8.4 Basic Trigonometric Functions
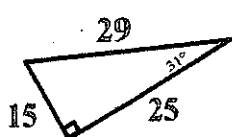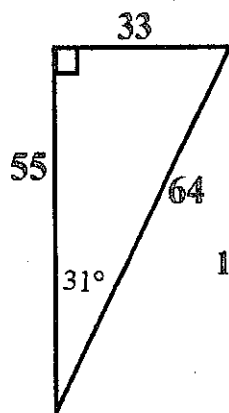
Write your questions here!

Trigonometric Ratios!

58
30
31°
50

70
?
31°

33
55
64
31°

29
31°
15
25

35
31°
41
21

Basic Trigonometric Functions

$\sin \theta =$

$\cos \theta =$

$\tan \theta =$

c
b
a
θ

$\sin =$

$\cos =$

$\tan =$

12
α
13
5

$\sin \alpha =$

$\cos \alpha =$

$\tan \alpha =$

8
15
β
17

$\sin \beta =$

$\cos \beta =$

$\tan \beta =$

Find missing side.
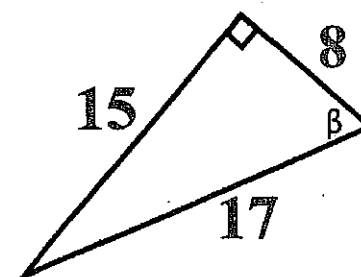
22

28°

x
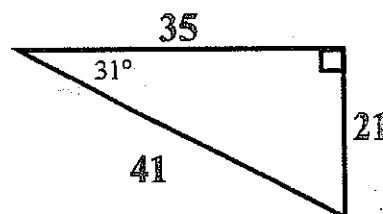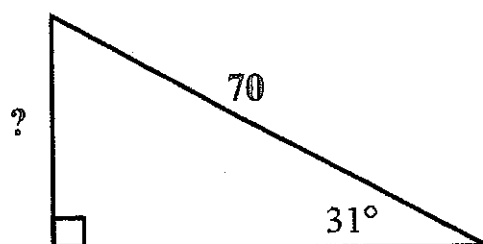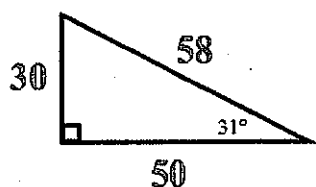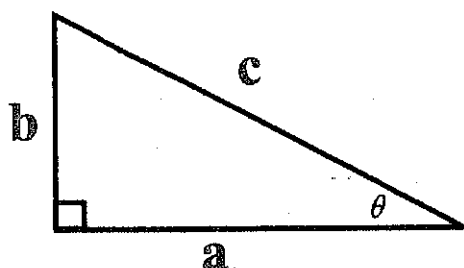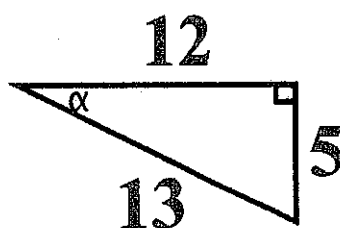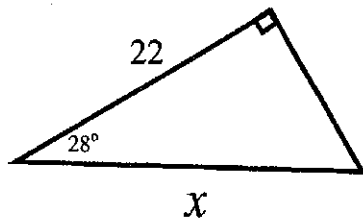
Find missing angle.

20

12

x

Solve

R

12

62°

D   E
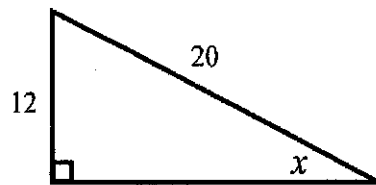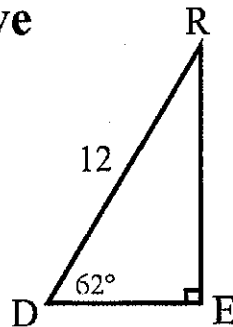
Angle of Elevation

Airplane takes of with an angle of elevation of
and raises to an altitude of 1500 ft.
How far is the plane from the airport via ground distance?

Angle of Depression

Line of Sight

Mr. Brust looks out his window with an angle of depression of 32 degrees
to and sees two kids fighting.
He decides to break up the fight if it is less than 50 meters away.
If his window is 28 meters from the ground, will he break up the fight?

SUMMARY:

Now, summarize your notes here!

8.4 Basic Trigonometric Functions

Find the value of the trig functions indicated.

1.

$sin\ \alpha =$

$tan\ \beta =$

2.

$cos\ \theta =$

$tan\ \theta =$

3.

$sin\ \alpha =$

$sin\ \beta =$

$tan\ \alpha =$

$cos\ \beta =$

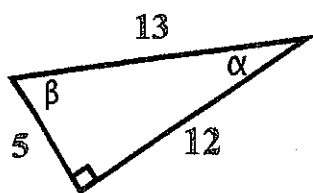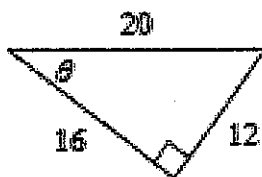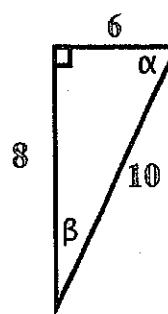## Find the measure of the indicated side. Round to the nearest hundredth.

4.

5.
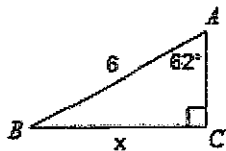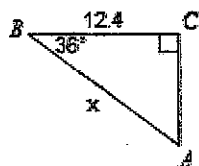
6. Given ΔDEF where $\angle D$ is a right angle. Find f if $m\angle E = 16°$ and $e = 4$. (Draw a picture!)

Find the measure of the indicated angle. Round to the nearest hundredth.

7.

8.
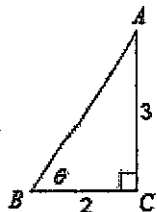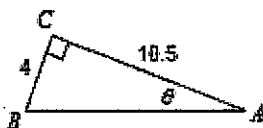
9. Given ΔDEF where $\angle D$ is a right angle. Find $m\angle E$ if $e = 11.7$ and $f = 8$. (Draw a picture!)

Solve each triangle. Round to the nearest hundredth.

10.

11.

12. Given ΔDEF where $\angle D$ is a right angle and $m\angle F = 35°$ and $d = 16$. (Draw a picture!)

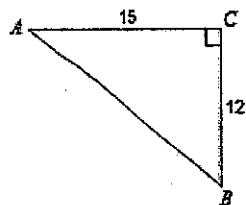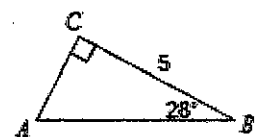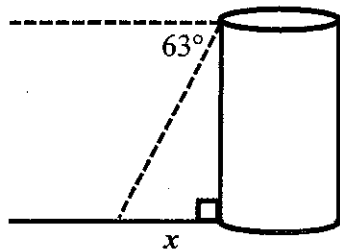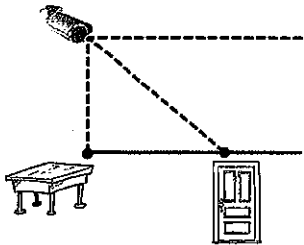| **Label the picture given and then solve it. If no picture is given, draw your own and solve!**	
13. The angle of depression is measured from the top of a 43 ft tower to a reference point on the ground. Its value is found to be 63°. How far is the base of the tower from the point on the ground?	14. The entrance of the old town library is 2.3 ft above ground level. A ramp from the ground level to the library entrance is scheduled to be built. The angle of elevation form the base of the ramp to its top is to be 15°. Find the length of the ramp
15. A closed circuit TV camera is mounted on a wall 7.4 ft above a security desk in an office building. It is used to view an entrance door 9.3 ft from the desk. Find the angle of depression from the camera lens to the entrance door.	16. A jet took off at a rate of 260 ft/s and climbed in a straight path for 3.2 min. What was the angle of elevation of its path if its final altitude was 12,000 ft?
17. The angle of elevation from the bottom of the world's largest slide located in Peru, Vermont, is approximately 10.3°. The slide has a vertical drop of 821 ft. Find the length of the slide.	18. The extension ladder on top of a 6 ft high hook and ladder truck is 150 ft long. If the angle of elevation of the ladder is 70°, to what height on a building will the ladder reach?
19. A rectangle is 14 cm wide and 48 cm long. Find the measure of the angles on either side of the diagonals.	20. The Statue of Liberty stands on a 150 ft pedestal. From a point 280 ft from the base of the pedestal, the angle of elevation to the top of Liberty's torch is 47°. Find the height of the statue.

1. $\dfrac{\frac{2}{5}}{\frac{3}{4}}$	2. $\dfrac{\frac{5}{8}}{\frac{\sqrt{3}}{8}}$	3. $\dfrac{1}{\left(\frac{\sqrt{3}}{2}\right)}$	4. $\dfrac{\left(\frac{\sqrt{3}}{4}\right)}{2\sqrt{2}}$

8.4 Basic Trigonometric Functions

APPLICATION

1. Solve the triangle. Round to the nearest hundredth.
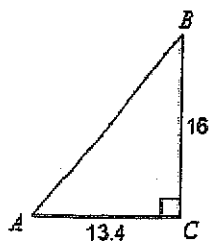
2. An isosceles trapezoid has sides whose lengths are 5, 5,8, and 14. Find all four angles of the trapezoid.

3. The Hersch Building and the County Hospital are 38 meters apart. From a window in the Hersch Building, the angle of elevation of the top of the hospital is 72.7°. From the same window the angle of depression to the ground at the base of the hospital is 63.21°. Find the height of the hospital.

4. An engineer determines that the angle of elevation from her position to the top of a tower is 52°. She measures the angle of elevation again from a point 47 m farther from the tower and finds it to be 31°. Both positions are due east of the tower. Find the height of the tower.

47 m
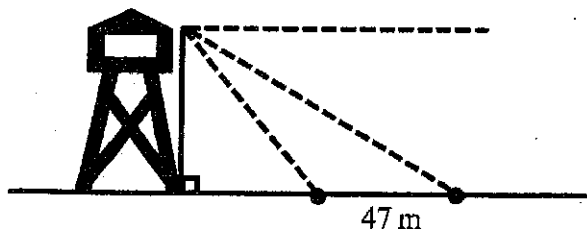
5. Given the trig ratio, draw a right triangle, label all sides, find the other 2 trig ratios. DO NOT FIND θ !

$$\sin \theta = \frac{9}{11}$$

6. Given the right triangle that connects the origin and the coordinate point (3, -4) shown below, find $\sin \alpha$.

7. Use a combination of trig and Pythagorean Theorem to find the exact value of the x and y coordinate for the circles below whose centers are the origin of the coordinate plane and radii are equal to one.
   (Answers must be expressed as exact value fractions, do not give approximate decimal values!)

a.

b.

c.
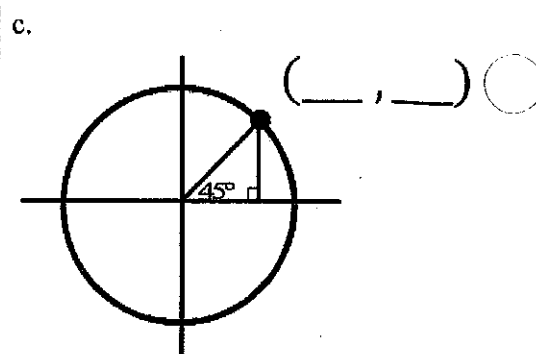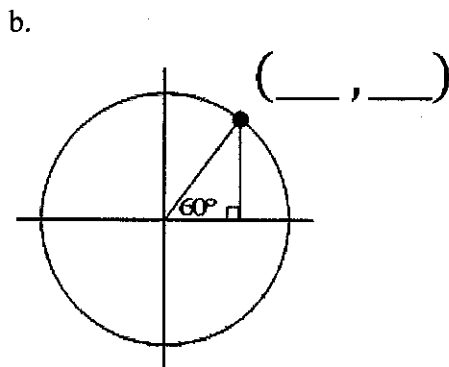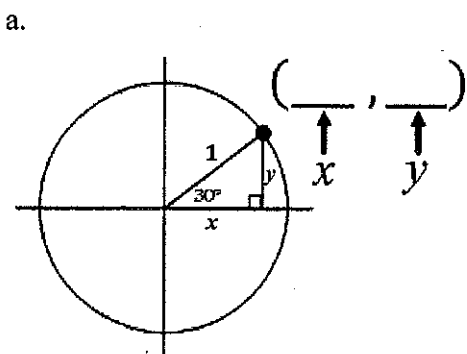
8. The population of grasshoppers after t weeks where $0 \le t \le 12$ is estimated by $P(t) = 7500 + 3000 \sin(90t)$.

   a. Find $P(5)$. What does it mean in this situation?

   b. What is the initial estimate?

Find the value of the trig functions indicated.

1.

$$\sin \alpha = \frac{5}{13}$$

$$\tan \beta = \frac{12}{5}$$

2.

$$\cos \theta = \frac{16}{20} = \frac{4}{5}$$

$$\tan \theta = \frac{12}{16} = \frac{3}{4}$$

3.

$$\sin \alpha = \frac{8}{10} = \frac{4}{5}$$

$$\sin \beta = \frac{6}{10} = \frac{3}{5}$$

$$\tan \alpha = \frac{8}{6} = \frac{4}{3}$$

$$\cos \beta = \frac{8}{10} = \frac{4}{5}$$

Find the measure of the indicated side. Round to the nearest hundredth.

4.

$$\sin 62 = \frac{x}{6}$$

$$6 \cdot \sin 62 = \frac{x}{6} \cdot 6$$

$$x = 5.3$$

5.

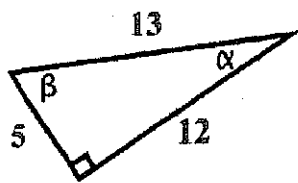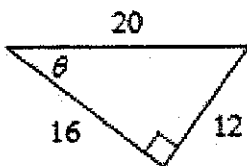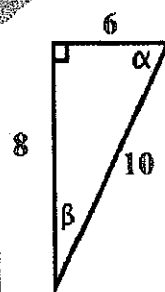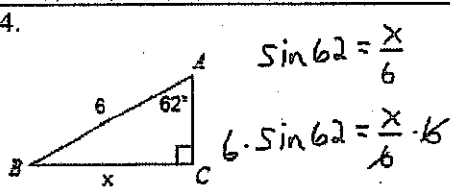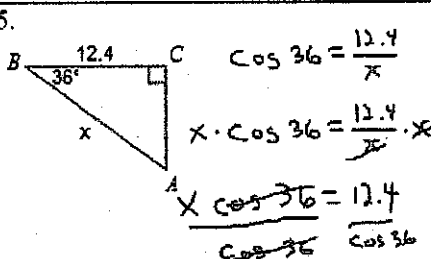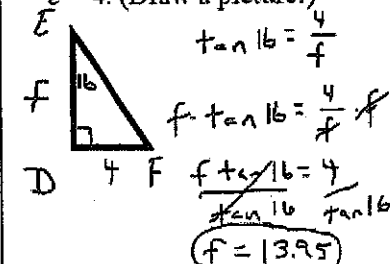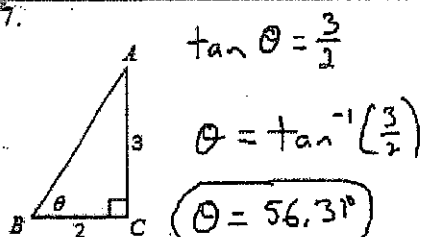$$\cos 36 = \frac{12.4}{x}$$

$$x \cdot \cos 36 = \frac{12.4}{x} \cdot x$$

$$\frac{x \cos 36}{\cos 36} = \frac{12.4}{\cos 36}$$

$$x = 15.33$$

6. Given $\triangle DEF$ where $\angle D$ is a right angle. Find f if $m\angle E = 16°$ and $e = 4$. (Draw a picture!)
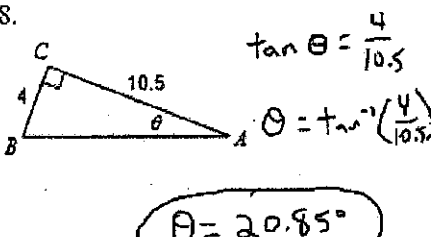
$$\tan 16 = \frac{4}{f}$$

$$f \cdot \tan 16 = \frac{4}{f} f$$

$$\frac{f \tan 16}{\tan 16} = \frac{4}{\tan 16}$$

$$f = 13.95$$

Find the measure of the indicated angle. Round to the nearest hundredth.

7.

$$\tan \theta = \frac{3}{2}$$

$$\theta = \tan^{-1}\left(\frac{3}{2}\right)$$

$$\theta = 56.31°$$

8.

$$\tan \theta = \frac{4}{10.5}$$

$$\theta = \tan^{-1}\left(\frac{4}{10.5}\right)$$

$$\theta = 20.85°$$

9. Given $\triangle DEF$ where $\angle D$ is a right angle. Find $m\angle E$ if $e = 11.7$ and $f = 8$. (Draw a picture!)
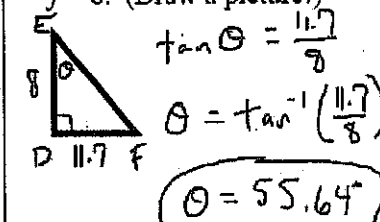
$$\tan \theta = \frac{11.7}{8}$$

$$\theta = \tan^{-1}\left(\frac{11.7}{8}\right)$$

$$\theta = 55.64°$$

Solve each triangle. Round to the nearest hundredth.
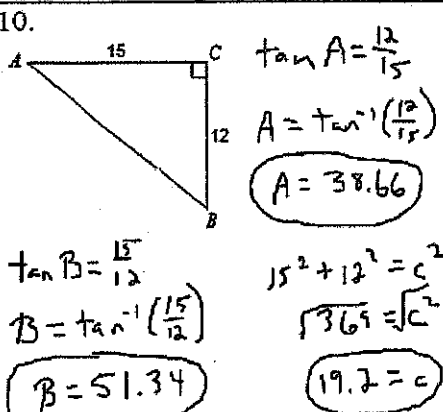
10.

$$\tan A = \frac{12}{15}$$
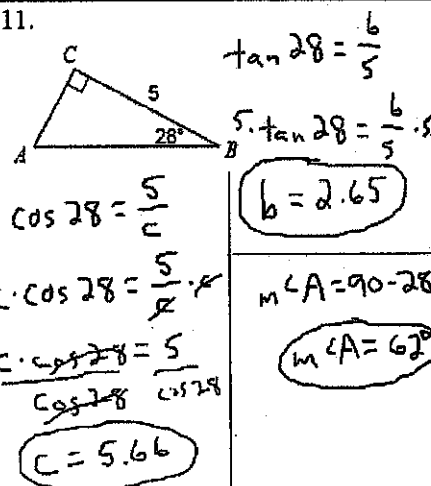
$$A = \tan^{-1}\left(\frac{12}{15}\right)$$

$$A = 38.66$$

$$\tan B = \frac{15}{12}$$

$$B = \tan^{-1}\left(\frac{15}{12}\right)$$

$$B = 51.34$$

$$15^2 + 12^2 = c^2$$

$$\sqrt{369} = \sqrt{c^2}$$

$$19.2 = c$$

11.

$$\tan 28 = \frac{6}{5}$$

$$5 \cdot \tan 28 = \frac{6}{5} \cdot 5$$

$$b = 2.65$$

$$\cos 28 = \frac{5}{c}$$

$$c \cdot \cos 28 = \frac{5}{c} \cdot c$$

$$\frac{c \cos 28}{\cos 28} = \frac{5}{\cos 28}$$

$$c = 5.66$$

$$m\angle A = 90 - 28$$

$$m\angle A = 62°$$

12. Given $\triangle DEF$ where $\angle D$ is a right angle and $m\angle F = 35°$ and $d = 16$. (Draw a picture!)

$$\sin 35 = \frac{f}{16}$$

$$16 \cdot \sin 35 = \frac{f}{16} \cdot 16$$

$$f = 9.18$$

$$\cos 35 = \frac{e}{16}$$

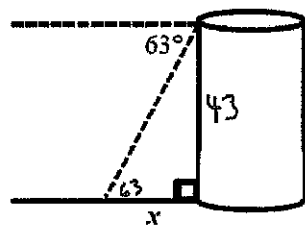$$16 \cdot \cos 35 = \frac{e}{16} \cdot 16$$

$$e = 13.11$$

$$m\angle E = 90 - 35$$
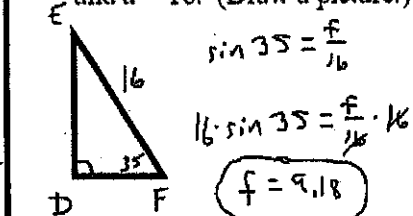
$$E = 55°$$

Label the picture given and then solve it. If no picture is given, draw your own and solve!

13. The angle of depression is measured from the top of a 43 ft tower to a reference point on the ground. Its value is found to be 63°. How far is the base of the tower from the point on the ground?

$$\tan 63 = \frac{43}{x}$$

$$x \cdot \tan 63 = \frac{43}{x} \cdot x$$

$$\frac{x \tan 63}{\tan 63} = \frac{43}{\tan 63}$$

$$\boxed{x = 21.91 \text{ ft}}$$

14. The entrance of the old town library is 2.3 ft above ground level. A ramp from the ground level to the library entrance is scheduled to be built. The angle of elevation form the base of the ramp to its top is to be 15°. Find the length of the ramp
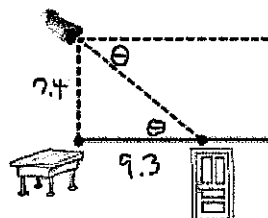
$$\sin 15 = \frac{2.3}{x}$$

$$x \cdot \sin 15 = \frac{2.3}{x} \cdot x$$

$$\frac{x \cdot \sin 15}{\sin 15} = \frac{2.3}{\sin 15}$$

$$\boxed{x = 8.89 \text{ ft}}$$

15. A closed circuit TV camera is mounted on a wall 7.4 ft above a security desk in an office building. It is used to view an entrance door 9.3 ft from the desk. Find the angle of depression from the camera lens to the entrance door.
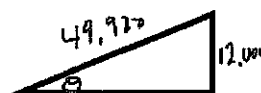
$$\tan \theta = \frac{7.4}{9.3}$$

$$\theta = \tan^{-1}\left(\frac{7.4}{9.3}\right)$$

$$\boxed{\theta = 38.51°}$$

16. A jet took off at a rate of 260 ft/s and climbed in a straight path for 3.2 min. What was the angle of elevation of its path if its final altitude was 12,000 ft?

$$\sin \theta = \frac{12000}{49920}$$

$$\theta = \sin^{-1}\left(\frac{12000}{49920}\right)$$

$3.2 \min = 192 \sec$

$260 \text{ ft} \cdot 192$

49920

$$\boxed{\theta = 13.91°}$$

17. The angle of elevation from the bottom of the world's largest slide located in Peru, Vermont, is approximately 10.3°. The slide has a vertical drop of 821 ft. Find the length of the slide.
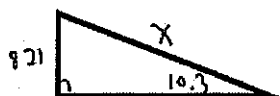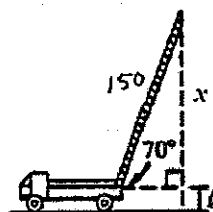
$$\sin 10.3 = \frac{821}{x}$$

$$x \cdot \sin 10.3 = \frac{821}{x} \cdot x$$

$$\frac{x \cdot \sin 10.3}{\sin 10.3} = \frac{821}{\sin 10.3}$$

$$\boxed{x = 4591.67 \text{ ft}}$$

18. The extension ladder on top of a 6 ft high hook and ladder truck is 150 ft long. If the angle of elevation of the ladder is 70°, to what height on a building will the ladder reach?
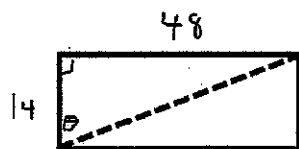
$$\sin 70 = \frac{x}{150}$$

$$150 \sin 70 = \frac{x}{150} \cdot 150$$

$$x = 140.95$$

$$+ 6$$

$$\boxed{146.95 \text{ ft}}$$

19. A rectangle is 14 cm wide and 48 cm long. Find the measure of the angles on either side of the diagonals.
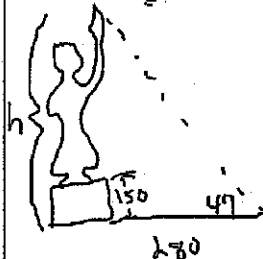
$$\tan \theta = \frac{48}{14}$$

$$\theta = \tan^{-1}\left(\frac{48}{14}\right)$$

$$\boxed{\theta = 73.74°}$$

$$90 - 73.74 = \boxed{16.26°}$$

20. The Statue of Liberty stands on a 150 ft pedestal. From a point 280 ft from the base of the pedestal, the angle of elevation to the top of Liberty's torch is 47°. Find the height of the statue.

$$\tan 47 = \frac{h}{280}$$

$$280 \tan 47 = \frac{h}{280} \cdot 280$$

$$h = 300.26 \text{ ft}$$

$$-150$$

$$\boxed{150.26 \text{ ft}}$$

Skillz Review Simplify the following.

1. $\dfrac{\frac{2}{5}}{\frac{3}{4}} \quad \dfrac{2}{5} \cdot \dfrac{4}{3} = \boxed{\dfrac{8}{15}}$

2. $\dfrac{\frac{5}{8}}{\frac{\sqrt{3}}{8}} \quad \dfrac{5}{8} \cdot \dfrac{8}{\sqrt{3}} = \dfrac{5 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} \quad \boxed{\dfrac{5\sqrt{3}}{3}}$

3. $\dfrac{\frac{1}{1}}{\frac{\sqrt{3}}{2}} \quad \dfrac{1}{1} \cdot \dfrac{2}{\sqrt{3}} = \dfrac{2 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} \quad \boxed{\dfrac{2\sqrt{3}}{3}}$

4. $\dfrac{\frac{\sqrt{3}}{4}}{2\sqrt{2}} \quad \dfrac{\sqrt{3}}{4} \cdot \dfrac{1}{2\sqrt{2}} = \dfrac{\sqrt{3} \cdot \sqrt{2}}{8\sqrt{2} \cdot \sqrt{2}} \quad \boxed{\dfrac{\sqrt{6}}{16}}$

1. $\dfrac{\frac{2}{5}}{\frac{3}{4}}$	2. $\dfrac{\frac{5}{8}}{\frac{\sqrt{3}}{8}}$	3. $\dfrac{1}{\left(\frac{\sqrt{3}}{2}\right)}$	4. $\dfrac{\left(\frac{\sqrt{3}}{4}\right)}{2\sqrt{2}}$

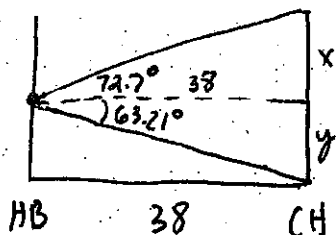## 8.4 Basic Trigonometric Functions

APPLICATION

1. Solve the triangle. Round to the nearest hundredth.

B
16
A
13.4
C
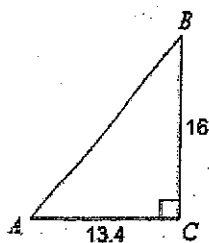
2. An isosceles trapezoid has sides whose lengths are 5, 5, 8, and 14. Find all four angles of the trapezoid.

3. The Hersch Building and the County Hospital are 38 meters apart. From a window in the Hersch Building, the angle of elevation of the top of the hospital is $72.7°$. From the same window the angle of depression to the ground at the base of the hospital is $63.21°$. Find the height of the hospital.

$72.7°$ 38
$63.21°$
HB   38   CH
x
y

$\tan 72.7° = \dfrac{x}{38}$ $x = 38 \tan 72.7°$

$+$

$\tan 63.21° = \dfrac{y}{38}$ $y = 38 \tan 63.21°$

$\underline{\qquad\qquad\qquad}$

197.26 meters

4. An engineer determines that the angle of elevation from her position to the top of a tower is $52°$. She measures the angle of elevation again from a point 47 m farther from the tower and finds it to be $31°$. Both positions are due east of the tower. Find the height of the tower.

y
$52°$ $31°$
47 m
x
x+47

$X \approx 41.58627$

$y = 41.58627(\tan 52°)$
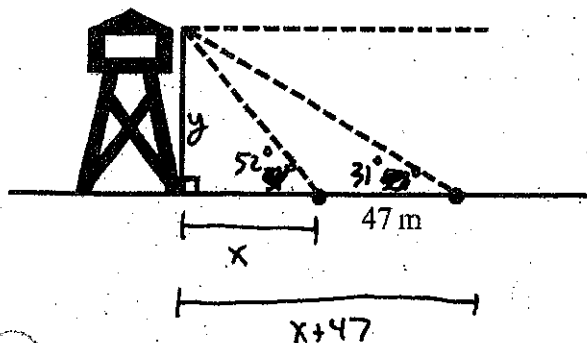
$\boxed{y = 53.23 \text{ meters}}$

$\tan 52° = \dfrac{y}{x} \rightarrow y = x \tan 52°$

$\tan 31° = \dfrac{y}{x+47}$ $y = (x+47)\tan 31°$

$x \tan 52° = (x+47)\tan 31°$

$x \tan 52° = x \tan 31° + 47 \tan 31°$

$x \tan 52° - x \tan 31° = 47 \tan 31°$

$\dfrac{x(\tan 52° - \tan 31°)}{\tan 52° - \tan 31°} = \dfrac{47 \tan 31°}{\tan 52° - \tan 31°}$

5. Given the trig ratio, draw a right triangle, label all sides, find the other 2 trig ratios. DO NOT FIND θ!

$\sin\theta = \dfrac{9}{11} \dfrac{o}{h}$
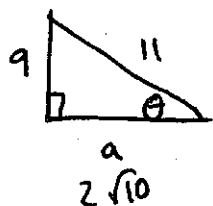
$a^2 + 9^2 = 11^2$
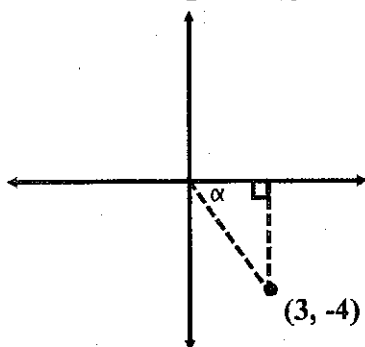
$a^2 + 81 = 121$

$a^2 = 40$

$\sqrt{a^2} = \sqrt{40}$

$a = \sqrt{4 \cdot 10}$

$a = 2\sqrt{10}$

$\cos\theta = \dfrac{a}{h} = \dfrac{2\sqrt{10}}{11}$

$\tan\theta = \dfrac{o}{a} = \dfrac{9}{2\sqrt{10}} = \dfrac{9\cdot\sqrt{10}}{2\cdot\sqrt{10}\cdot\sqrt{10}}$

6. Given the right triangle that connects the origin and the coordinate point (3, -4) shown below, find sin α.
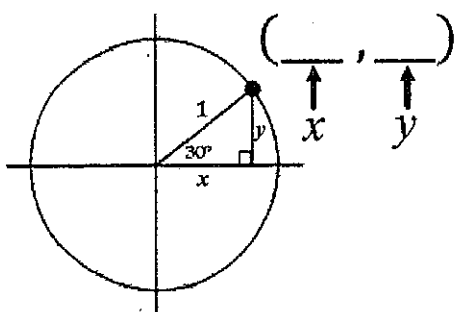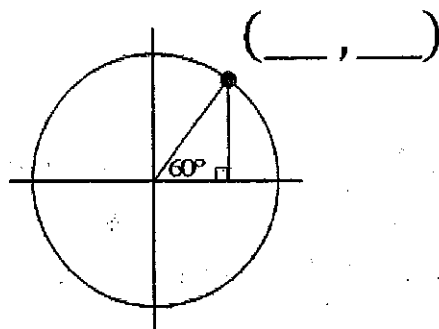

(3, -4)

$\dfrac{9\sqrt{10}}{20}$

7. Use a combination of trig and Pythagorean Theorem to find the exact value of the x and y coordinate for the circles below whose centers are the origin of the coordinate plane and radii are equal to one.

(Answers must be expressed as exact value fractions, do not give approximate decimal values!)
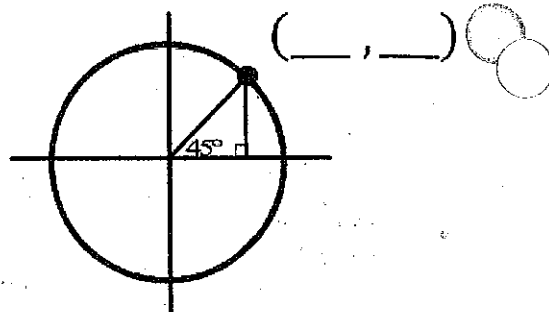
a.

$(\underline{\quad}, \underline{\quad})$

b.

$(\underline{\quad}, \underline{\quad})$

c.

$(\underline{\quad}, \underline{\quad})$

8. The population of grasshoppers after t weeks where $0 \le t \le 12$ is estimated by $P(t) = 7500 + 3000\sin(90t)$.

   a. Find $P(5)$. What does it mean in this situation?

   b. What is the initial estimate?