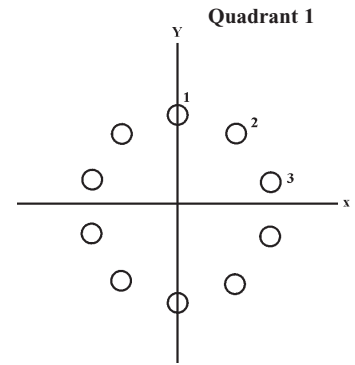


Unit 3 Locating X and Y Positions

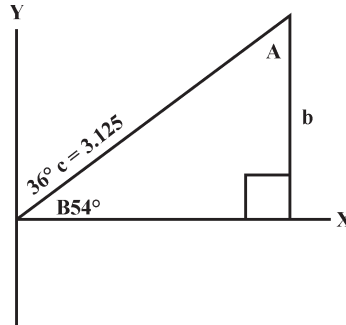
In machine work, often the x and y positions need to be known. For example, what are the x and y positions of 10 holes equally spaced with a bolt circle diameter of 6.250 inches?



Example : Find the hole location for Quadrant I:

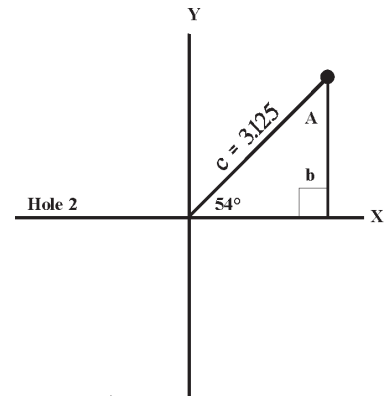
Hole 1 $x =$ Hole 2 $x =$ Hole 3 $x =$
 $y =$ $y =$ $y =$

Step 1 : Divide $360^\circ \div 10 = 36^\circ$.
 Radius $= \frac{1}{2}D = \frac{1}{2} \times 6.250 = 3.125$

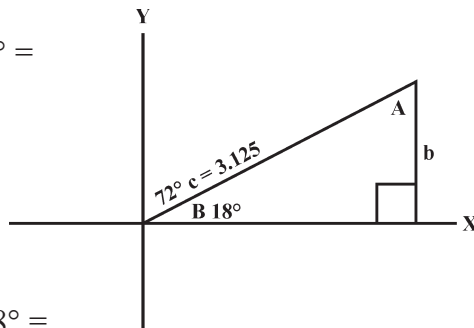


Step 2 : Hole 1 $x = 0$
 $y = 3.125$

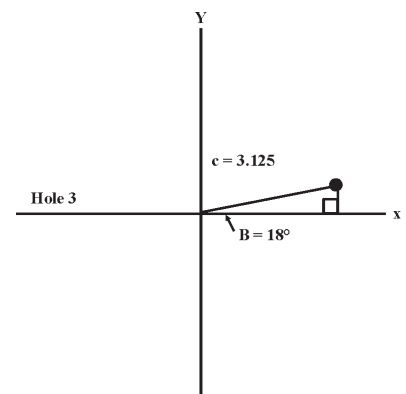
Step 3 : Find x position for hole 2.
 $a = c \times \text{Cos } B = 3.125 \times \text{Cos } 54^\circ =$
 $3.125 \times .587785 = 1.8368$
 $x = 1.8368$



Find y position for hole 2.
 $b = c \times \text{Sin } B = 3.125 \times \text{Sin } 54^\circ =$
 $3.125 \times .80902 = 2.5282$
 $y = 2.5282$



Step 4 : Find x position for hole 3.
 $\angle B = 72^\circ (2 \times 36^\circ)$
 $a = c \times \text{Cos } B = 3.125 \times \text{Cos } 18^\circ =$
 $3.125 \times .95106 = 2.9271$
 $x = 2.9271$



Find y position for hole 3.
 $b = c \times \text{Sin } B = 3.125 \times \text{Sin } 18^\circ =$
 $3.125 \times .30902 = .9657$
 $y = .9657$

Answers : Hole 1: $x = 0$ Hole 2 : $x = 1.8368$ Hole 3 : $x = 2.9271$
 $y = 3.125$ $y = 2.5282$ $y = .9657$

Unit 3 Locating X and Y Positions

1. Find the x and y positions of holes A, B, and C in an 8-hole equally-spaced bolt circle of 5.750.

Hole A : $x =$

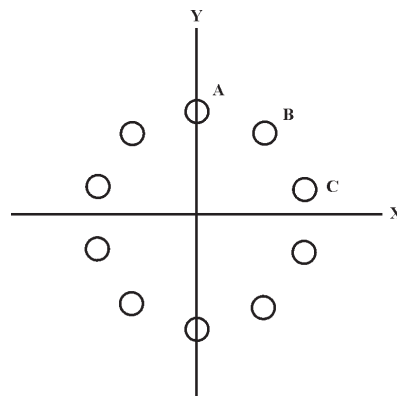
$y =$

Hole B : $x =$

$y =$

Hole C : $x =$

$y =$



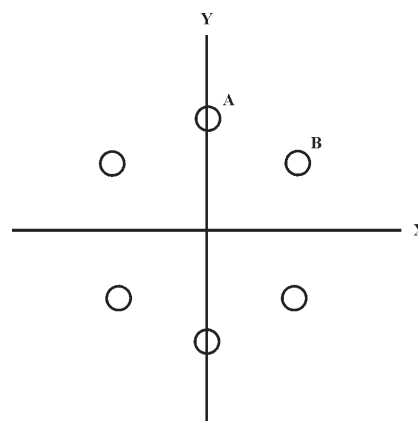
2. Find the x and y positions of hole A and B in a 6-hole equally-spaced bolt circle of 10.500.

Hole A : $x =$

$y =$

Hole B : $x =$

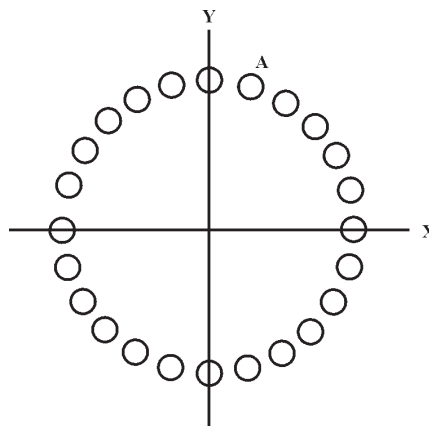
$y =$



3. Find the x and y position of hole A in a 24-hole equally-spaced bolt circle of 12.000.

Hole A : $x =$

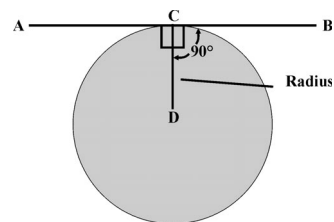
$y =$



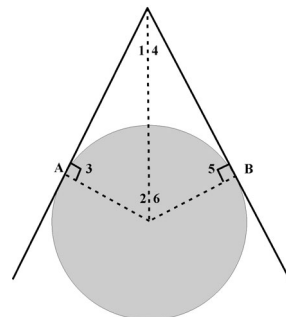
Unit 3 Trigonometry and Circles

When doing trigonometry, certain rules (known as **propositions**) are important to know.

Proposition 1 : A straight line is perpendicular to a radius when its point is tangent to a circle.
 $\angle ACD = 90^\circ$
 $\angle BCD = 90^\circ$
 C = point of tangency

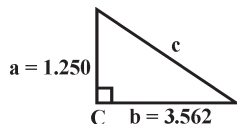


Proposition 2 : When two tangents are drawn from the same exterior point (P), then the corresponding angles, line segments, and triangles are equal.
 Corresponding angles $\angle 1 = \angle 4$; $\angle 2 = \angle 6$; $\angle 3 = \angle 5$.
 Line segments $AP = BP$.
 Line PC bisects $\angle APB$ creating two equal triangles.
 $\therefore \triangle PAC = \triangle PBC$.



Example 1 : Find the outside distance between the two holes.

Step 1 : Find the center distance between the two holes.



$$c = \sqrt{a^2 + b^2} = \sqrt{1.250^2 + 3.562^2} = \sqrt{28.5007}$$

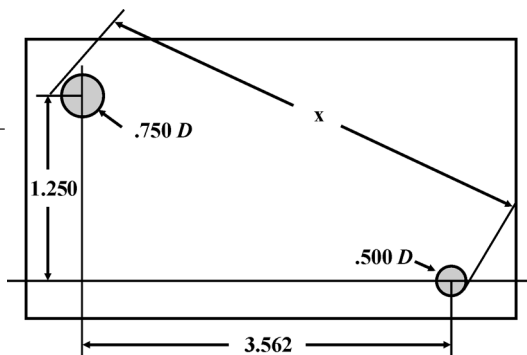
$$c = 3.7750$$

Step 2 : Add the radius of both pins.

$$x = 3.7750 + \frac{1}{2} \cdot .750 + \frac{1}{2} \cdot .500$$

$$= 3.7750 + .375 + .250 = 4.4$$

Answer : $x = 4.4$



Example 2 : Find what diameter pin will fit into an equilateral triangle whose three equal sides are .194.

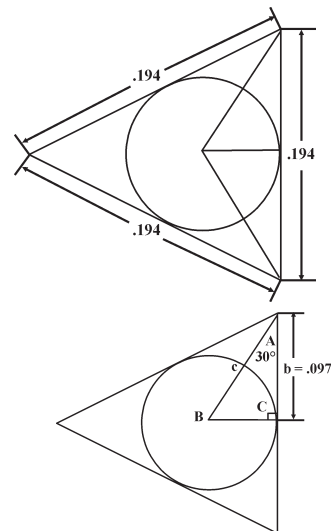
Step 1 : Since it is an equilateral triangle, then each angle is 60° . The right-angled leg bisects the side ($.194 \div 2$), and the hypotenuse. The hypotenuse bisects the angle ($60^\circ \div 2$).

Step 2 : Find the radius of the pin.

$$a = b \times \tan A = .097 \times \tan 30^\circ = .097 \times .57735 = .056$$

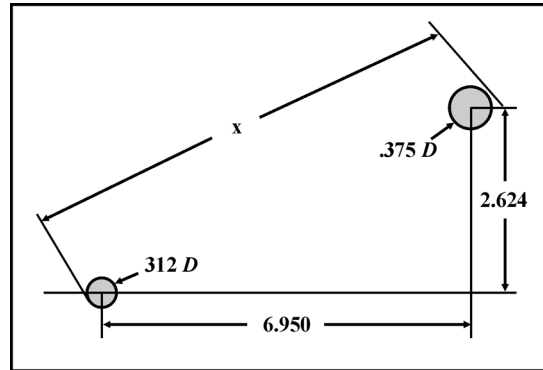
Step 3 : $D = 2r = 2 \times .056 = .112$

Answer : The diameter of the pin is .112.

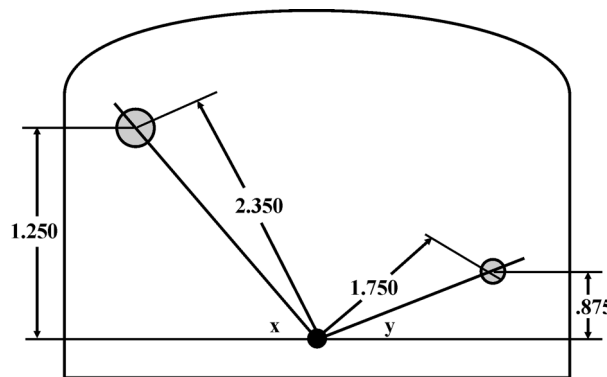


Unit 3 Trigonometry and Circles

1. $X =$



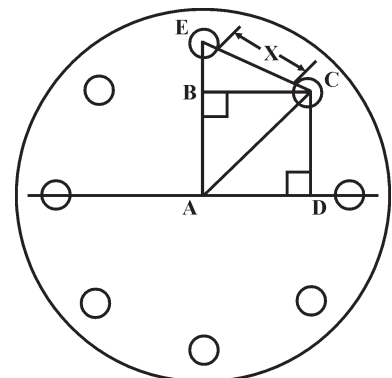
2. $\angle X =$
 $\angle Y =$



3. Eight holes of .750 diameter are equally spaced on a 10.000-inch bolt circle. What is the distance of X ?

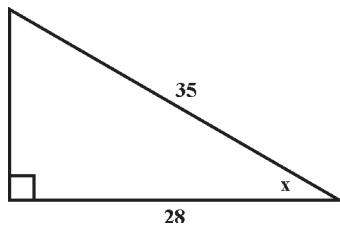
- Solution :**
1. First find BC in $\triangle CBA$.
 2. Then find CD in $\triangle ADC$.
 3. Deduct CD from EA.
 4. Known now are EB and BC. Find EC in $\triangle EBC$.
 5. Deduct radii from the two holes to get X .

$X =$

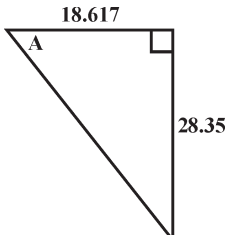


Unit 3 Review Final Examination

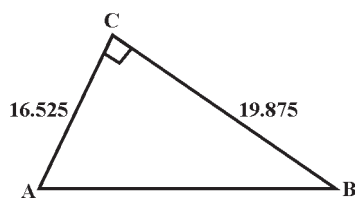
Find the unknown angle. Unless otherwise noted, round off all angles to nearest minute.



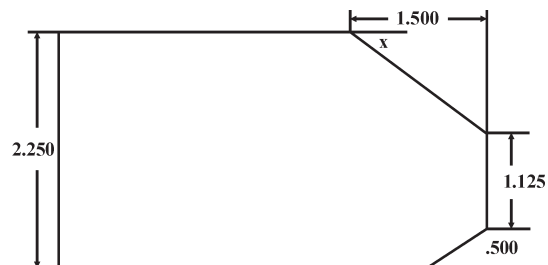
1. $X =$



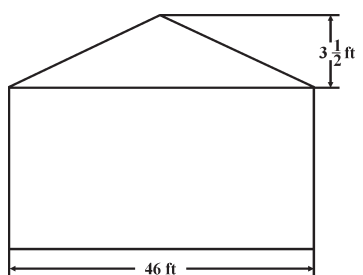
2. $\angle A =$



3. $\angle CBA =$



4. $X =$



5. $X =$

Convert the following into decimals of a degree. Round off to four places.

6. $28^\circ 17' 18'' =$

7. $7^\circ 14' =$

8. $75^\circ 46' 19'' =$

9. $39^\circ 25' 18'' =$

Convert the following to the nearest minute.

10. $48.8563^\circ =$

11. $16.0456^\circ =$

12. $78.35^\circ =$

13. $56.735^\circ =$

Add or subtract.

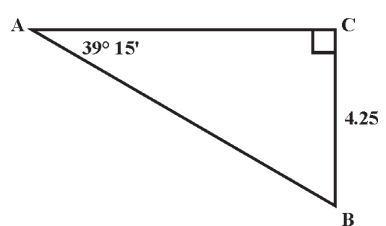
14. $14^\circ 35' 17'' + 25^\circ 42' 54'' =$

15. $78^\circ 14' 35'' - 18^\circ 25' 48'' =$

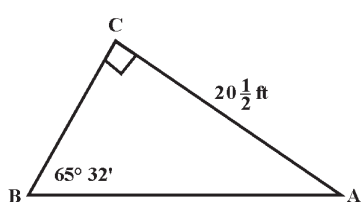
16. $42^\circ 25' - 18^\circ 34' 25'' =$

17. $35^\circ 18' 52'' + 25^\circ 10' 38'' =$

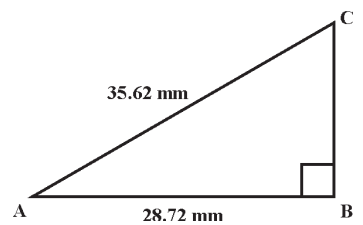
Find the unknown sides or angles.



1. $AB =$
 $CA =$



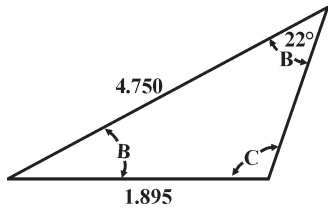
2. $CB =$
 $BA =$



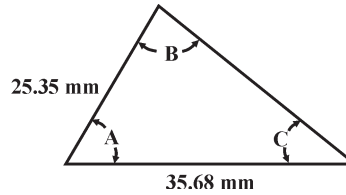
3. $BC =$
 $\angle A =$
 $\angle B =$

Unit 3 Review Final Examination

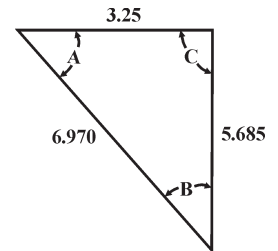
Find the unknown sides and angles.



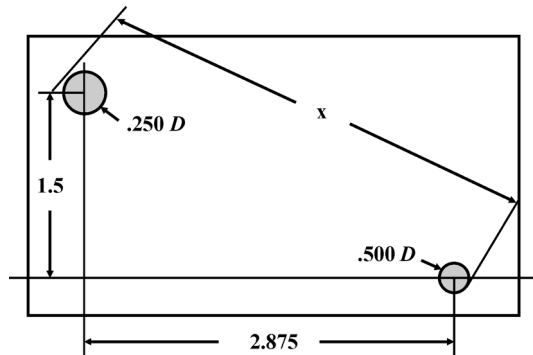
21. $b =$
 $\angle B =$
 $\angle C =$



22. $a =$
 $\angle B =$
 $\angle C =$

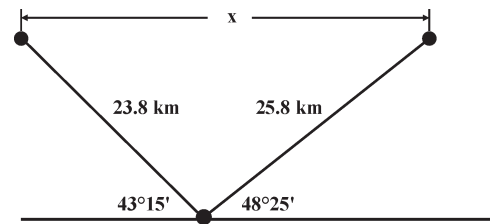


23. $\angle A =$
 $\angle B =$
 $\angle C =$

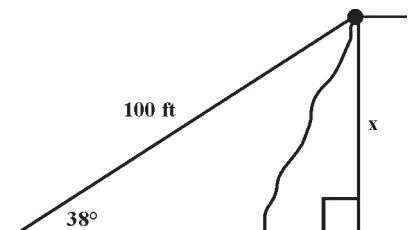


24. $X =$

- _____ 25. Two ships left the port at the same time. One traveled 25.8 kilometers on a $48^\circ 25'$ angle, whereas the other traveled 23.8 kilometers in the opposite direction on a $43^\circ 15'$ angle. What is the distance between the two ships?



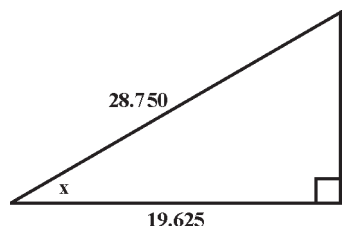
- _____ 26. Sandra wanted to know the height of the cliff. She threw down a 100-foot rope and measured the angle at 38° . How high was the cliff?



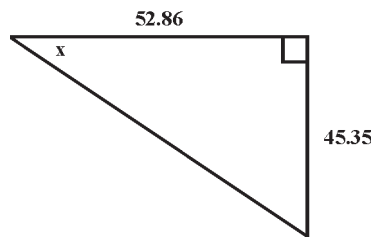
Time Spent _____

Number Correct _____ / 22 minimum

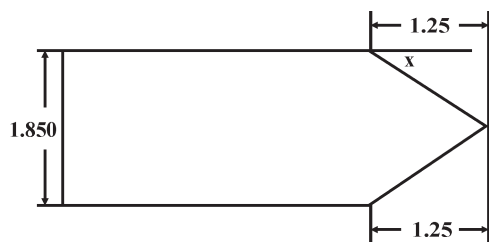
Find the unknown angle.



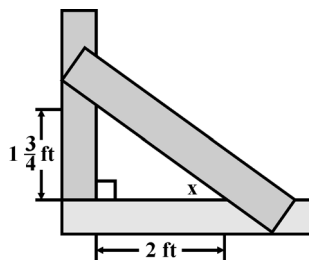
1. $\angle X =$



2. $\angle A =$



3. $\angle X =$



4. $\angle X =$

Convert each of the following into decimal of a degree. Round off to four places.

5. $87^\circ 14' 36'' =$

6. $31^\circ 38' 5'' =$

Convert the following to the nearest minute.

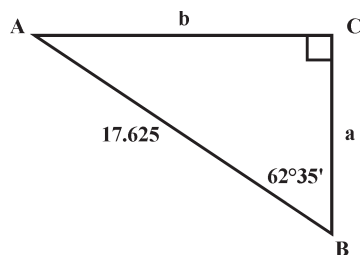
7. $48.2778^\circ =$

8. $7.8995^\circ =$

Add or subtract.

9. $14^\circ 32' 27'' + 25^\circ 45' 39'' =$

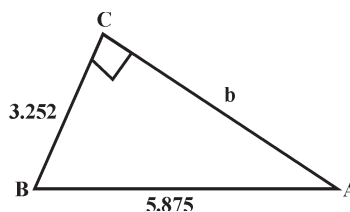
10. $42^\circ 17' 14'' - 13^\circ 42' 18'' =$



11. $\angle A =$

12. $a =$

13. $b =$

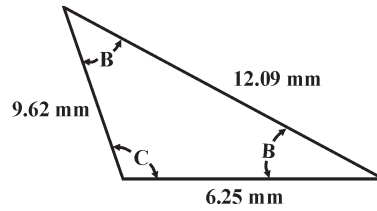
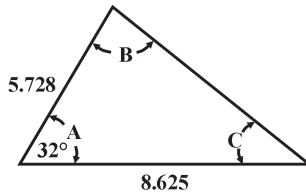


14. $b =$

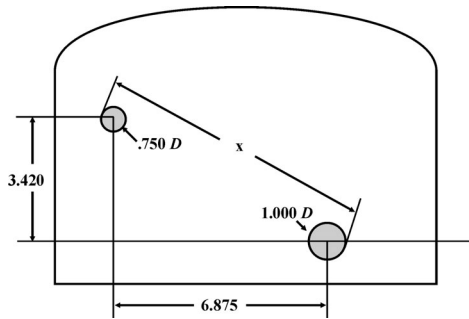
15. $\angle A =$

16. $\angle B =$

Find the unknown side and angles.

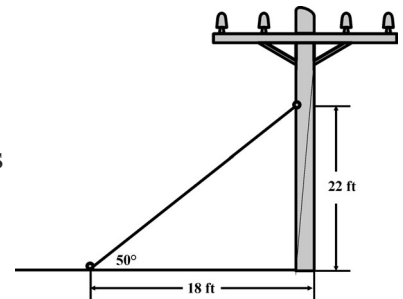


- 17. $a =$
- 18. $\angle B =$
- 19. $\angle C =$
- 20. $\angle A =$
- 21. $\angle B =$
- 22. $\angle C =$

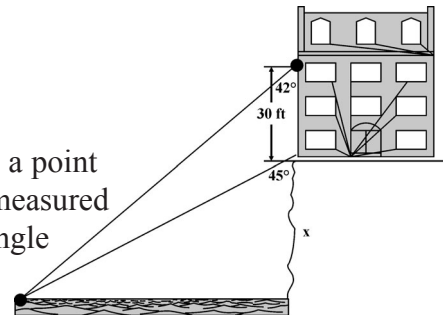


23. $X =$

24. Ken needed to know how much cable would be required to support 25 telephone poles. The cables were to be attached 22 feet up on the pole and 18 feet away from the pole. Allow one foot per cable for clamping. What is the total amount of cable needed (in feet) to do the job?



25. Cindy measured and found that it was 42° from a point in the valley to her hotel on a cliff. When she measured again from a point that was 30 feet lower, the angle was 45° . What is the height of the cliff?



Study Help

If You Missed Questions

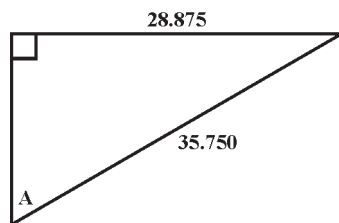
- 1 – 16
- 17 – 25

Review These Pages

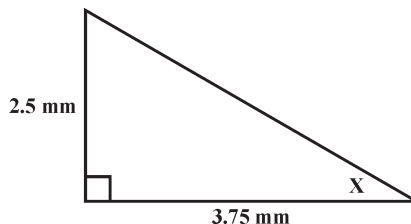
- 14 – 39
- 44 – 55

Unit 3 Additional Help Final Examination

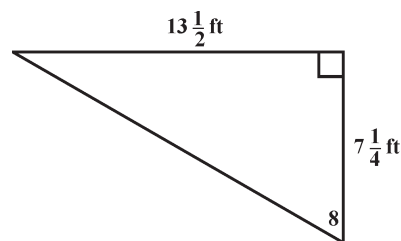
Find the unknown angles.



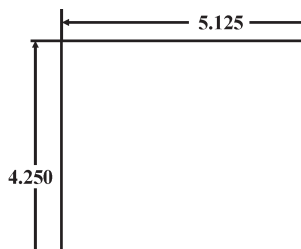
1. $\angle A =$



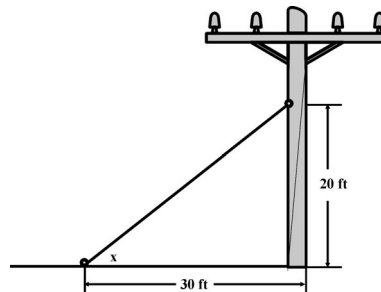
2. $\angle X =$



3. $\angle B =$



4. $\angle X =$



5. $\angle X =$

Convert each of the following into a decimal of a degree. Round off to four places.

6. $42^\circ 18' 19'' =$

7. $8^\circ 35' 50'' =$

8. $17^\circ 45' =$

9. $63^\circ 47' 7'' =$

Convert the following to the nearest minute.

10. $15.1944 =$

11. $86.965 =$

12. $59.0581 =$

13. $48.6268 =$

Add or subtract.

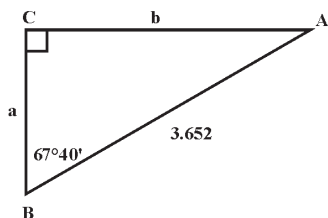
14. $35^\circ 14' 12'' - 12^\circ 35' 45'' =$

15. $22^\circ 14' 58'' + 14^\circ 52' 10'' =$

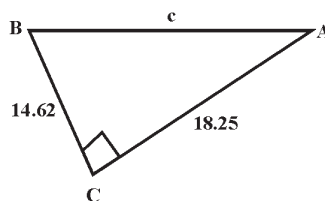
16. $72^\circ 25' 8'' + 8^\circ 45' 32'' =$

17. $85^\circ 35' 13'' - 42^\circ 58' 40'' =$

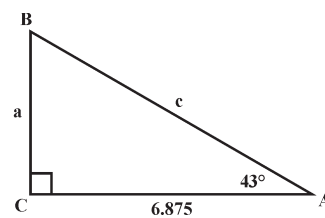
Find the unknown sides or angles.



18. $A =$
 $a =$
 $b =$



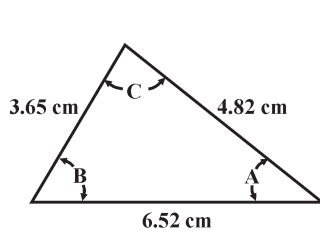
22. $c =$
 $\angle A =$
 $\angle B =$



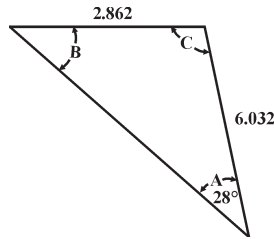
23. $\angle B =$
 $a =$
 $c =$

Unit 3 Additional Help Final Examination

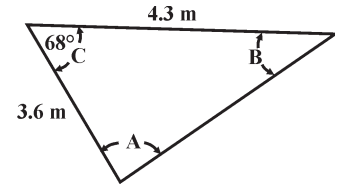
Find the unknown sides and angles.



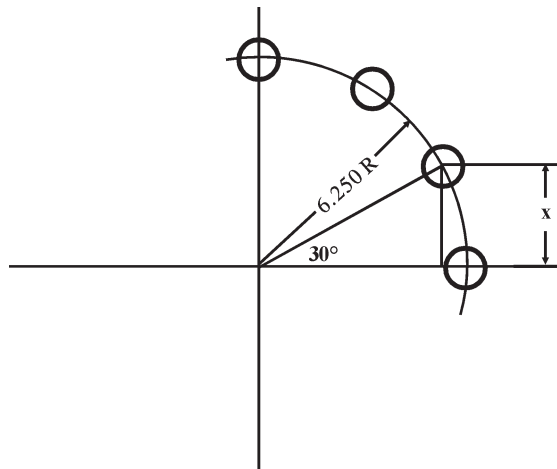
21. $\angle A =$
 $\angle B =$
 $\angle C =$



22. $c =$
 $\angle B =$
 $\angle C =$

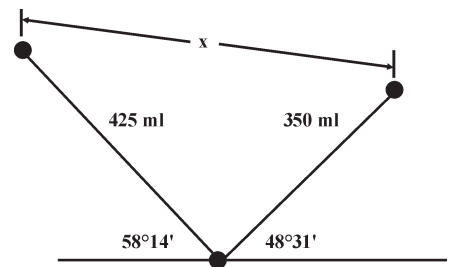


23. $c =$
 $\angle A =$
 $\angle B =$

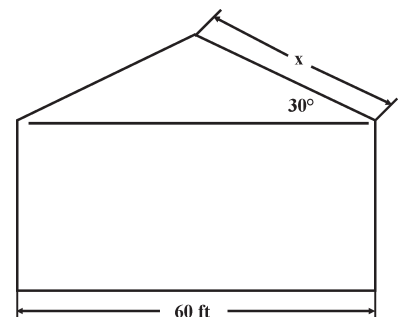


24. $X =$

- _____ 25. Two planes left the airport at the same time. One flew out at $48^\circ 31'$ and traveled 350 miles. The other flew out at $58^\circ 14'$ and traveled 425 miles. How far apart are they?



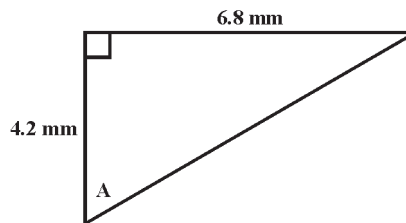
- _____ 26. The blueprint called for a 30° pitched roof on a 60-foot wide house. The roofer wanted to know how long the roof would be from the peak to the edge. What is the length of the peak to the edge?



Time Spent _____

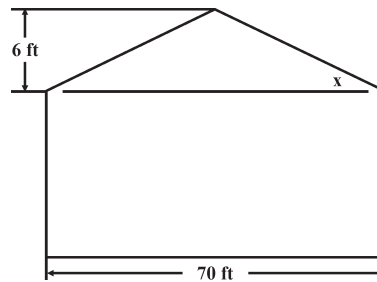
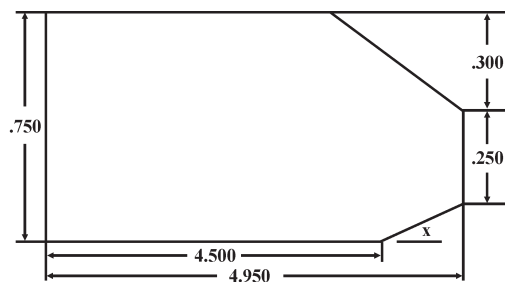
Number Correct _____ / 22 minimum

Find the unknown angle.



1. $\angle X =$

2. $\angle A =$



3. $\angle X =$

4. $\angle X =$

Convert each of the following into decimal of a degree. Round off to four places.

5. $38^\circ 14' 13'' =$

6. $6^\circ 42' 29'' =$

Convert the following to the nearest minute.

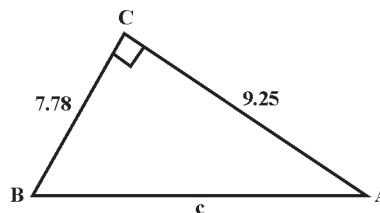
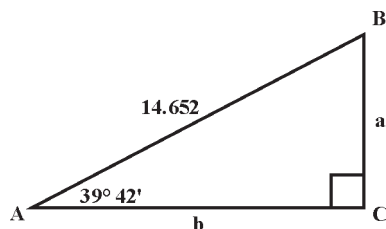
7. $56.827^\circ =$

8. $25.4486^\circ =$

Add or subtract.

9. $25^\circ 13' 42'' - 10^\circ 28' 52'' =$

10. $18^\circ 25' 45'' + 25^\circ 45' 33'' =$



11. $\angle B =$

14. $c =$

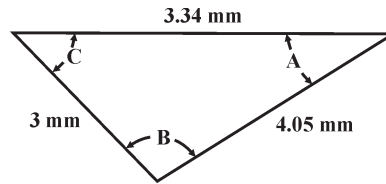
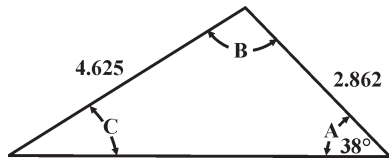
12. $a =$

15. $\angle A =$

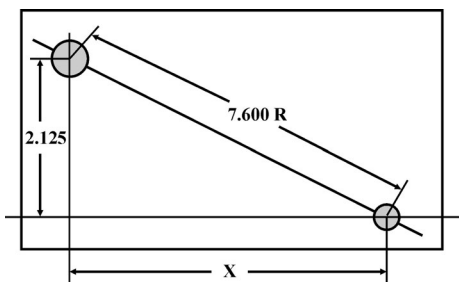
13. $b =$

16. $\angle B =$

Find the unknown side and angles.

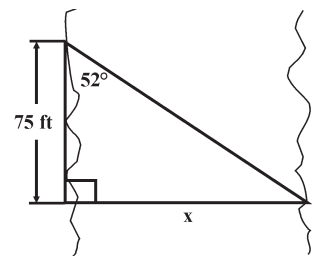


- 17. $b =$
- 18. $\angle B =$
- 19. $\angle C =$
- 20. $\angle A =$
- 21. $\angle B =$
- 22. $\angle C =$

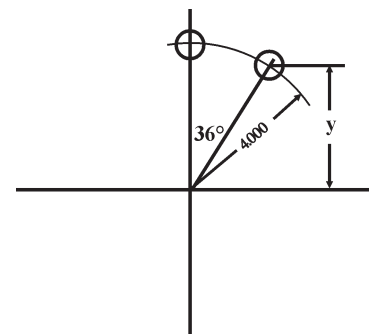


23. $X =$

24. Betty and Jane marked off 75 feet from a point across the river. They found the angle to be 52 degrees. What is the width of the river?



25. A machinist had to bore 10 equally-spaced holes in a steel plate. The print called for a radius of 4.000 inches. What is the y dimension?



Study Help

If You Missed Questions

1 – 16

17 – 25

Review These Pages

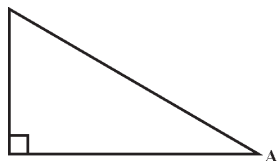
14 – 39

44 – 55

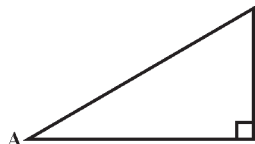
Triple-Check Additional Help : Unit 1

Label the various angles and sides of each right triangle. Also label side opposite, side adjacent, and hypotenuse for finding $\angle A$.

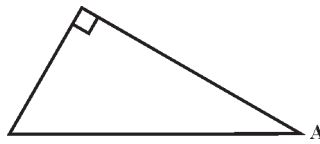
1.



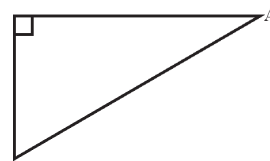
2.



3.



4.



Find the various angles by using the Tables of Trigonometric Functions. Write the degree and the nearest ten minutes.

5. $\tan \angle x = .31434$
 $\angle x =$

6. $\cos \angle x = .49571$
 $\angle x =$

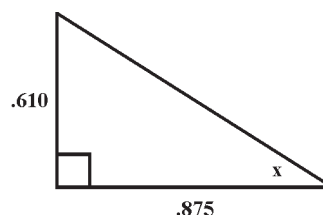
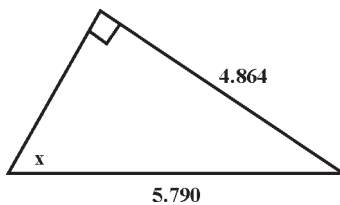
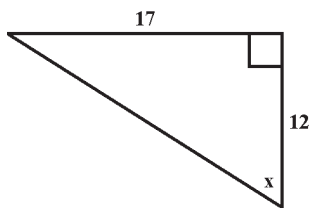
7. $\cot \angle x = 3.63800$
 $\angle x =$

8. $\sin \angle x = .99414$
 $\angle x =$

9. $\tan \angle x = 5.80106$
 $\angle x =$

10. $\cos \angle x = .499197$
 $\angle x =$

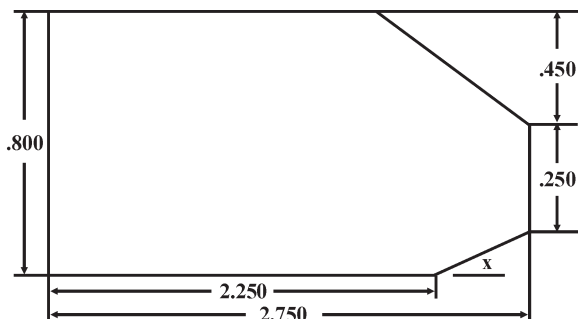
Find the unknown angle.



11. _____

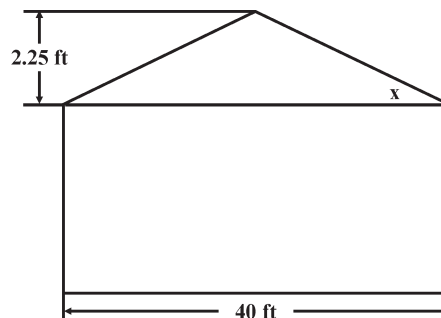
12. _____

13. _____



14. _____

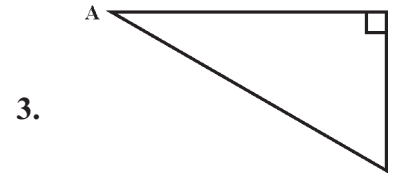
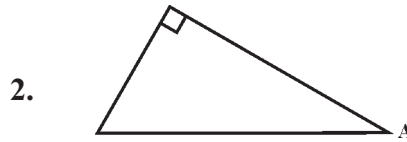
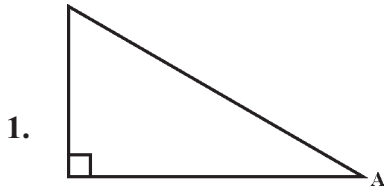
15. _____



Time Spent _____

Number Correct _____ / 12 minimum

Label the various angles and sides of each right triangle. Also, label the side opposite, side adjacent, and hypotenuse for finding $\angle A$.



Find the various angles by using the Tables of Trigonometric Functions. Write the degree and the nearest ten minutes.

4. $\sin \angle x = .25094$
 $\angle x =$

5. $\tan \angle x = 1.75845$
 $\angle x =$

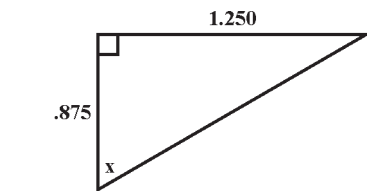
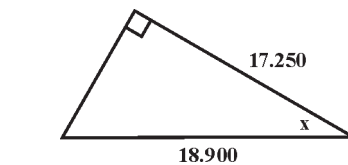
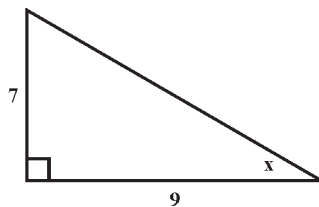
6. $\cot \angle x = 3.38745$
 $\angle x =$

7. $\cos \angle x = .49510$
 $\angle x =$

5. $\tan \angle x = 3.53810$
 $\angle x =$

6. $\cos \angle x = .71043$
 $\angle x =$

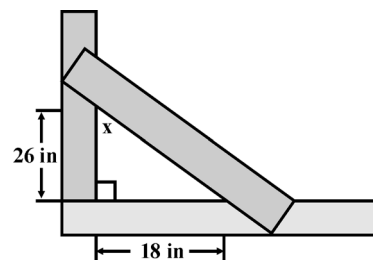
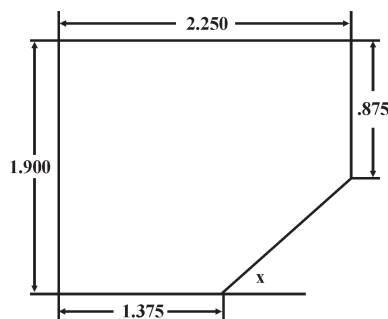
Find the unknown angle.



10. _____

11. _____

12. _____



13. _____

14. _____

Triple-Check Additional Help : Unit 2

Convert the following into decimals of a degree. Round off to four places.

1. $72^\circ 19' 32'' =$

2. $6^\circ 58' 18'' =$

3. $30^\circ 25' 7'' =$

4. $46^\circ 7' 29'' =$

Convert the following to the nearest minute.

5. $25.9380 =$

6. $79.9800 =$

7. $60.12 =$

8. $4.0500 =$

Add or subtract.

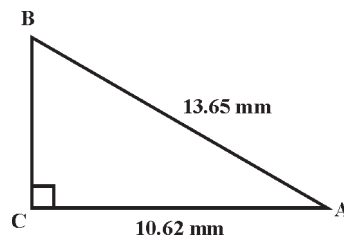
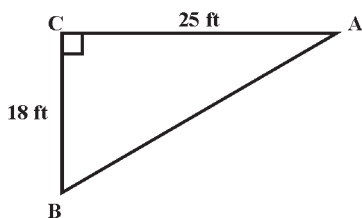
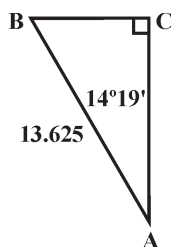
9. $69^\circ 26' 7'' - 13^\circ 42' 12'' =$

10. $22^\circ 41' 18'' - 8^\circ 56' 29'' =$

11. $22^\circ 14' 39'' + 13^\circ 52' 28'' =$

12. $52^\circ 35' 49'' + 8^\circ 22' 35'' =$

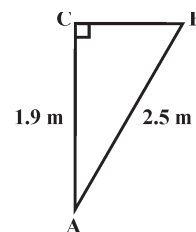
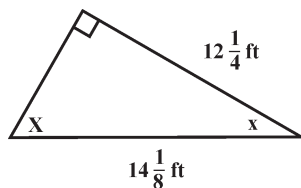
Find the unknown angle or side.



13. $BC =$

14. $BA =$

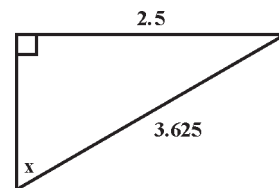
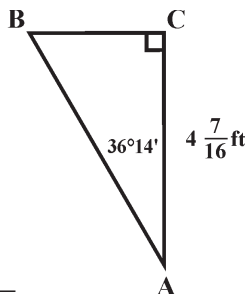
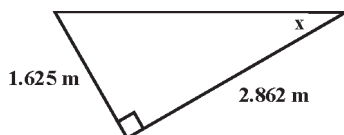
15. $\angle A =$



16. $\angle X =$

17. $BA =$

18. $CB =$



19. $\angle X =$

20. $BC =$

21. $\angle X =$

Time Spent _____

Number Correct _____ / 10 minimum

Convert the following into decimals of a degree. Round off to four places.

1. $28^\circ 35' 7'' =$

2. $74^\circ 52' 19'' =$

Convert the following to the nearest minute.

3. $48.8570^\circ =$

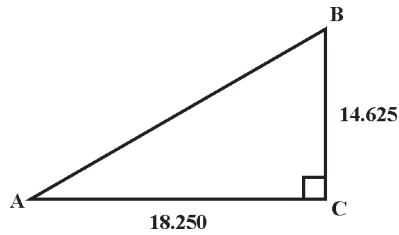
4. $20.0401^\circ =$

Add or subtract.

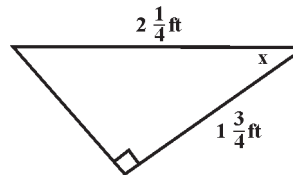
5. $35^\circ 14' 26'' - 22^\circ 45' 30'' =$

6. $17^\circ 25' 46'' + 8^\circ 43' 29'' =$

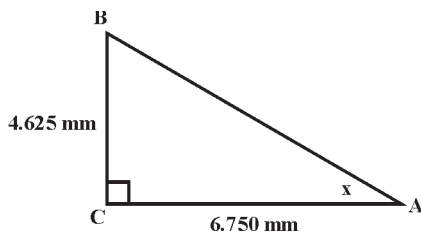
Find the unknown angle or side.



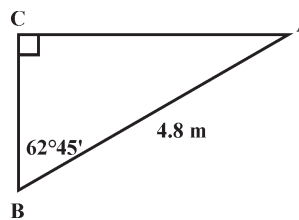
7. $AB =$



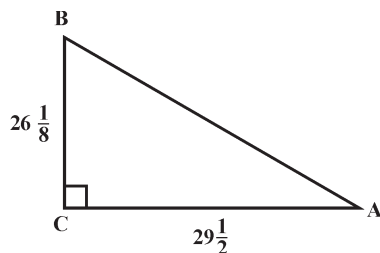
8. $\angle X =$



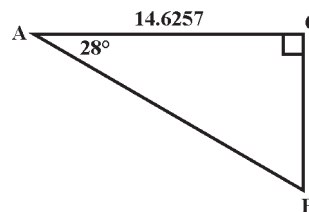
9. $\angle X =$



10. $CA =$



11. $\angle B =$



12. $CB =$