sin\frac{\pi}{4} - \cos\frac{\pi}{4}$	32. $\tan\frac{\pi}{4} + \cos\frac{\pi}{3}$	33. $2\sec\frac{\pi}{4} + 4\cot\frac{\pi}{3}$
34. $3\csc\frac{\pi}{3} + \cot\frac{\pi}{4}$	35. $\tan\pi - \cos 0$	36. $\sin\frac{3\pi}{2} + \tan\pi$
37. $\csc\frac{\pi}{2} + \cot\frac{\pi}{2}$	38. $\sin\pi - \csc\frac{\pi}{2}$	

In problems 39-56, find the exact values of the six trigonometric functions of the given angle. If any are not defined, say "not defined." Do not use a calculator.			
39. $\frac{2\pi}{3}$	40. $\frac{5\pi}{6}$	41. $210°$	42. $240°$
43. $\frac{3\pi}{4}$	44. $\frac{11\pi}{4}$	45. $\frac{8\pi}{3}$	46. $\frac{13\pi}{6}$
47. $405°$	48. $390°$	49. $-\frac{\pi}{6}$	50. $-\frac{\pi}{3}$
51. $-45°$	52. $-60°$	53. $\frac{5\pi}{2}$	54. 5π
55. $720°$	56. $630°$		

Unit Circle Approach		Trig Worksheet 2	
In problems 57-72, use a calculator to find the approximate value of each expression rounded to two decimal places.			
57. $\sin 28°$	58. $\cos 14°$	59. $\tan 21°$	60. $\cot 70°$
61. $\sec 41°$	62. $\csc 55°$	63. $sin\frac{\pi}{10}$	64. $cos\frac{\pi}{8}$
65. $tan\frac{5\pi}{12}$	66. $cot\frac{\pi}{18}$	67. $sec\frac{\pi}{12}$	68. $csc\frac{5\pi}{13}$
69. $\sin 1$	70. $\tan 1$	71. $\sin 1°$	72. $\tan 1°$
In problems 73-82, a point on the terminal side of an angle Θ is given. Find the exact values of the six trigonometric functions of Θ.			
73. $(-3,4)$	74. $(5,-12)$	75. $(2,-3)$	76. $(-1,-2)$
77. $(-2,-2)$	78. $(1,-1)$	79. $(-3,-2)$	80. $(2,2)$
81. $\left(\frac{1}{3},-\frac{1}{4}\right)$	82. $(-0.3,-0.4)$		
83. Find the exact value of $\sin 45° + \sin 135° + \sin 225° + \sin 315°$.			
84. Find the exact value of $\tan 60° + \tan 150°$			
85. If $\sin\theta = 0.1$, find $\sin(\theta + \pi)$.		86. If $\cos\theta = 0.3$, find $\cos(\theta + \pi)$.	
87. If $\tan\theta = 3$, find $\tan(\theta + \pi)$.		88. If $\cot\theta = -2$, find $\cot(\theta + \pi)$.	
89. If $\sin\theta = \frac{1}{5}$, find $\csc\theta$.		90. If $\cos\theta = \frac{2}{3}$, find $\sec\theta$.	

Properties of Trig Functions	**Worksheet 3A**

In problems 1-16, use the fact that the trigonometric functions are periodic to find the exact value of each expression. Do not use a calculator.

1. $\sin 405°$	2. $\cos 420°$	3. $\tan 405°$	4. $\sin 390°$
5. $\csc 450°$	6. $\sec 540°$	7. $\cot 390°$	8. $\sec 420°$
9. $\cos\frac{33\pi}{4}$	10. $\sin\frac{9\pi}{4}$	11. $\tan(21\pi)$	12. $\csc\frac{9\pi}{2}$
13. $\sec\frac{17\pi}{4}$	14. $\cot\frac{17\pi}{4}$	15. $\tan\frac{19\pi}{6}$	16. $\sec\frac{25\pi}{6}$

In problems 17-24, name the quadrant in which the angle Θ lies.

17. $\sin\Theta > 0$, $\cos\Theta < 0$	18. $\sin\Theta < 0$, $\cos\Theta > 0$	19. $\sin\Theta < 0$, $\tan\Theta < 0$
20. $\cos\Theta > 0$, $\tan\Theta > 0$	21. $\cos\Theta > 0$, $\tan\Theta < 0$	22. $\cos\Theta < 0$, $\tan\Theta > 0$
23. $\sec\Theta < 0$, $\sin\Theta > 0$	24. $\csc\Theta > 0$, $\cos\Theta < 0$	

In problems 25-32, $\sin\Theta$ and $\cos\Theta$ are given. Find the exact value of each of the four remaining trigonometric functions.

25. $\sin\Theta = -\frac{3}{5}$, $\cos\Theta = \frac{4}{5}$	26. $\sin\Theta = \frac{4}{5}$, $\cos\Theta = -\frac{3}{5}$
27. $\sin\Theta = \frac{2\sqrt{5}}{5}$, $\cos\Theta = \frac{\sqrt{5}}{5}$	28. $\sin\Theta = -\frac{\sqrt{5}}{5}$, $\cos\Theta = -\frac{2\sqrt{5}}{5}$
29. $\sin\Theta = \frac{1}{2}$, $\cos\Theta = \frac{\sqrt{3}}{2}$	30. $\sin\Theta = \frac{\sqrt{3}}{2}$, $\cos\Theta = \frac{1}{2}$
31. $\sin\Theta = -\frac{1}{3}$, $\cos\Theta = \frac{2\sqrt{2}}{3}$	32. $\sin\Theta = \frac{2\sqrt{2}}{3}$, $\cos\Theta = -\frac{1}{3}$

In problems 33-48, find the exact value of each of the remaining trigonometric functions of Θ.

33. $\sin\Theta = \frac{12}{13}$, θ in quadrant II	34. $\cos\Theta = \frac{3}{5}$, θ in quadrant IV
35. $\cos\Theta = -\frac{4}{5}$, θ in quadrant III	36. $\sin\Theta = -\frac{5}{13}$, θ in quadrant III
37. $\sin\Theta = \frac{5}{13}$, $90° < \theta < 180°$	38. $\cos\Theta = \frac{4}{5}$, $270° < \theta < 360°$
39. $\cos\Theta = -\frac{1}{3}$, $\pi/2 < \theta < \pi$	40. $\sin\Theta = -\frac{2}{3}$, $\pi < \theta < 3\pi/2$
41. $\sin\Theta = \frac{2}{3}$, $\tan\theta < 0$	42. $\cos\Theta = -\frac{1}{4}$, $\tan\theta > 0$

Properties of Trig Functions	Worksheet 3A
43. $\sec\theta = 2,\ \sin\theta < 0$	44. $\csc\theta = 3,\ \cot\theta < 0$
45. $\tan\theta = 3/4,\ \sin\theta < 0$	46. $\cot\theta = 4/3,\ \cos\theta < 0$
47. $\tan\theta = -1/3,\ \sin\theta > 0$	48. $\sec\theta = -2,\ \tan\theta > 0$

In problems 49-66, use the even-odd properties to find the exact value of each expression. Do not use a calculator.

49. $\sin(-60)°$	50. $\cos(-30)°$	51. $\tan(-30)°$	52. $\sin(-135)°$
53. $\sec(-60)°$	54. $\csc(-30)°$	55. $\sin(-90)°$	56. $\cos(-270)°$
57. $\tan\left(-\frac{\pi}{4}\right)$	58. $\sin(-\pi)$	59. $\cos\left(-\frac{\pi}{4}\right)$	60. $\sin\left(-\frac{\pi}{3}\right)$
61. $\tan(-\pi)$	62. $\sin\left(-\frac{3\pi}{2}\right)$	63. $\csc\left(-\frac{\pi}{4}\right)$	64. $\sec(-\pi)$
65. $\sec\left(-\frac{\pi}{6}\right)$	66. $\csc\left(-\frac{\pi}{3}\right)$		

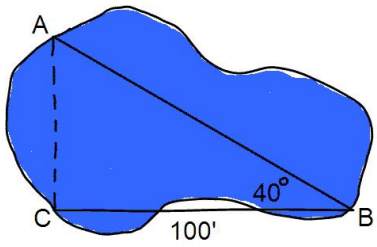
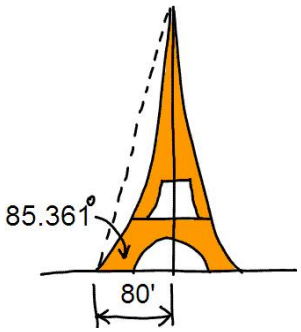
In problems 67-78, use the properties of the trigonometric functions to find the exact value of each expression. Do not use a calculator.

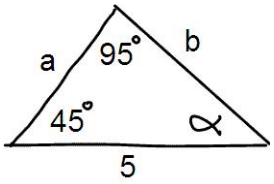
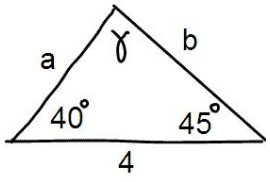
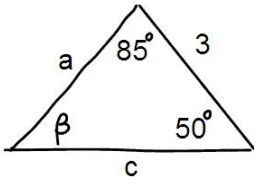
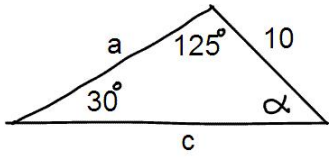
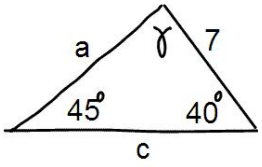
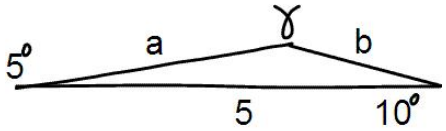
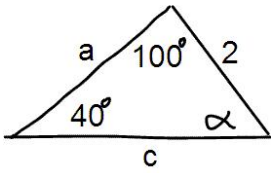
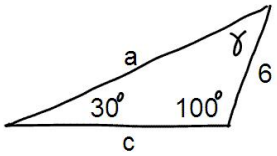
67. $\sin^2 40° + \cos^2 40°$	68. $\sec^2 10° - \tan^2 10°$	69. $\sin 80° \csc 80°$
70. $\tan 10° \cot 10°$	71. $\tan 40° - \frac{\sin 40°}{\cos 40°}$	72. $\cot 20° - \frac{\cos 20°}{\sin 20°}$
73. $\cos 400° \sec 40°$	74. $\tan 200° \cot 20°$	75. $\sin\left(-\frac{\pi}{12}\right)\csc\left(\frac{25\pi}{12}\right)$
76. $\sec\left(-\frac{\pi}{18}\right)\cos\left(\frac{37\pi}{18}\right)$	77. $\frac{\sin(-20°)}{\cos(380°)} + \tan 200°$	78. $\frac{\sin(70°)}{\cos(-430°)} + \tan(-70°)$

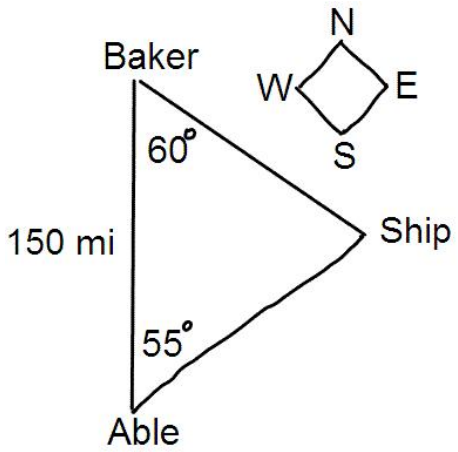
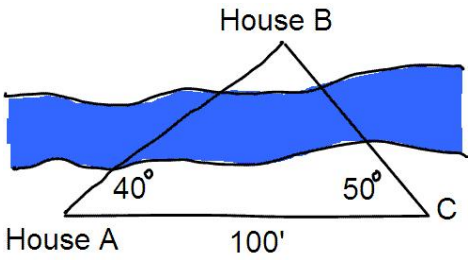
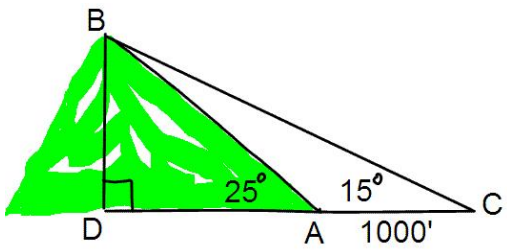
Properties of Trig Functions	**Worksheet 3B**
In problems 1-10, if necessary, refer to the graphs to answer each question.	
1.	What is the y-intercept of y=sin x?
2.	What is the y-intercept of y=cos x?
3.	For what numbers x, $-\pi \le x \le \pi$, is the graph of y=sin x increasing?
4.	For what numbers x, $-\pi \le x \le \pi$, is the graph of y=cos x increasing?
5.	What is the largest value of y=sin x?
6.	What is the smallest value of y=cos x?
7.	For what numbers x, $0 \le x \le 2\pi$, does sin x = 0?
8.	For what numbers x, $0 \le x \le 2\pi$, does cos x = 0?
9.	For what numbers x, $-2\pi \le x \le 2\pi$, does sin x = 1? What about sin x = -1?
10.	For what numbers x, $-2\pi \le x \le 2\pi$, does cos x = 1? What about cos x = -1?

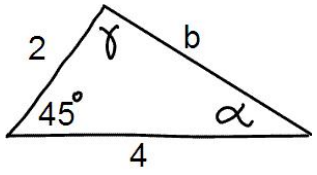
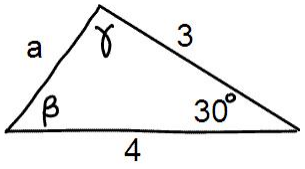
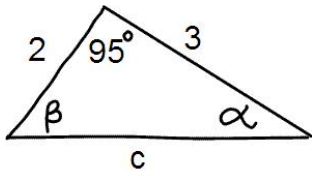
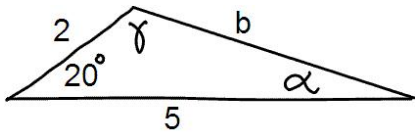
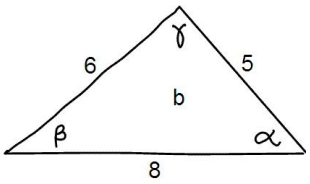
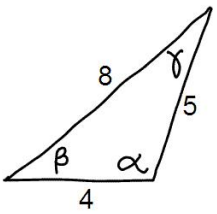
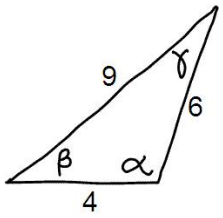
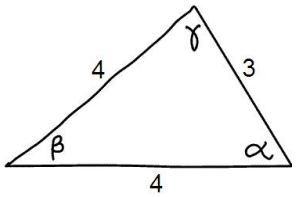
Properties of Trig Functions	**Worksheet 3C**
In problems 1-10, if necessary, refer to the graphs to answer each question.	
1.	What is the y-intercept of y=tan x?
2.	What is the y-intercept of y=cot x?
3.	What is the y-intercept of y=sec x?
4.	What is the y-intercept of y=csc x?
5.	For what numbers x, $-2\pi \le x \le 2\pi$, does sec x = 1? What about sec x = -1?
6.	For what numbers x, $-2\pi \le x \le 2\pi$, does csc x = 1? What about csc x = -1?
7.	For what numbers x, $-2\pi \le x \le 2\pi$, does the graph of y=sec x have vertical asymptotes?
8.	For what numbers x, $-2\pi \le x \le 2\pi$, does the graph of y=csc x have vertical asymptotes?
9.	For what numbers x, $-2\pi \le x \le 2\pi$, does the graph of y=tan x have vertical asymptotes?
10.	For what numbers x, $-2\pi \le x \le 2\pi$, does the graph of y=cot x have vertical asymptotes?

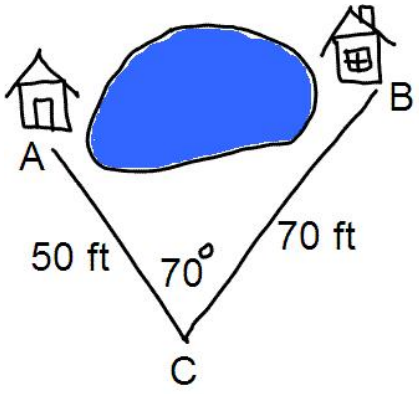
Trig Equations		**Worksheet 4**	
Solve each equation. Give a general formula for all the solutions and list four possible solutions.			
1. $\sin\Theta = -1/2$	2. $\tan\Theta = 1$	3. $\tan\Theta = \frac{-\sqrt{3}}{3}$	4. $\cos\Theta = \frac{-\sqrt{3}}{2}$
5. $\cos\Theta = 0$	6. $\sin\Theta = \frac{\sqrt{2}}{2}$	7. $\cos\Theta = 1/2$	8. $\sin\Theta = -1$
9. $\sin\Theta = \frac{-\sqrt{3}}{2}$	10. $\tan\Theta = -1$	11. $2\sin\Theta + 3 = 2$	12. $1 - \cos\Theta = 1/2$
13. $\sec\Theta = -2$	14. $\tan\Theta = \sqrt{3}$	15. $\cot\Theta = -\sqrt{3}$	16. $\cos\Theta + 1 = 0$
17. $\sqrt{3}\cot\Theta + 1 = 0$	18. $4\sec\Theta + 6 = -2$	19. $5\cos ec\Theta - 3 = 2$	20. $\sin\Theta = 0.4$
21. $3\sqrt{2}\cos\Theta + 2 = -1$		22. $\cos\Theta = -0.2$	

Right Triangle Trigonometry	Worksheet 5
1. A right triangle has a hypotenuse of length 8". If one angle is 35°, find the length of each leg.	
2. A right triangle contains a 25° angle. If one leg is of length 5", what is the length of the hypotenuse? (Hint: two answers are possible)	
3. The hypotenuse of a right triangle is 3'. If one leg is 1', find the degree measurement of each angle.	
4. Find the distance from A to C across the pond illustrated in the figure.	
5. A 22' extension ladder leaning against a building makes a 70° angle with the ground. How far up the building does the ladder reach.	
6. At 10:00am on April 26, 2000, a building 300 feet high casts a shadow 50' long. What is the angle of elevation of the Sun?	
7. The tallest tower built before the era of television masts, the Eiffel Tower was completed on March 31, 1889. Find the height of the Eiffel Tower (before a television mast was added to the top) using the information given in the illustration.	
8. A ship, offshore from a vertical cliff known to be 100' in height, takes a sighting of the top of the cliff. If the angle of elevation is found to be 25°, how far offshore is the ship?	
9. Suppose that you are headed toward a plateau 50 meters high. If the angle of elevation to the top of the plateau is 20°, how far are you from the base of the plateau?	
10. A ship is just offshore of new York City. A sighting is taken of the Statue of Liberty, which is about 305' tall. If the angle of elevation to the top of the statue is 20°, how far is the ship from the base of the statue?	

Trigonometry – Sine Rule			Worksheet 6
	Problems 1-8: solve each triangle.		
1.		2.	
3.		4.	
5.		6.	
7.		8.	
	Problems 9-16: solve each triangle.		
9.	$\alpha=40°,\ \beta=20°,\ a=2$	10.	$\alpha=50°,\ \gamma=20°,\ a=3$
11.	$\beta=70°,\ \gamma=10°,\ b=5$	12.	$\alpha=70°,\ \beta=60°,\ c=4$
13.	$\alpha=110°,\ \gamma=30°,\ c=3$	14.	$\beta=10°,\ \gamma=100°,\ b=2$
15.	$\alpha=40°,\ \beta=40°,\ c=2$	16.	$\beta=20°,\ \gamma=70°,\ a=1$
	Problems 17-28: two sides and an angle are given. Determine whether the given information results in one triangle, two triangles, or no triangle at all. Solve any triangle(s) that result(s).		
17.	$a=3,\ b=2,\ \alpha=50°$	18.	$b=4,\ c=3,\ \beta=40°$
19.	$b=5,\ c=3,\ \beta=100°$	20.	$a=2,\ c=1,\ \alpha=120°$
21.	$a=4,\ b=5,\ \alpha=60°$	22.	$b=2,\ c=3,\ \beta=40°$
23.	$b=4,\ c=6,\ \beta=20°$	24.	$a=3,\ b=7,\ \alpha=70°$
25.	$a=2,\ c=1,\ \gamma=100°$	26.	$b=4,\ c=5,\ \beta=95°$
27.	$a=2,\ c=1,\ \gamma=25°$	28.	$b=4,\ c=5,\ \beta=40°$

Trigonometry – Sine Rule	Worksheet 6
Lesson	
29. Coast Guard station Able is located 150 miles due south of station Baker. A ship at sea sends an SOS call that is received by each station. The call to station Able indicates that the ship is located N55°E; the call to station Baker indicates that the ship is located S60°E. a) How far is each station from the ship? b) If a helicopter capable of flying 200 miles per hour is dispatched from the nearest station to the ship, how long will it take to reach the ship?	
30. Consult the figure. To find the distance from the house at A to the house at B, a surveyor measures the a ∠BAC to be 40° and then walks off a distance of 100' to C and measures the ∠ACB to be 50°. What is the distance from A to B?	
31. Consult the figure. To find the length of the span of a proposed ski lift from A to B, a surveyor measures the ∠DAB to be 25° and then walks off a distance of 1000' to C and measures the ∠ACB to be 15°. What is the distance from A to B?	

Trigonometry – Cosine Rule			Worksheet 7
	Problems 1-8: solve each triangle.		
1.		2.	
3.		4.	
5.		6.	
7.		8.	
	Problems 9-24: solve each triangle.		
9.	a=2, b=4, γ=40°	10.	a=2, c=1, β=10°
11.	b=1, c=3, α=80°	12.	a=6, b=4, γ=60°
13.	a=3, c=2, β=110°	14.	b=4, c=1, α=120°
15.	a=2, b=2, γ=50°	16.	a=3, c=2, β=90°
17.	a=12, b=13, c=5	18.	a=4, b=5, c=3
19.	a=2, b=2, c=2	20.	a=3, b=3, c=2
21.	a=5, b=8, c=9	22.	a=4, b=3, c=6
23.	a=10, b=8, c=5	24.	a=9, b=7, c=10

Trigonometry – Cosine Rule	Worksheet 7
25. Consult the figure at right. To find the distance from the house at A to the house at B, a surveyor measures the angle ACB, which is found to be 70°, and then walks off the distance to each house, 50 feet and 70 feet, respectively. How far apart are the houses?	
26. Navigation: An airplane flies from Ft. Myers to Sarasota, a distance of 150 miles, and then turns through an angle of 50° and flies to Orlando, a distance of 100 miles (per the figure at right). a) How far is it from Ft. Myers to Orlando? b) Through what angle should the pilot turn at Orlando to return to Ft. Myers?