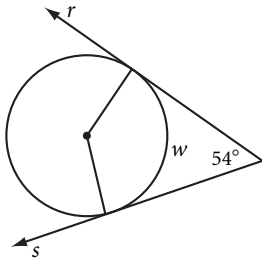


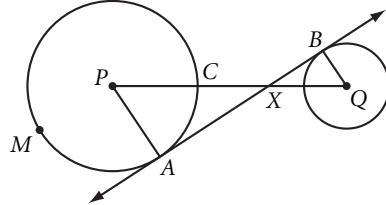
# Lesson 9.1 • Tangent Properties

Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

1. Rays  $r$  and  $s$  are tangents.  $w =$  \_\_\_\_\_

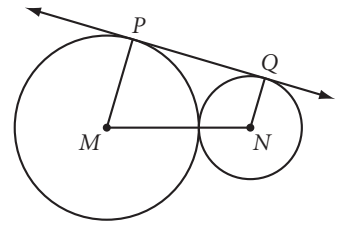


2.  $\overleftrightarrow{AB}$  is tangent to both circles and  $m\widehat{AMC} = 295^\circ$ .  $m\angle BQX =$  \_\_\_\_\_

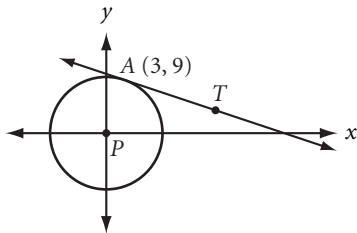


3.  $\overleftrightarrow{PQ}$  is tangent to two externally tangent noncongruent circles,  $M$  and  $N$ .

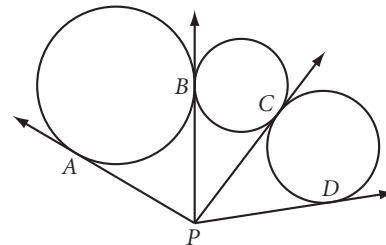
- a.  $m\angle NQP =$  \_\_\_\_\_,  $m\angle MPQ =$  \_\_\_\_\_  
 b. What kind of quadrilateral is  $MNQP$ ? Explain your reasoning.



4.  $\overleftrightarrow{AT}$  is tangent to circle  $P$ . Find the equation of  $\overleftrightarrow{AT}$ .



5.  $\overline{PA}$ ,  $\overline{PB}$ ,  $\overline{PC}$ , and  $\overline{PD}$  are tangents. Explain why  $\overline{PA} \cong \overline{PD}$ .



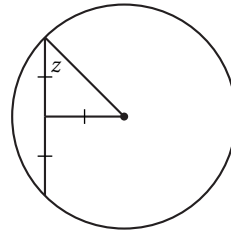
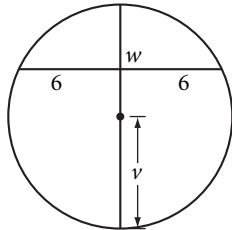
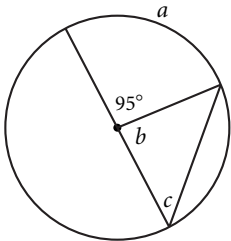
6. Circle  $A$  has diameter 16.4 cm. Circle  $B$  has diameter 6.7 cm.  
 a. If  $A$  and  $B$  are internally tangent, what is the distance between their centers?  
 b. If  $A$  and  $B$  are externally tangent, what is the distance between their centers?
7. Construct a circle,  $P$ . Pick a point,  $A$ , on the circle. Construct a tangent through  $A$ . Pick a point,  $T$ , on the tangent. Construct a second tangent to the circle through  $T$ .

# Lesson 9.2 • Chord Properties

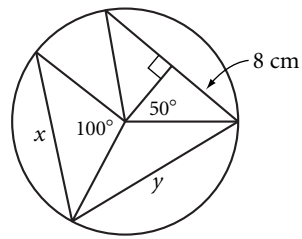
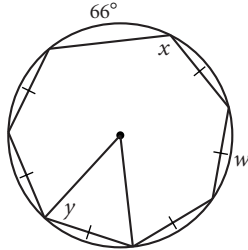
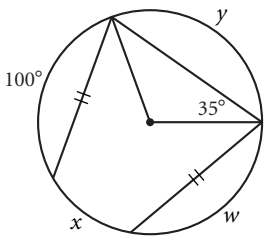
Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

In Exercises 1–6, find each unknown or write “cannot be determined.”

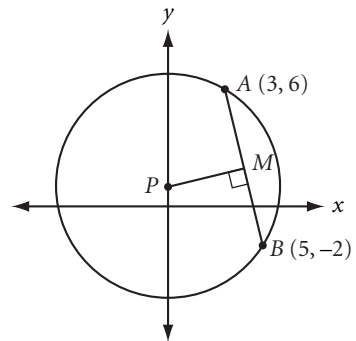
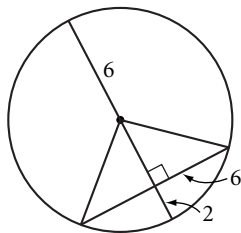
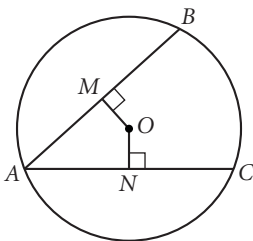
1.  $a = \underline{\hspace{2cm}}$ ,  $b = \underline{\hspace{2cm}}$ ,  $c = \underline{\hspace{2cm}}$       2.  $w = \underline{\hspace{2cm}}$ ,  $v = \underline{\hspace{2cm}}$       3.  $z = \underline{\hspace{2cm}}$



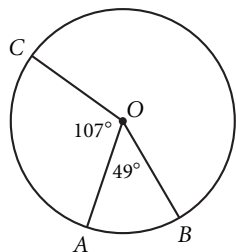
4.  $w = \underline{\hspace{2cm}}$ ,  $x = \underline{\hspace{2cm}}$ ,  $y = \underline{\hspace{2cm}}$       5.  $w = \underline{\hspace{2cm}}$ ,  $x = \underline{\hspace{2cm}}$ ,  $y = \underline{\hspace{2cm}}$       6.  $x = \underline{\hspace{2cm}}$ ,  $y = \underline{\hspace{2cm}}$



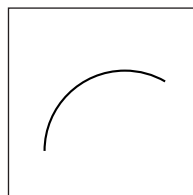
7.  $\overline{AB} \cong \overline{AC}$ .  $\overline{AMON}$  is a \_\_\_\_\_.  
Justify your answer.
8. What's wrong with this picture?
9. Find the coordinates of  $P$  and  $M$ .



10.  $m\widehat{AB} = \underline{\hspace{2cm}}$   
 $m\widehat{ABC} = \underline{\hspace{2cm}}$   
 $m\widehat{BAC} = \underline{\hspace{2cm}}$   
 $m\widehat{ACB} = \underline{\hspace{2cm}}$



11. Trace part of a circle onto patty paper. Fold to find the center. Explain your method.



# Lesson 9.3 • Arcs and Angles

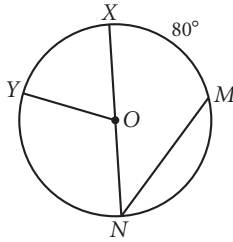
Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

1.  $m\widehat{XM} = 80^\circ$

$m\angle XNM = \underline{\hspace{2cm}}$

$m\widehat{XN} = \underline{\hspace{2cm}}$

$m\widehat{MN} = \underline{\hspace{2cm}}$

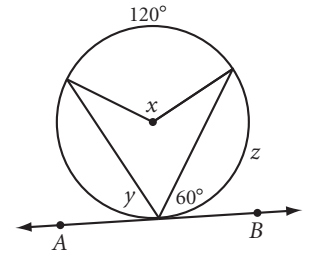


2.  $\overrightarrow{AB}$  is a tangent.

$x = \underline{\hspace{2cm}}$

$y = \underline{\hspace{2cm}}$

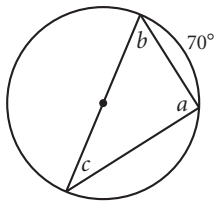
$z = \underline{\hspace{2cm}}$



3.  $a = \underline{\hspace{2cm}}$

$b = \underline{\hspace{2cm}}$

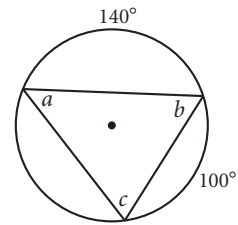
$c = \underline{\hspace{2cm}}$



4.  $a = \underline{\hspace{2cm}}$

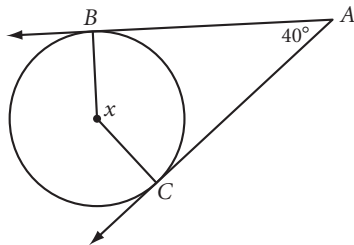
$b = \underline{\hspace{2cm}}$

$c = \underline{\hspace{2cm}}$



5.  $\overrightarrow{AB}$  and  $\overrightarrow{AC}$  are tangents.

$x = \underline{\hspace{2cm}}$



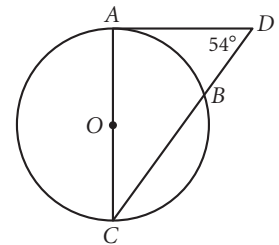
6.  $\overrightarrow{AD}$  is a tangent.  $\overline{AC}$  is a diameter.

$m\angle A = \underline{\hspace{2cm}}$

$m\widehat{AB} = \underline{\hspace{2cm}}$

$m\angle C = \underline{\hspace{2cm}}$

$m\widehat{CB} = \underline{\hspace{2cm}}$

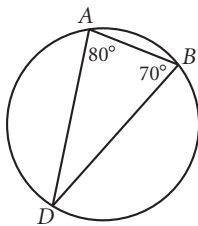


7.  $m\widehat{AD} = \underline{\hspace{2cm}}$

$m\angle D = \underline{\hspace{2cm}}$

$m\widehat{AB} = \underline{\hspace{2cm}}$

$m\widehat{DAB} = \underline{\hspace{2cm}}$

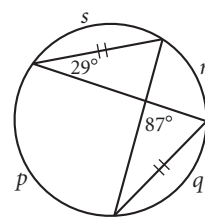


8.  $p = \underline{\hspace{2cm}}$

$q = \underline{\hspace{2cm}}$

$r = \underline{\hspace{2cm}}$

$s = \underline{\hspace{2cm}}$



9. Find the lettered angle and arc measures.  $\overrightarrow{AT}$  and  $\overrightarrow{AZ}$  are tangents.

$a = \underline{\hspace{2cm}}$

$b = \underline{\hspace{2cm}}$

$c = \underline{\hspace{2cm}}$

$d = \underline{\hspace{2cm}}$

$e = \underline{\hspace{2cm}}$

$f = \underline{\hspace{2cm}}$

$g = \underline{\hspace{2cm}}$

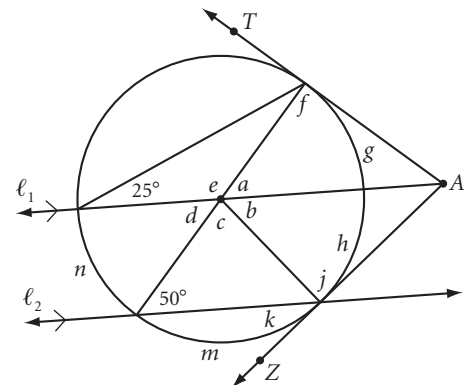
$h = \underline{\hspace{2cm}}$

$j = \underline{\hspace{2cm}}$

$k = \underline{\hspace{2cm}}$

$m = \underline{\hspace{2cm}}$

$n = \underline{\hspace{2cm}}$

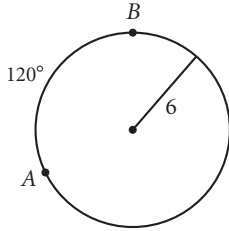


# Lesson 9.6 • Arc Length

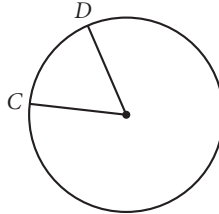
Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

In Exercises 1–10, leave your answers in terms of  $\pi$ .

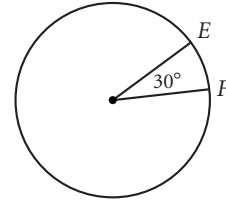
1. Length of  $\widehat{AB}$  = \_\_\_\_\_



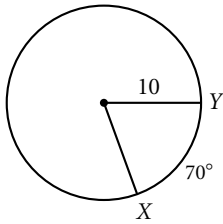
2. The circumference is  $24\pi$  and  $m\widehat{CD} = 60^\circ$ . Length of  $\widehat{CD}$  = \_\_\_\_\_



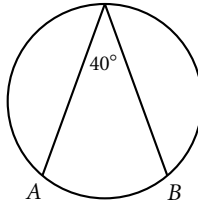
3. The length of  $\widehat{EF}$  is  $5\pi$ . Radius = \_\_\_\_\_



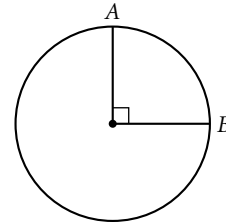
4. Length of  $\widehat{XY}$  = \_\_\_\_\_



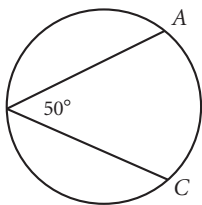
5. The radius is 20. Length of  $\widehat{AB}$  = \_\_\_\_\_



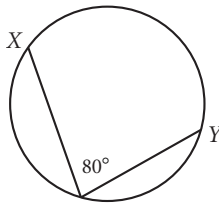
6. The circumference is  $25\pi$ . Length of  $\widehat{AB}$  = \_\_\_\_\_



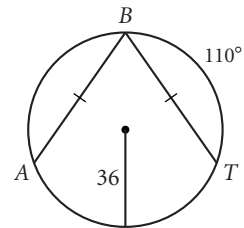
7. The diameter is 40. Length of  $\widehat{AC}$  = \_\_\_\_\_



8. The length of  $\widehat{XY}$  is  $14\pi$ . Diameter = \_\_\_\_\_



9. Length of  $\widehat{AB}$  = \_\_\_\_\_



10. A circle has an arc with measure  $80^\circ$  and length  $88\pi$ . What is the diameter of the circle?

## LESSON 9.1 • Tangent Properties

- $w = 126^\circ$
- $m\angle BQX = 65^\circ$
- a.**  $m\angle NQP = 90^\circ$ ,  $m\angle MPQ = 90^\circ$   
**b.** Trapezoid. Possible explanation:  $\overline{MP}$  and  $\overline{NQ}$  are both perpendicular to  $\overline{PQ}$ , so they are parallel to each other. The distance from  $M$  to  $\overline{PQ}$  is  $MP$ , and the distance from  $N$  to  $\overline{PQ}$  is  $NQ$ . But the two circles are not congruent, so  $MP \neq NQ$ . Therefore,  $\overline{MN}$  is not a constant distance from  $\overline{PQ}$  and they are not parallel. Exactly one pair of sides is parallel, so  $MNQP$  is a trapezoid.
- $y = -\frac{1}{3}x + 10$
- Possible answer: Tangent segments from a point to a circle are congruent. So,  $\overline{PA} \cong \overline{PB}$ ,  $\overline{PB} \cong \overline{PC}$ , and  $\overline{PC} \cong \overline{PD}$ . Therefore,  $\overline{PA} \cong \overline{PD}$ .
- a.** 4.85 cm  
**b.** 11.55 cm

## LESSON 9.3 • Arcs and Angles

- $m\angle XNM = 40^\circ$ ,  $m\widehat{XN} = 180^\circ$ ,  $m\widehat{MN} = 100^\circ$
- $x = 120^\circ$ ,  $y = 60^\circ$ ,  $z = 120^\circ$
- $a = 90^\circ$ ,  $b = 55^\circ$ ,  $c = 35^\circ$
- $a = 50^\circ$ ,  $b = 60^\circ$ ,  $c = 70^\circ$
- $x = 140^\circ$
- $m\angle A = 90^\circ$ ,  $m\widehat{AB} = 72^\circ$ ,  $m\angle C = 36^\circ$ ,  $m\widehat{CB} = 108^\circ$
- $m\widehat{AD} = 140^\circ$ ,  $m\angle D = 30^\circ$ ,  $m\widehat{AB} = 60^\circ$ ,  
 $m\widehat{DAB} = 200^\circ$
- $p = 128^\circ$ ,  $q = 87^\circ$ ,  $r = 58^\circ$ ,  $s = 87^\circ$
- $a = 50^\circ$ ,  $b = 50^\circ$ ,  $c = 80^\circ$ ,  $d = 50^\circ$ ,  $e = 130^\circ$ ,  
 $f = 90^\circ$ ,  $g = 50^\circ$ ,  $h = 50^\circ$ ,  $j = 90^\circ$ ,  $k = 40^\circ$ ,  
 $m = 80^\circ$ ,  $n = 50^\circ$

## LESSON 9.6 • Arc Length

- $4\pi$
- $4\pi$
- 30
- $\frac{35\pi}{9}$
- $\frac{80\pi}{9}$
- $6.25\pi$  or  $\frac{25\pi}{4}$
- $\frac{100\pi}{9}$
- 31.5
- $22\pi$
- 396

## LESSON 9.2 • Chord Properties

- $a = 95^\circ$ ,  $b = 85^\circ$ ,  $c = 47.5^\circ$
- $v$  cannot be determined,  $w = 90^\circ$
- $z = 45^\circ$
- $w = 100^\circ$ ,  $x = 50^\circ$ ,  $y = 110^\circ$
- $w = 49^\circ$ ,  $x = 122.5^\circ$ ,  $y = 65.5^\circ$
- $x = 16$  cm,  $y$  cannot be determined
- Kite. Possible explanation:  $\overline{OM} \cong \overline{ON}$  because congruent chords  $\overline{AB}$  and  $\overline{AC}$  are the same distance from the center.  $\overline{AM} \cong \overline{AN}$  because they are halves of congruent chords. So,  $AMON$  has two pairs of adjacent congruent sides and is a kite.
- The perpendicular segment from the center of the circle bisects the chord, so the chord has length 12 units. But the diameter of the circle is 12 units, and the chord cannot be as long as the diameter because it doesn't pass through the center of the circle.
- $P(0,1)$ ,  $M(4, 2)$
- $m\widehat{AB} = 49^\circ$ ,  $m\widehat{ABC} = 253^\circ$ ,  $m\widehat{BAC} = 156^\circ$ ,  
 $m\widehat{ACB} = 311^\circ$
- Possible answer: Fold and crease to match the endpoints of the arc. The crease is the perpendicular bisector of the chord connecting the endpoints. Fold and crease so that one endpoint falls on any other point on the arc. The crease is the perpendicular bisector of the chord between the two matching points. The center is the intersection of the two creases.

