

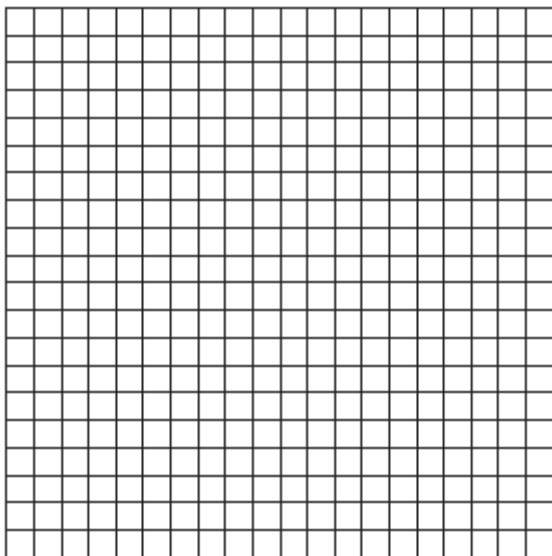
CHAPTER 12-1

GRAPHING CIRCLES

1. 010208a
What is the greatest possible number of points of intersection of a triangle and a circle?

[A] 3 [B] 2 [C] 6 [D] 4

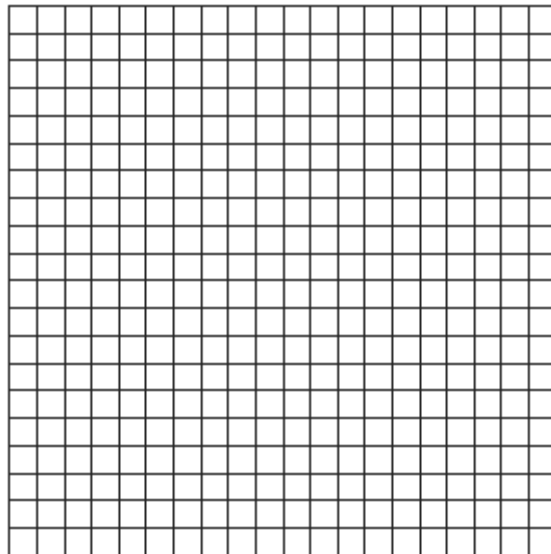
2. 010633a
In a circle whose center is (2,3), one endpoint of a diameter is (-1,5). Find the coordinates of the other endpoint of that diameter. [The use of the accompanying grid is optional.]



3. 010426a
In the coordinate plane, the points (2,2) and (2,12) are the endpoints of a diameter of a circle. What is the length of the radius of the circle?

[A] 7 [B] 10 [C] 5 [D] 6

4. 080230a
On the accompanying grid, graph a circle whose center is at (0,0) and whose radius is 5. Determine if the point (5,-2) lies on the circle.



SOLVING NONLINEAR SYSTEMS

5. 060119a
What is the total number of points of intersection in the graphs of the equations $x^2 + y^2 = 16$ and $y = 4$?

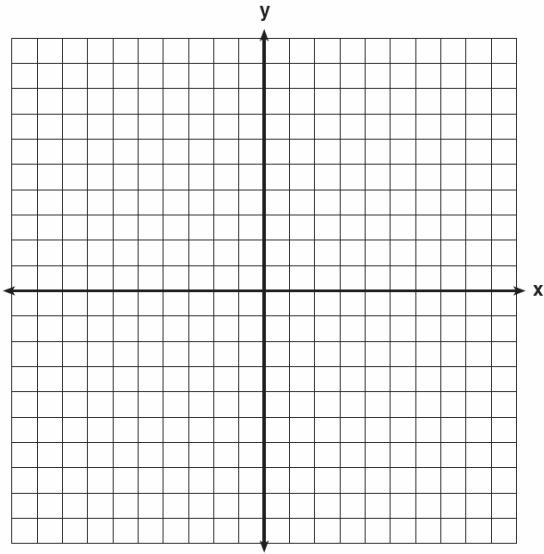
[A] 2 [B] 3 [C] 0 [D] 1

6. 080625a
What is the total number of points of intersection of the graphs of the equations $x^2 + y^2 = 16$ and $y = x$?

[A] 3 [B] 1 [C] 4 [D] 2

7. 010029a

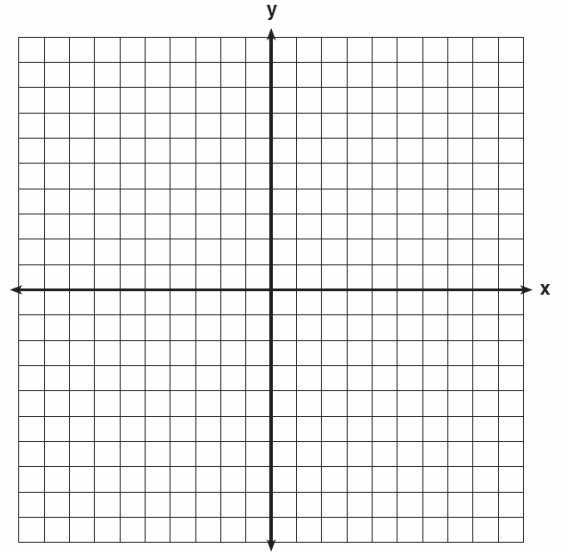
On the set of axes provided below, sketch a circle with a radius of 3 and center at (2,1) and also sketch the graph of the line $2x + y = 8$.



b What is the total number of points of intersection of the two graphs?

8. 010839a

On the accompanying set of axes, graph the parabola whose equation is $y = x^2 - 2x - 8$ over the interval $-3 \leq x \leq 5$ and graph the circle whose center is at (1,-5) and whose radius is 4. Using your graphs, determine how many points of intersection the two graphs have.



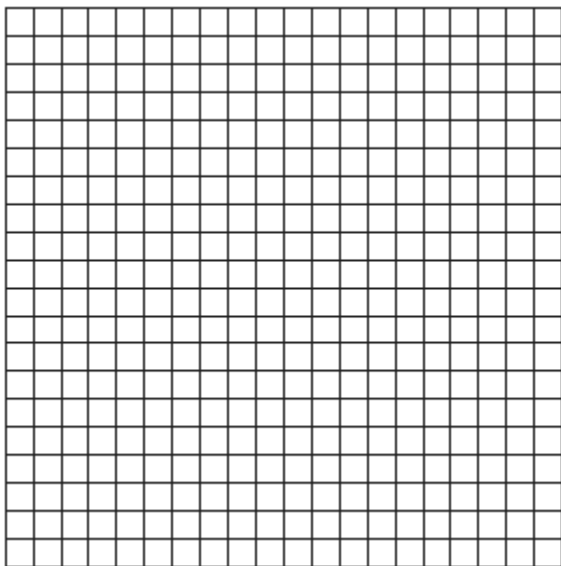
9. 060439a

Solve the following system of equations algebraically or graphically:

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

$$3y - 4x = 0$$

[The use of the accompanying grid is optional.]



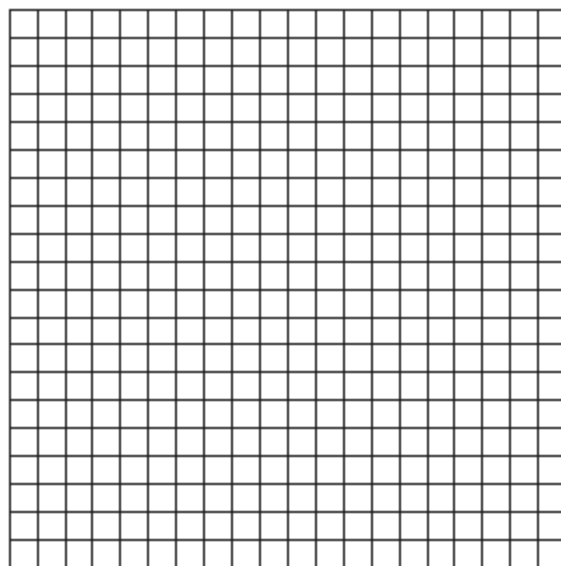
10. 080732b

Two circles whose equations are

$$(x - 3)^2 + (y - 5)^2 = 25 \text{ and}$$

$$(x - 7)^2 + (y - 5)^2 = 9 \text{ intersect in two points.}$$

What is the equation of the line passing through these two points? [The use of the accompanying grid is optional.]



EQUATIONS OF CIRCLES

11. 010625a

Which point is on the circle whose equation is $x^2 + y^2 = 289$?

[A] (-12,12)

[B] (-1,-16)

[C] (8,-15)

[D] (7,-10)

12. 060506b, P.I. G.G.73

What are the coordinates of the center of the circle represented by the equation

$$(x + 3)^2 + (y - 4)^2 = 25?$$

[A] (-3,4)

[B] (-3,-4)

[C] (3,-4)

[D] (3,4)

13. 080404b, P.I. G.G.73

A circle has the equation $(x+1)^2 + (y-3)^2 = 16$. What are the coordinates of its center and the length of its radius?

- [A] (1,-3) and 4 [B] (-1,3) and 16
[C] (-1,3) and 4 [D] (1,-3) and 16

14. 010620b, P.I. G.G.73

The center of a circle represented by the equation $(x-2)^2 + (y+3)^2 = 100$ is located in Quadrant

- [A] II [B] IV [C] III [D] I

15. 060008a

Which equation represents a circle whose center is (3, -2)?

- [A] $(x+3)^2 + (y-2)^2 = 4$
[B] $(x-2)^2 + (y+3)^2 = 4$
[C] $(x-3)^2 + (y+2)^2 = 4$
[D] $(x+2)^2 + (y-3)^2 = 4$

16. 060110b

The center of a circular sunflower with a diameter of 4 centimeters is $(-2,1)$. Which equation represents the sunflower?

- [A] $(x-2)^2 + (y+1)^2 = 2$
[B] $(x+2)^2 + (y-1)^2 = 2$
[C] $(x-2)^2 + (y-1)^2 = 4$
[D] $(x+2)^2 + (y-1)^2 = 4$

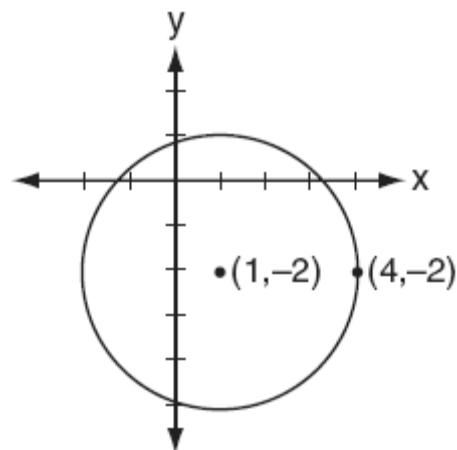
17. 010514b, P.I. G.G.71

What is the equation of a circle with center $(-3,1)$ and radius 7?

- [A] $(x-3)^2 + (y+1)^2 = 7$
[B] $(x+3)^2 + (y-1)^2 = 49$
[C] $(x-3)^2 + (y+1)^2 = 49$
[D] $(x+3)^2 + (y-1)^2 = 7$

18. 010716b, P.I. G.G.72

Which equation represents the circle shown in the accompanying graph?

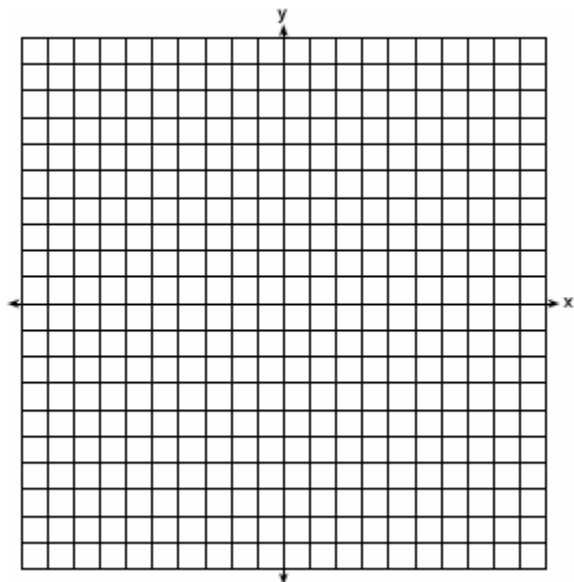


- [A] $(x+1)^2 + (y-2)^2 = 9$
[B] $(x+1)^2 - (y-2)^2 = 9$
[C] $(x-1)^2 + (y+2)^2 = 9$
[D] $(x-1)^2 - (y+2)^2 = 9$

19. 010133a, P.I. G.G.74

John uses the equation $x^2 + y^2 = 9$ to represent the shape of a garden on graph paper.

a Graph $x^2 + y^2 = 9$ on the accompanying grid.

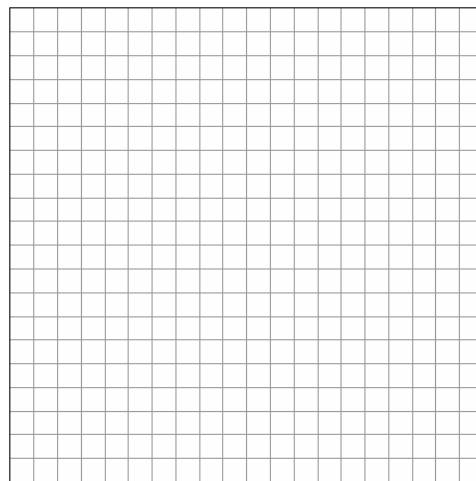


b What is the area of the garden to the nearest square unit?

20. 060334b, P.I. G.G.74

For a carnival game, John is painting two circles, V and M , on a square dartboard.

a On the accompanying grid, draw and label circle V , represented by the equation $x^2 + y^2 = 25$, and circle M , represented by the equation $(x - 8)^2 + (y + 6)^2 = 4$.



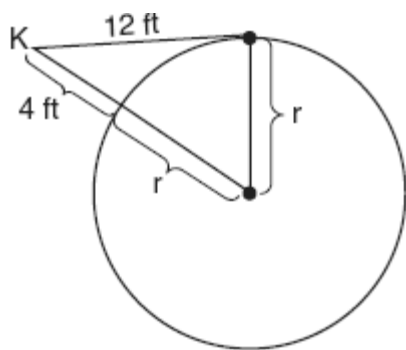
b A point, (x,y) , is randomly selected such that $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$. What is the probability that point (x,y) lies outside both circle V and circle M ?

CHAPTER 12-2

CHORDS SECANTS AND TANGENTS

21. 080518b, P.I. G.G.50

Kimi wants to determine the radius of a circular pool without getting wet. She is located at point K , which is 4 feet from the pool and 12 feet from the point of tangency, as shown in the accompanying diagram.



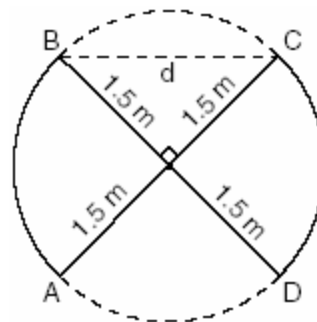
What is the radius of the pool?

- [A] 32 ft [B] $4\sqrt{10}$ ft
[C] 20 ft [D] 16 ft

CHAPTER 12-3

22. 010403b, P.I. G.G.48

An overhead view of a revolving door is shown in the accompanying diagram. Each panel is 1.5 meters wide.

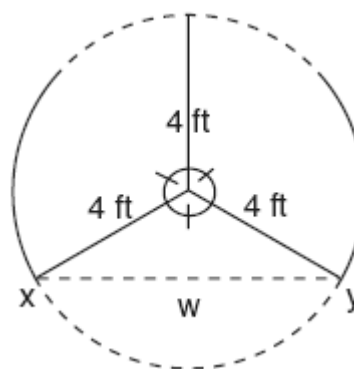


What is the approximate width of d , the opening from B to C ?

- [A] 2.12 m [B] 1.50 m
[C] 3.00 m [D] 1.73 m

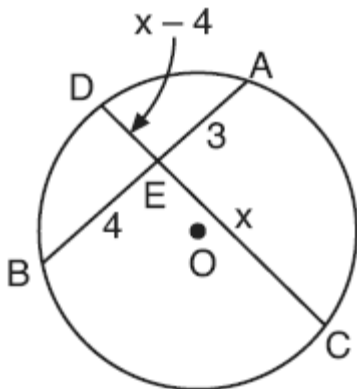
23. 010722b

The accompanying diagram shows a revolving door with three panels, each of which is 4 feet long. What is the width, w , of the opening between x and y , to the *nearest tenth of a foot*?



24. 060723b

In the accompanying diagram of circle O , chords \overline{AB} and \overline{CD} intersect at E . If $AE = 3$, $EB = 4$, $CE = x$, and $ED = x - 4$, what is the value of x ?

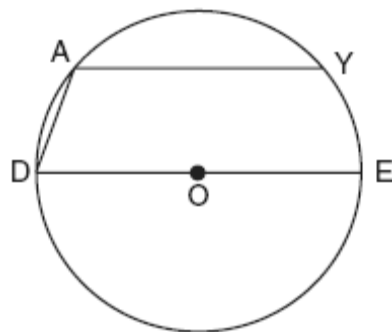


25. 080225b

A toy truck is located within a circular play area. Alex and Dominic are sitting on opposite endpoints of a chord that contains the truck. Alex is 4 feet from the truck, and Dominic is 3 feet from the truck. Meira and Tamara are sitting on opposite endpoints of another chord containing the truck. Meira is 8 feet from the truck. How many feet, to the nearest tenth of a foot, is Tamara from the truck? Draw a diagram to support your answer.

26. 060603b

In the accompanying diagram of circle O , chord \overline{AY} is parallel to diameter \overline{DOE} , \overline{AD} is drawn, and $m\widehat{AD} = 40$.



What is $m\angle DAY$?

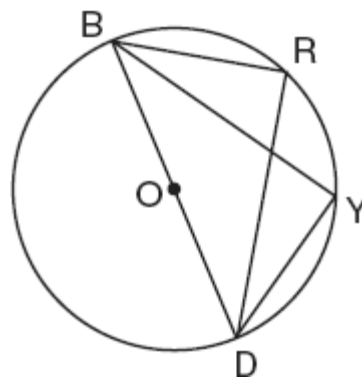
[A] 130 [B] 150 [C] 90 [D] 110

CHAPTER 12-4

PROOFS

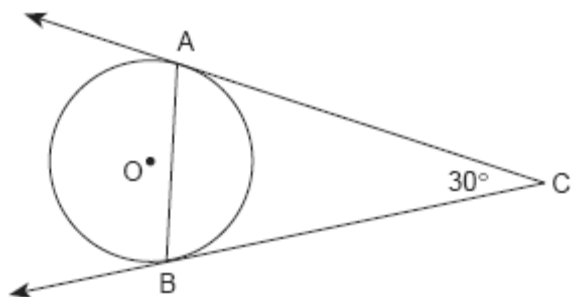
27. 010732b, P.I. G.G.27

In the accompanying diagram, $m\widehat{BR} = 70$, $m\widehat{YD} = 70$, and \overline{BOD} is the diameter of circle O . Write an explanation or a proof that shows $\triangle RBD$ and $\triangle YDB$ are congruent.



28. 010213b, P.I. G.G.50

The accompanying diagram represents circular pond O with docks located at points A and B . From a cabin located at C , two sightings are taken that determine an angle of 30° for tangents \overrightarrow{CA} and \overrightarrow{CB} .



What is $m\angle CAB$?

- [A] 75 [B] 30 [C] 150 [D] 60

29. 010510b, P.I. G.G.51

A small fragment of something brittle, such as pottery, is called a shard. The accompanying diagram represents the outline of a shard from a small round plate that was found at an archaeological dig.

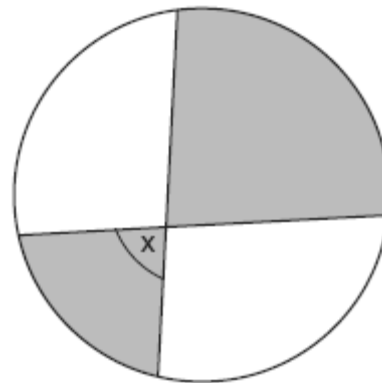


If \overrightarrow{BC} is a tangent to \widehat{AC} at B and $m\angle ABC = 45$, what is the measure of \widehat{AC} , the outside edge of the shard?

- [A] 225° [B] 45° [C] 135° [D] 90°

30. 080408b, P.I. G.G.53

The accompanying diagram shows a child's spin toy that is constructed from two chords intersecting in a circle. The curved edge of the larger shaded section is one-quarter of the circumference of the circle, and the curved edge of the smaller shaded section is one-fifth of the circumference of the circle.

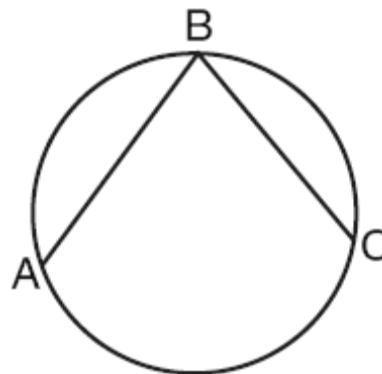


What is the measure of angle x ?

- [A] 108° [B] 40° [C] 72° [D] 81°

31. 060203b, P.I. G.G.53

In the accompanying diagram, the length of \widehat{ABC} is $\frac{3\pi}{2}$ radians.



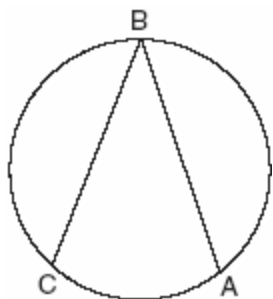
(Not drawn to scale)

What is $m\angle ABC$?

- [A] 72 [B] 36 [C] 53 [D] 45

32. 080107b, P.I. G.G.53

The new corporate logo created by the design engineers at Magic Motors is shown in the accompanying diagram.

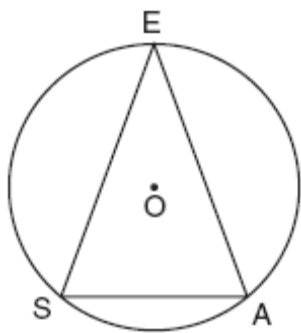


If chords \overline{BA} and \overline{BC} are congruent and $m\widehat{BC} = 140$, what is $m\angle B$?

[A] 140 [B] 80 [C] 280 [D] 40

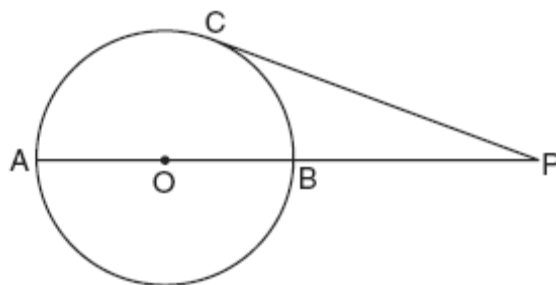
33. 080629b, P.I. G.G.51

A machine part consists of a circular wheel with an inscribed triangular plate, as shown in the accompanying diagram. If $\overline{SE} \cong \overline{EA}$, $SE = 10$, and $m\widehat{SE} = 140$, find the length of \overline{SA} to the nearest tenth.



34. 010721b, P.I. G.G.53

In the accompanying diagram of circle O , diameter \overline{AOB} is extended through B to external point P , tangent \overline{PC} is drawn to point C on the circle, and $m\widehat{AC} : m\widehat{BC} = 7 : 2$. Find $m\angle CPA$.



(Not drawn to scale)

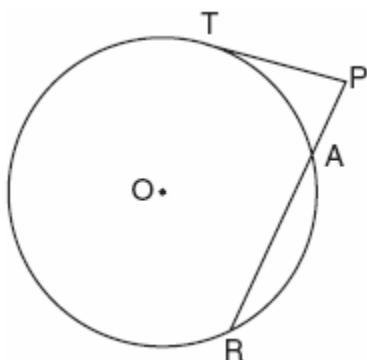
35. 060132b, P.I. G.G.51

Point P lies outside circle O , which has a diameter of \overline{AOC} . The angle formed by tangent \overline{PA} and secant \overline{PBC} measures 30° . Sketch the conditions given above and find the number of degrees in the measure of minor arc CB .

36. 060433b, P.I. G.G.53

The accompanying diagram shows a circular machine part that has rods \overline{PT} and \overline{PAR} attached at points T , A , and R , which are located on the circle;

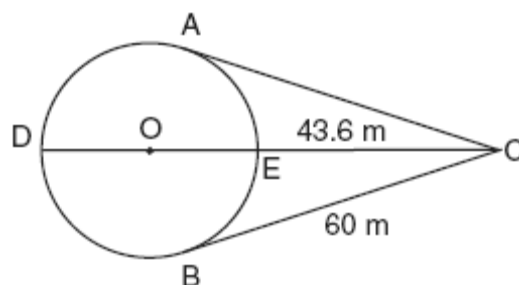
$m\widehat{TA} : m\widehat{AR} : m\widehat{RT} = 1 : 3 : 5$; $RA = 12$ centimeters; and $PA = 5$ centimeters.



Find the measure of $\angle P$, in degrees, and find the length of rod \overline{PT} , to the nearest tenth of a centimeter.

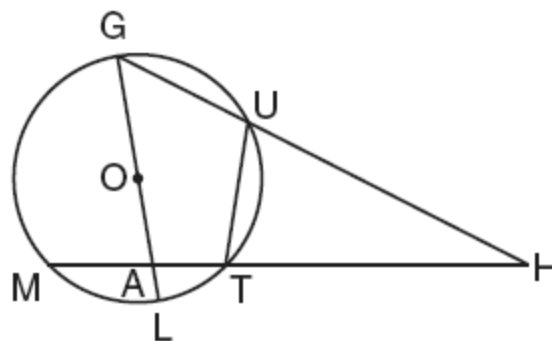
37. 060534b, P.I. G.G.53

An architect is designing a park with an entrance represented by point C and a circular garden with center O , as shown in the accompanying diagram. The architect plans to connect three points on the circumference of the garden, A , B , and D , to the park entrance, C , with walkways so that walkways \overline{CA} and \overline{CB} are tangent to the garden, walkway \overline{DOEC} is a path through the center of the garden, $m\widehat{ADB} : m\widehat{AEB} = 3 : 2$, $BC = 60$ meters, and $EC = 43.6$ meters. Find the measure of the angle between walkways \overline{CA} and \overline{CB} . Find the diameter of the circular garden, to the nearest meter.



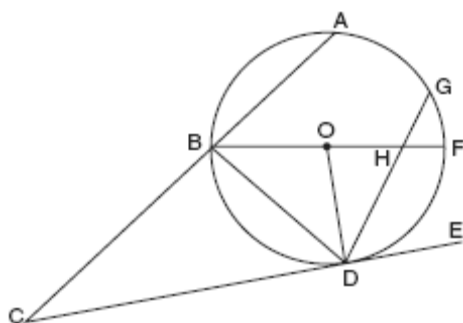
38. 080333b, P.I. G.G.53

Given circle O with diameter \overline{GOAL} ; secants \overline{HUG} and \overline{HTAM} intersect at point H ; $m\widehat{GM} : m\widehat{ML} : m\widehat{LT} = 7 : 3 : 2$; and chord $\overline{GU} \cong$ chord \overline{UT} . Find the ratio of $m\angle UGL$ to $m\angle H$.



39. 080633b, P.I. G.G.53

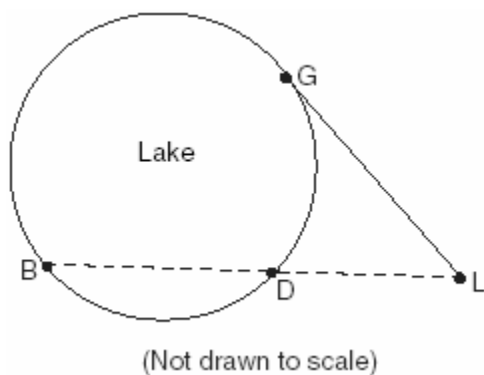
In the accompanying diagram, circle O has radius \overline{OD} , diameter \overline{BOHF} , secant \overline{CBA} , and chords \overline{DHG} and \overline{BD} ; \overline{CE} is tangent to circle O at D ; $m\widehat{DF} = 80$; and $m\widehat{BA} : m\widehat{AG} : m\widehat{GF} = 3 : 2 : 1$. Find $m\widehat{GF}$, and $m\angle BHD$, $m\angle BDG$, $m\angle GDE$, $m\angle C$, and $m\angle BOD$.



CHAPTER 12-6

40. 080103b, P.I. G.G.53

In the accompanying diagram, cabins B and G are located on the shore of a circular lake, and cabin L is located near the lake. Point D is a dock on the lake shore and is collinear with cabins B and L . The road between cabins G and L is 8 miles long and is tangent to the lake. The path between cabin L and dock D is 4 miles long.

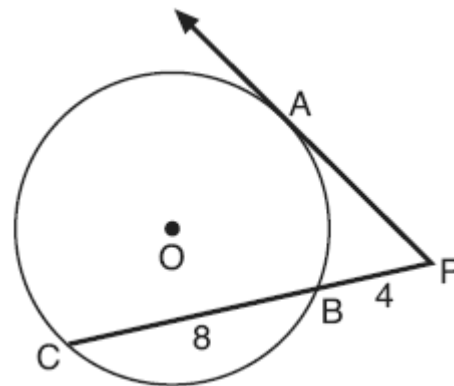


What is the length, in miles, of \overline{BD} ?

- [A] 12 [B] 8 [C] 24 [D] 4

41. 080719b, P.I. G.G.53

In the accompanying diagram, \overline{PA} is tangent to circle O at A , \overline{PBC} is a secant, $PB = 4$, and $BC = 8$.

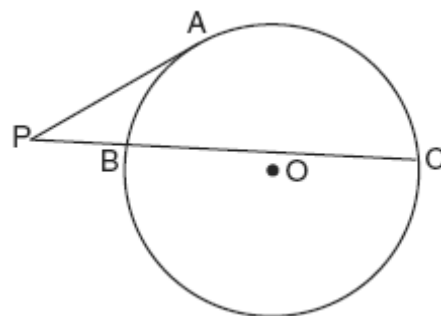


What is the length of \overline{PA} ?

- [A] $4\sqrt{6}$ [B] 4 [C] $4\sqrt{3}$ [D] $4\sqrt{2}$

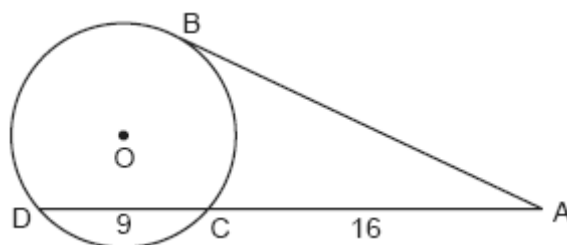
42. 010623b, P.I. G.G.53

In the accompanying diagram, \overline{PA} is tangent to circle O at A , secant \overline{PBC} is drawn, $PB = 4$, and $BC = 12$. Find PA .



43. 010821b, P.I. G.G.53

In the accompanying diagram, \overline{AB} is tangent to circle O at B . If $AC = 16$ and $CD = 9$, what is the length of \overline{AB} ?



[1] C

[2] (5,1), and appropriate work is shown, such as a graph using the slope or $2 = \frac{x-1}{2}$ and

$$3 = \frac{y+5}{2}.$$

[1] Both (2,3) and (-1,5) are plotted correctly, but one graphing error is made in finding the other endpoint.

or [1] Appropriate work is shown, but one conceptual error is made.

or [1] Appropriate work is shown, but only $x = 5$ or $y = 1$ is found.

or [1] Appropriate work is shown, and the correct endpoint is designated, but the coordinates are not stated.

or [1] (5,1), but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[2] incorrect procedure.

[3] C

[3] The circle is graphed correctly, and appropriate work shows that (5,-2) does not lie on the circle.

[2] The circle is graphed correctly, but the work fails to show that (5,-2) does not lie on the circle.

[1] The circle is graphed incorrectly, but the location of (5,-2) is determined appropriately, based on the incorrect graph.

[0] Yes or no, but no work is shown.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[4] obviously incorrect procedure.

[5] D

[6] D

a [2] A correct circle is sketched with its center at (2,1) and a radius of 3 and the line $2x + y = 8$ is drawn.

[1] Only one of the graphs is sketched correctly.

b [1] 2

or [1] The correct number of intersections is found, based on the incorrect graphs drawn in part a.

a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[7] obviously incorrect procedure.

[4] Both the parabola and the circle are graphed correctly and the number of points of intersection is stated as three.

[3] Appropriate work is shown, but one graphing error is made, but an appropriate number of points of intersection is stated.

or [3] Both graphs are drawn correctly, but the number of points of intersection is missing or is incorrect.

[2] Appropriate work is shown, but two or more graphing errors are made, but an appropriate number of points of intersection is stated.

[1] Both graphs are drawn incorrectly, but an appropriate number of points of intersection is stated.

or [1] Either the parabola or the circle is graphed correctly, but no further correct work is shown.

or [1] Three points of intersection, but no work is shown and no graphs are drawn.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[8] incorrect procedure.

- [4] (3,4) and $(-3,-4)$, and a correct algebraic or graphic solution is shown.
- [3] Appropriate work is shown, but one computational or graphing error is made.
- or [3] Appropriate work is shown for an algebraic or graphic solution, but only one correct ordered pair is found or the correct values are found only for x or for y .
- [2] Appropriate work is shown, but two or more computational or graphing errors are made.
- or [2] Both equations are graphed correctly, but neither ordered pair is identified.
- or [2] The line is graphed correctly, but the circle is graphed as a semicircle, and only one correct solution is identified.
- or [2] An incorrect quadratic equation of equal difficulty is solved appropriately, and an appropriate solution or solutions are found.
- or [2] The linear equation is graphed correctly and correct points of the circle are graphed, but the points are connected to form a quadrilateral, but appropriate ordered pairs are identified.
- [1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
- or [1] One equation is graphed correctly, but no further correct work is shown.
- or [1] An incorrect equation of a lesser degree of difficulty, such as a linear equation, is solved appropriately, and an appropriate solution or solutions are found.
- or [1] A correct quadratic equation is set equal to zero, but no further correct work is shown.
- or [1] (3,4) and $(-3,-4)$, but no work is shown.
- [0] (3,4) or $(-3,-4)$, but no work is shown.
- or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [9] _____

- [4] $x = 7$, and appropriate algebraic work is shown or a correct sketch of the graph of the circles is drawn.
- [3] Appropriate work is shown, but one computational or graphing error is made, but an appropriate equation is written.
- or [3] The two points of intersection are correctly identified, but the equation is missing or is incorrect.
- [2] Appropriate work is shown, but two or more computational or graphing errors are made.
- or [2] Appropriate work is shown, but one conceptual error is made.
- or [2] Both circles are graphed correctly, but no further correct work is shown.
- [1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
- or [1] One circle is graphed correctly, but no further correct work is shown.
- or [1] $x = 7$, but no work or sketch is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [10] _____
- [11] C _____
- [12] A _____
- [13] C _____
- [14] B _____
- [15] C _____
- [16] D _____
- [17] B _____
- [18] C _____

- a [2] The student draws a circle with its center at (0,0) and a radius of 3.
[1] The student draws a circle, but it has an incorrect center or radius.
b [2] 28, and appropriate work or the expression 9π is shown, which rounds to 28.
or [2] An appropriate area is shown for the incorrect figure in part a.
[1] The correct expression is shown, but the answer is left as 9π , not rounded, or not rounded correctly.
or [1] An incorrect radius is used, but the area is rounded appropriately.
a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[19]

- a [2] Both circles are drawn and labeled correctly.
[1] Both circles are drawn, but one conceptual error is made.
or [1] Only one circle is drawn and labeled correctly.
b [4] 0.7722345326 or an equivalent decimal answer, and appropriate work is shown, such as $\frac{400 - 29\pi}{400}$.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] The probability that point (x,y) lies inside the circles is found, and appropriate work is shown.
[2] Appropriate work is shown, but more than one computational or rounding error is made.
or [2] Only the correct areas of the square and the circles are found.
[1] Only the correct area of the square or the circles is found.
or [1] 0.7722345326 or an equivalent answer, but no work is shown.
a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[20]

[21] D

[22] A

- [2] 6.9, and appropriate work is shown, such as using special right triangles, the Law of Cosines, or the Law of Sines.
[1] Appropriate work is shown, but one computational or rounding error is made.
or [1] Appropriate work is shown, but one conceptual error is made.
or [1] 6.9, but no work is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[23]

- [2] 6, and appropriate work is shown.
[1] Appropriate work is shown, but one computational error is made.
or [1] Appropriate work is shown, but one conceptual error is made.
or [1] Appropriate work is shown, but the negative root is not rejected.
or [1] A correct equation is written, but no further correct work is shown.
or [1] An incorrect equation of equal difficulty is solved appropriately.
or [1] 6, but no work is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[24]

- [2] 1.5 and a correct diagram is drawn, and appropriate work is shown.
[1] Appropriate work is shown and a correct answer is found, but an incorrect diagram is drawn.
or [1] A correct diagram is drawn, but no further correct work is shown.
or [1] An incorrect diagram is drawn, but an appropriate answer is found.
or [1] 1.5, but no work is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

[25]

[26] D

[4] Appropriate work is shown to explain why or prove the triangles are congruent.

[3] An explanation is written that demonstrates a thorough understanding of the method of proof and contains no conceptual errors, but one reason is missing or is incorrect.

[2] An explanation is written that demonstrates a good understanding of the method of proof, but one conceptual error is made.

[1] Some correct relevant statements about the method of proof are made, but two or three statements or reasons are missing or are incorrect.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[27] incorrect procedure.

[28] A

[29] D

[30] D

[31] D

[32] D

[4] 6.8, and appropriate work is shown, such as using the Law of Cosines or the Law of Sines or right triangle trigonometry.

[3] Appropriate work is shown, but one computational or rounding error is made.

or [3] 3.4, and appropriate work is shown, such as $\cos 70 = \frac{x}{10}$ or $\sin 20 = \frac{x}{10}$.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or [2] Appropriate work is shown, but one conceptual error is made, such as using an incorrect trigonometric function.

or [2] Correct substitution is made into the Law of Sines or the Law of Cosines, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or [1] The measures of \widehat{EA} and \widehat{SA} are found correctly, but no further correct work is shown.

or [1] The measures of the three angles of triangle SEA are found correctly, but no further correct work is shown.

or [1] 6.8, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[33] incorrect procedure.

[2] 50, and appropriate work is shown, such as $m\widehat{AC} = 140$, $m\widehat{BC} = 40$, and $m\angle CPA = \frac{1}{2}(140 - 40)$.

[1] Appropriate work is shown, but one computational error is made.

or [1] Appropriate work is shown, but one conceptual error is made.

or [1] $m\widehat{AC}$ and $m\widehat{BC}$ are found correctly, but no further correct work is shown.

or [1] 50, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[34] incorrect procedure.

[4] 60° , and an appropriate sketch is drawn, and appropriate work is shown.

[3] A correct sketch is shown, and $m\widehat{AB}$ is correct.

or [3] A correct sketch is shown, but one computational error is made, leading to an incorrect $m\widehat{AB}$, but $m\widehat{CB}$ is appropriate, based on the incorrect $m\widehat{AB}$.

[2] A correct sketch is shown, but an incorrect procedure is used to find either the correct or incorrect $m\widehat{AB}$, but $m\widehat{CB}$ is appropriate, based on the incorrect $m\widehat{AB}$.

or [2] An incorrect sketch is shown, but an appropriate $m\widehat{CB}$ is found, based on the incorrect sketch.

[1] Only a correct sketch is shown.

or [1] 60° , but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[35] incorrect procedure.

[6] 80 and 9.2, and appropriate work is shown.

[5] Appropriate work is shown, but one computational or rounding error is made.

[4] Appropriate work is shown, but two or more computational or rounding errors are made.

or [4] Appropriate work is shown, but one conceptual error is made in solving for one of the values.

or [4] 80, and appropriate work is shown, but the length of \overline{PT} is not found or is found incorrectly.

or [4] The measure of all three arcs and the length of \overline{PT} are found correctly, but the measure of $\angle P$ is not found or is found incorrectly.

[3] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

[2] Appropriate work is shown, but one conceptual error is made in solving for each value.

or [2] 80 and 9.2, but no work is shown.

or [2] 9.2, and appropriate work is shown, but no further correct work is shown.

or [2] The measures of all three arcs are found correctly, but no further correct work is shown.

[1] 80 or 9.2, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[36] incorrect procedure.

- [6] $m\angle ACB = 36$ and $DOE = 39$, and appropriate work is shown. [If trigonometry is used to find that $m\angle ACB = 35.98138002$, allow full credit for the full display of the calculator or any correctly rounded response.]
- [5] Appropriate work is shown, but one computational or rounding error is made.
- [4] Appropriate work is shown, but two or more computational or rounding errors are made.
- [3] Appropriate work is shown, but one conceptual error is made.
- or [3] $m\angle ACB = 36$, and appropriate work is shown, but no further correct work is shown.
- or [3] $DOE = 39$, and appropriate work is shown, but no further correct work is shown.
- [2] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- or [2] $m\angle ACB = 36$ and $DOE = 39$, but no work is shown.
- [1] The measures of the arcs are found correctly, but no further correct work is shown.
- or [1] $m\angle ACB = 36$ or $DOE = 39$, but no work is shown.
- [0] 36 and 39, but no work is shown and the answers are not labeled.
- or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [37] _____

- [6] $\frac{2}{1}$ or 2:1 or an equivalent ratio, and appropriate work is shown.
- [5] Appropriate work is shown, but one computational error is made, but an appropriate ratio is found.
- or [5] Appropriate work is shown, but the answer is not written as a ratio.
- or [5] Appropriate work is shown, but the ratio is reversed or is simplified incorrectly.
- [4] Appropriate work is shown, but two or more computational errors are made, but an appropriate ratio is found.
- or [4] Correct measures are found for all the arcs and the angles, and appropriate work is shown, but no ratio is found.
- or [4] Correct measures are found for all the arcs, but the measure of one angle is found incorrectly, but an appropriate ratio is found.
- [3] One conceptual error is made, but appropriate work is shown, and an appropriate ratio is found.
- or [3] Correct measures are found for all the arcs, but the measures of both angles are found incorrectly, but an appropriate ratio is found.
- [2] Correct measures are found for all the arcs, but no further correct work is shown.
- [1] Only the value of x is found correctly, and appropriate work is shown.
- or [1] $\frac{2}{1}$ or 2:1 or an equivalent ratio, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [38] _____

[6] $m\widehat{GF} = 30$, $m\angle BHD = 65$,
 $m\angle BDG = 75$, $m\angle GDE = 55$, $m\angle C = 35$,
and $m\angle BOD = 100$, and appropriate work is
shown.

[5] $m\widehat{GF}$ is determined correctly, but $m\widehat{BD}$
is determined incorrectly, but all five of the
angle measures are determined appropriately.

or [5] $m\widehat{GF}$ is determined incorrectly, but all
five of the angle measures are determined
appropriately, based on the incorrect arc
measure.

or [5] $m\widehat{GF}$ is determined correctly, but only
four of the angle measures are determined
correctly.

[4] $m\widehat{GF}$ is determined incorrectly, and only
four of the angle measures are determined
appropriately, based on the incorrect arc
measure.

or [4] $m\widehat{GF}$ is determined correctly, but only
three of the angle measures are determined
correctly.

[3] $m\widehat{GF}$ is determined incorrectly, and only
three of the angle measures are determined
appropriately, based on the incorrect arc
measure.

or [3] $m\widehat{GF}$ is determined correctly, but only
two of the angle measures are determined
correctly.

[2] $m\widehat{GF}$ is determined incorrectly, and only
two of the angle measures are determined
appropriately, based on the incorrect arc
measure.

or [2] $m\widehat{GF}$ is determined correctly, but only
one angle measure is determined correctly.

[1] $m\widehat{GF}$ is determined incorrectly, and only
one angle measure is determined
appropriately.

or [1] $m\widehat{GF}$ is determined correctly, but no
further correct work is shown.

[0] A zero response is completely incorrect,
irrelevant, or incoherent or is a correct
response that was obtained by an obviously

[39] incorrect procedure.

[40] A

[41] C

[2] 8, and appropriate work is shown, such as
 $(PA)^2 = 4 \times 16 = 64$.

[1] Appropriate work is shown, but one
computational error is made.

or [1] Appropriate work is shown, but one
conceptual error is made, such as failing to
reject the negative root.

or [1] 8, but no work is shown.

[0] A zero response is completely incorrect,
irrelevant, or incoherent or is a correct
response that was obtained by an obviously

[42] incorrect procedure.

[2] 20, and appropriate work is shown.

[1] Appropriate work is shown, but one
computational error is made.

or [1] Appropriate work is shown, but one
conceptual error is made.

or [1] A correct equation is written, but no
further correct work is shown.

or [1] 20, but no work is shown.

[0] A zero response is completely incorrect,
irrelevant, or incoherent or is a correct
response that was obtained by an obviously

[43] incorrect procedure.