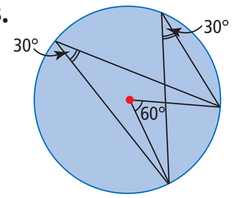
## Chapter 10

### 10.1 Exploring Angles in a Circle, pages 382–385

**3.** ADB and AEB are inscribed angles that are subtended by the same arc as the central ACB. The measure of ACB is 82°. Therefore, ADB and AEB have measures that are half the measure of ACB. Half of 82 is 41. So, the measure of ADB is 41° and the measure of AEB is 41°.

**4. a)** 23°. Example: The inscribed angles subtended by the same arc of a circle are equal. **b)** 46° Example: A central angle is twice the measure of an inscribed angle subtended by the same arc.

**5.**



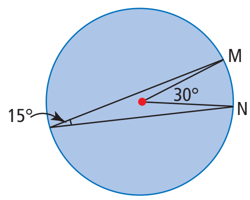

**6. a)** 90°. Example: ∠ABD is an inscribed angle subtended by the diameter of the circle. **b)** 8 cm

**7. a)** 90° **b)** 11.3 cm

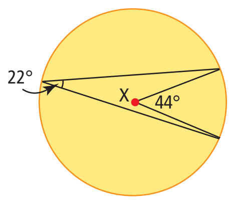
Example: Since △CFG is a right triangle, by the Pythagorean relationship,

$$8^2 + 8^2 = FG^2$$
$$64 + 64 = FG^2$$
$$128 = FG^2$$
$$\sqrt{128} = FG$$
$$11.3 \approx FG$$

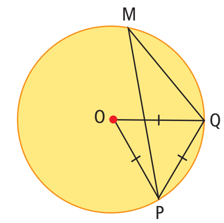
**8.** Example: Jacob could place his flashlight anywhere on the major arc MN.



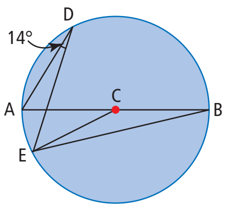

**9.** Example: In the diagram, X is the ideal location.



**10. a)** 76°. Example: ∠ACD is a central angle subtended by the same arc as the inscribed angle ∠ABD. Its measure is twice the inscribed angle's measure. **b)** △ACD is an isosceles triangle because the sides AC and DC are radii of the same circle and are therefore equal.
**c)** 52°. Subtract the measure of ∠ACD, 76°, from 180° and divide by 2.
**11. a)** 130° **b)** 65°. △FCE is an isosceles triangle since sides FC and EC are radii of the same circle. Therefore, the measure of $\angle ECF = 180° - 2(25°) = 130°$. ∠EGF is an inscribed angle subtended by the same arc as the central angle ∠EGF and is therefore one half its measure.
**12. a)** 15° **b)** 24° **c)** 48° **d)** 30°
**13. a)** 56° **b)** 90° **c)** a right triangle **d)** 90°
**14.** No. Example: Neither △ADB or △ACB are right triangles. The Pythagorean relationship can only be used with right triangles.
**15. a)** $x = 45°, y = 45°$ **b)** $x = 60°, y = 120°$
**c)** $x = 15°, y = 30°$ **d)** $x = 35°, y = 45°$
**16.** In the diagram, find the measure of ∠PMQ.




**17.** The measure of ∠ACE = 28° and the measure of ∠ABE = 14°.




**18. a)** $x = 25°, y = 50°$ **b)** $x = 95°, y = 55°$
**19.** 14.14 cm
**20. a)** 9° **b)** 17°
**21. a)** $180° \div 2 = 90°$ **b)** $180° - 90° - 27° = 63°$
**c)** 63°. ∠AEG is opposite ∠BEH and therefore equal.
**d)** 60° **e)** 120°

## 10.2 Exploring Chord Properties, pages 389–393

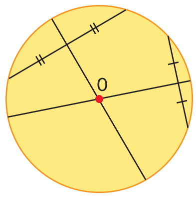
**4.** 9 cm. Example: Since △ACE is a right triangle, by the Pythagorean relationship,

$$\begin{aligned} 12^2 + CE^2 &= 15^2 \\ 144 + CE^2 &= 225 \\ CE^2 &= 81 \\ CE &= \sqrt{81} \\ CE &= 9 \end{aligned}$$

**5.** 8.1 mm. Example: Draw radius HC to form a right triangle. By the Pythagorean relationship,

$$\begin{aligned} 4^2 + 7^2 &= CH^2 \\ 16 + 49 &= CH^2 \\ 65 &= CH^2 \\ \sqrt{65} &= CH \\ 8.1 &\approx CH \end{aligned}$$

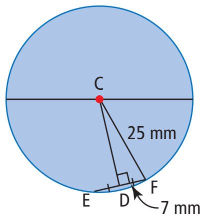
**6.** Example: Hannah should draw any two chords on the circle. She should then locate and draw the perpendicular bisectors of each chord. The intersection of the perpendicular bisectors is the centre of the trampoline.



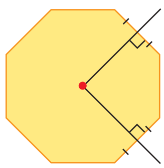

**7.** 30 m. Example: Find the length of EB by using the Pythagorean relationship.

$$\begin{aligned} 8^2 + EB^2 &= 17^2 \\ 64 + EB^2 &= 289 \\ EB^2 &= 225 \\ EB &= \sqrt{225} \\ EB &= 15 \end{aligned}$$

Double the length of EB to obtain the length of AB. 2(15) = 30. The length of AB is 30 m.
**8.** 16 cm
**9. a)** 5.2 **b)** 5.6
**10.** 7 cm
**11.** 16 $cm^2$
**12.** 24 mm




**13.** Example: Locate and draw the perpendicular bisectors of any two sides of the octagon. The point where the two perpendicular bisectors intersect is the centre of the octagon.



**14.** Example: Draw any two chords. Locate and draw the perpendicular bisectors of the two chords. The point of intersection of the two perpendicular bisectors is the centre of the circle. Measure the distance from the centre of the circle to the endpoint of any chord. If the measurement is 8 cm, his diagram was accurate.
**15. a)** 90°. An inscribed angle that subtends a diameter has a measure of 90°. **b)** 12 cm. △ADE is a right triangle. By using the Pythagorean relationship,

$$\begin{aligned} 16^2 + AD^2 &= 20^2 \\ 256 + AD^2 &= 400 \\ AD^2 &= 144 \\ AD &= \sqrt{144} \\ AD &= 12 \end{aligned}$$

**c)** 5.6 cm. △DFE is a right triangle. By using the Pythagorean relationship,

$$15^2 + DF^2 = 16^2$$
$$225 + DF^2 = 256$$
$$DF^2 = 31$$
$$DF = \sqrt{31}$$
$$DF \approx 5.6$$

**d)** 11.2 cm. The length of BD = twice the length of DF.

$$BD = 2DF$$
$$BD = 2(5.6)$$
$$= 11.2$$

**16. a)** 65°. ∠HMP subtends the same arc as the central angle that has a measure of 130°. Therefore, the measure of ∠HMP is half of 130°. **b)** 90°. Segment CJ is the perpendicular bisector of chord MP. Therefore ∠HEM is 90°. **c)** 25°. ∠HEM is 90°. Therefore, △HME is a right triangle, so 180° − 90° − 65° = 25°.

**d)** 25°. ∠MPJ is an inscribed angle subtending the same arc as the inscribed angle of 25°. **e)** 50°. ∠HCP and ∠PCE are supplementary angles. **f)** 40°. △CEP is a right triangle, so 180° − 90° − 50° = 40°.

**17.** 1.2 m

**18.** Example: Gavyn made two mistakes. The first mistake is that the diagram is labelled incorrectly: segment AC should be labelled as 13 cm. The second mistake is that segment AC is the hypotenuse, not a leg. So, by the Pythagorean relationship, $EC^2 + AE^2 = AC^2$. The correct length of AB is 24 cm.

**19.** 15.6 mm

**20. a)** If a bisector of a chord passes through the centre of a circle, then the bisector is perpendicular to the chord.

**b)** 22° and 68°

**21.** Since the bisectors of chords AB and DE pass through the centres of their respective circles, the bisectors are perpendicular to chords AB and DE. Two line segments perpendicular to the same segment are parallel.

## 10.3 Tangents to a Circle, pages 399–403

**3. a)** 90°. ∠BDC is 90° because segment AB is tangent to the circle at point D and segment DC is a radius. **b)** 150°. ∠DCB = 30° because triangle DBC is a right triangle and 180° − 90° − 60° = 30°. Since ∠DCB and ∠DCE are supplementary angles, ∠DEC = 180° − 30° = 150° **c)** △CDE is an isosceles triangle since two sides are radii of the circle and are therefore equal. **d)** 15°. ∠DEC is an inscribed angle subtending the same arc as central angle ∠DCB, which is 30°. Therefore, ∠DEC = $\frac{1}{2}$ the measure of ∠DCB.

**4. a)** △CGL is an isosceles triangle since two sides are radii of the circle and are therefore equal. **b)** 160°. Since △CGL is isosceles, 180° − 10° − 10° = 160°.

**c)** 20°. Since ∠JCH is a central angle subtending the same arc as ∠JGC, which is 10°, the measure of ∠JCH is twice the measure of ∠JGC.

**d)** 90°. Since segment JH is tangent to the circle at point H, it is perpendicular to the radius CH.

**e)** 70°. Since triangle CJH is a right triangle and ∠JCH = 20°, 180° − 90° − 20° = 70°.

**5. a)** 8 m. Since triangle ABD is a right triangle, by using the Pythagorean relationship,

$$6^2 + BD^2 = 10^2$$
$$36 + BD^2 = 100$$
$$BD^2 = 64$$
$$BD = \sqrt{64}$$
$$BD = 8$$

**b)** 4 m. Since chord BE is the same measure as a radius and the diameter is 8 m, the measure of chord BE is 4 m.

**c)** 90°. ∠BED is a right angle because it is an inscribed angle subtending a diameter.

**d)** 7 m. Since △DEB is a right triangle, by using the Pythagorean relationship,

$$4^2 + DE^2 = 8^2$$
$$16 + DE^2 = 64$$
$$DE^2 = 48$$
$$DE = \sqrt{48}$$
$$DE \approx 7$$

**6. a)** 10 mm. The diameter is twice the measure of the radius. **b)** Yes. Since inscribed angle ∠GJH subtends the diameter GH, it is therefore a right angle. **c)** 8.7 mm. Since △GHJ is a right triangle, by using the Pythagorean relationship,

$$5^2 + HJ^2 = 10^2$$
$$25 + HJ^2 = 100$$
$$HJ^2 = 75$$
$$HJ = \sqrt{75}$$
$$HJ \approx 8.7$$

**d)** 90°. Since segment FG is tangent to the circle at point G and segment CG is a radius of the circle, angle FGH = 90°.

**e)** 12.2 mm. Since △FGH is a right triangle, by using the Pythagorean relationship,

$$7^2 + 10^2 = FH^2$$
$$49 + 100 = FH^2$$
$$149 = FH^2$$
$$\sqrt{149} = FH$$
$$12.2 \approx FH$$

**7.** 16.8 m, 11.8 m

**8. a)** 17 m **b)** 12 cm

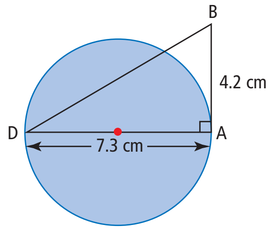
**9. a)** 35° **b)** 164°

**10. a)** Rectangle. Example: It is a rectangle because opposite sides are equal and all angles are 90°.

**b)** 30 cm

**11.** 8.4 cm. Since △ABD is a right triangle, by using the Pythagorean relationship,

$$\begin{aligned} 4.2^2 + 7.3^2 &= DB^2 \\ 17.64 + 53.29 &= DB^2 \\ 70.93 &= DB^2 \\ \sqrt{70.93} &= DB \\ 8.4 &\approx DB \end{aligned}$$




**12. a)** 90°. Since segment AD is tangent to the circle at point D and DB is a diameter, a right angle is formed at the point of tangency. **b)** 45°. Since △ADB is an isosceles right triangle, (180° − 90°) ÷ 2 = 45°. **c)** 45°. ∠DFE is an inscribed angle subtending the same arc as inscribed angle, ∠DBA which is 45°.

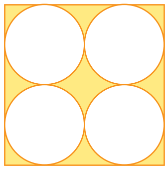
**13. a)** 90°. Since line *l* is tangent to the circle at point H and CH is a radius, a right angle is formed. **b)** 90°. Since chord JK is parallel to line *l* and line *l* is perpendicular to segment CH, segment JK is perpendicular to segment CH. **c)** 8.5 cm. Since a line passing through the centre of a circle that is perpendicular to a chord bisects the chord. **d)** 3.2 cm. Since △CGJ is a right triangle, by using the Pythagorean relationship,

$$\begin{aligned} 8.5^2 + CG^2 &= 9.1^2 \\ 72.25 + CG^2 &= 82.81 \\ CG^2 &= 10.56 \\ CG &= \sqrt{10.56} \\ CG &\approx 3.2 \end{aligned}$$

**14.** $x = 11$, ∠JGH = 53°

**15.** 40°. Example: The inscribed angle of 85° subtends the same arc as a central angle. Therefore, the measure of the central angle is twice the measure of the inscribed angle, or 170°. One of the angles of the right triangle has a measure of 360° − 170° − 140° = 50°. So, 180° − 90° − 50° = 40°.

**16.** Example: The four congruent circles represent watered regions of the square field. The circles are tangent to the sides of the square. If the area of the field is 400 m$^2$, what is the area of the field that is not watered?



Answer: The side length of the square is the square root of the area of the square, or 20 m. The radius of each circle is 5 m. To find the area of the unwatered region, subtract the area of the four circles from the area of the square field.

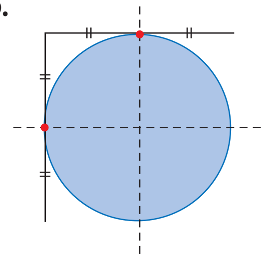
$$\begin{aligned} 400 - 4\pi r^2 &\approx 400 - 314.16 \\ &\approx 85.8 \end{aligned}$$

The area of the unwatered region is 85.8 m$^2$

**17.** 96 cm

**18.** B has coordinates (6, 2). C has coordinates (4, 6).

**19.**



**20.** 146 cm

**21.** 17.6 cm

**22.** 43.6 cm

## Chapter 10 Review, pages 404–405

**1.** radius

**2.** inscribed angle

**3.** chord

**4.** perpendicular bisector

**5. a)** 24° **b)** 48°

**6.** $x = 48°$, $y = 48°$

**7.** No, the central angle inscribed by the same arc as the inscribed angle has a measure that is twice as large.

**8.** 18°

**9.** 90°

**10.** 28°

**11.** Example: The perpendicular bisector of a chord passes through the centre of the circle.

**12.** Example: She should have found the perpendicular bisector of her string and the perpendicular bisector of a second string. The intersection of the two perpendicular bisectors would be the location of the centre of the table.

**13.** 48 m. Since △ACB is a right triangle, by using the Pythagorean relationship,

$$10^2 + AB^2 = 26^2$$
$$100 + AB^2 = 676$$
$$AB^2 = 576$$
$$AB = \sqrt{576}$$
$$AB = 24$$

The radius is 24 m. The diameter AE is twice the radius, or 48 m.

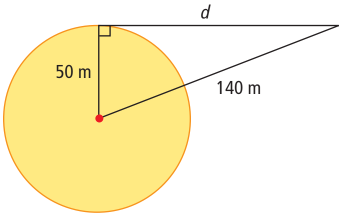
**14.** Example: Two chords should be drawn. Then the perpendicular bisector of each chord should be drawn. The intersection of the two perpendicular bisectors is the centre of the circle. Next, find the measure from the centre to a point on the circle. This distance is the radius, which would be used to find the circumference.

**15.** 6.3 cm

**16.** 133°

**17.** 6 mm

**18.** The horizontal distance was 131 m. The variable, *d*, represents the horizontal distance.




**19. a)** 90°. The line that is tangent to a circle at a point of tangency is perpendicular to the radius at that point. **b)** 42°. △CEF is a right triangle, so $180° - 90° - 48° = 42°$ **c)** 138°. ∠ECD and ∠ECF are supplementary angles, so $180° - 42° = 138°$.
**d)** 21°. △DEC is an isosceles triangle, so ∠DEC = $(180° - 138°) \div 2 = 21°$.
**e)** 69°. ∠AED + ∠DEC + ∠CEF = 180°, so $180° - 90° - 21° = 69°$.
**f)** 21°. ∠EDB is an inscribed angle that subtends the same arc as the central angle ∠ECF, which is 42°, and is therefore one half its measure.

**20. a)** 42° **b)** 48°