CHAPTER

10

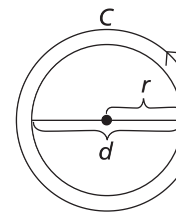
Circle Geometry

Name: ______________________________ Date: ____________

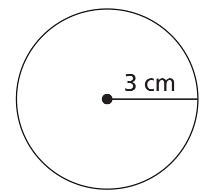
Get Ready

Working With Circles

- $\pi \approx 3.14$ — ≈ means approximately equal to
- diameter: the distance across the circle, passing through the centre; $d = 2r$
- radius: half the distance across the circle, starting at the centre; $r = \frac{d}{2}$
- circumference: the distance around the circle; $C = \pi \times d$ or $C = 2 \times \pi \times r$

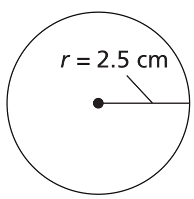


The radius of a circle is 3 cm.
$C = 2 \times \pi \times r$
$C \approx 2 \times 3.14 \times 3$
$C \approx 18.84$
The circumference is about 18.84 cm.

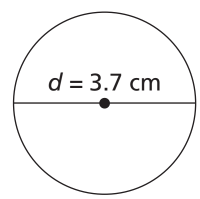


1. Find the circumference of each circle.

a)



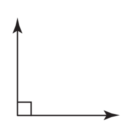
b)



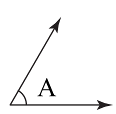
a)		b)
$C = 2 \times \pi \times r$	← Formula →	$C = \pi \times d$
$C \approx 2 \times 3.14 \times$ ________	← Substitute →	________
$C \approx$ ________ cm	← Solve →	________

Working With Angles

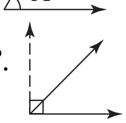
You can estimate the size of an angle by comparing it to a 90º angle.



Estimate ∠A.
∠A is less than 90º



A 45º angle is half of 90º.



∠A is between 45º and 90º. A reasonable estimate for ∠A is 55º.
The actual measure of the angle is 60º.

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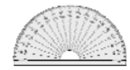
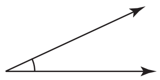
2. Estimate the size of each angle. Then, measure it with a protractor. 

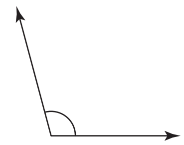
a)



Estimate: _______°

Measurement: _______°

b)



Estimate: _______°

Measurement: _______°

Bisecting Angles

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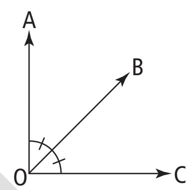
angle bisector

- the line that divides an angle into 2 equal parts
- mark equal angles with the same symbol
- example: OB bisects angle AOC



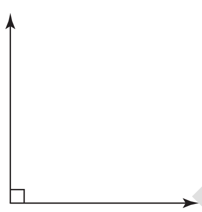
To bisect an angle:

- fold the angle in half

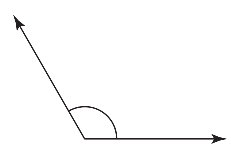
  or
- measure the angle with a protractor and then divide by 2

3. Bisect each angle.

a)



b)



Perpendicular Bisectors

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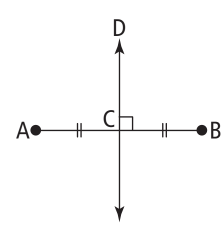
perpendicular bisector

- a line that divides a line segment in half and forms a 90° angle to the line
- example: DC is the perpendicular bisector of AB.



To make a perpendicular bisector:

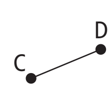
- fold the line in half and use a right triangle to draw a line from the halfway point

  or
- measure the length of the line, divide by 2, mark the halfway point, and use a right triangle to draw a line from that point

4. Draw the perpendicular bisector for each line segment.

a)

b)



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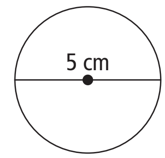
Math Link

Geometry in Design

The circle is an important shape for Aboriginal people. For example, the medicine wheel was often made by putting large rocks in a circle. Architects, graphic designers, and artists also use circles in their work. Answer the questions to explore circles.

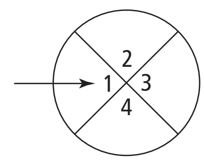
1. On tracing paper, use a compass to draw a circle that has a diameter of at least 5 cm.



2. **a)** Fold the circle in half.
Open the paper and draw a line segment along the fold.
Make sure each end of the line is on the edge of the circle.

b) What is this line called? ____________________

3. **a)** Fold the circle in half again, making a different fold.
Open the paper and draw a line segment along the new fold.



b) Where the 2 lines intersect is called the ____________________.

4. **a)** Estimate the measure of each of the 4 angles around the centre of the circle:

$\angle 1$: ______° $\angle 2$: ______° $\angle 3$: ______° $\angle 4$: ______°

b) Measure each angle with a protractor:

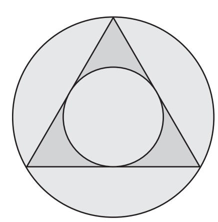
$\angle 1$: ______° $\angle 2$: ______° $\angle 3$: ______° $\angle 4$: ______°

c) How close was your estimate?

____

d) What is the total measure of these 4 angles? ______

5. An environmental club wants to use this logo.



What kind of triangle is this? ____________________
Give 1 reason for your answer.

____

____

6. Brainstorm some businesses that use circles in their advertisements.

____

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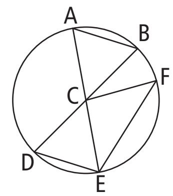
10.1 Warm Up

1. Point C is the centre of the circle.

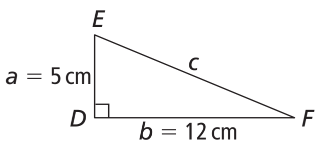


a) List the line segments that are radii. ______________________________

b) List the line segments that are diameters. ____________________

2. Calculate the length of *c* in each right triangle. Use the Pythagorean relationship.

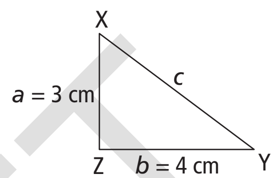
a)



$$a^2 + b^2 = c^2$$
$$DE^2 + DF^2 = EF^2$$
$$\boxed{}^2 + 12^2 = EF^2$$
$$\_\_\_\_\_ + \_\_\_\_\_ = EF^2$$
$$\_\_\_\_\_ = EF^2$$
$$\sqrt{\boxed{}} = EF$$
$$\_\_\_\_\_ = EF$$

The length of EF is ________ cm.

b)



3. Solve.

a) $6^2 =$ ________

b) $10^2 =$ ________

c) $\sqrt{16} =$ ________

d) $\sqrt{49} =$ ________

e) $180 \div 2 =$ ________

f) $90 \div 2 =$ ________

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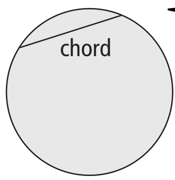
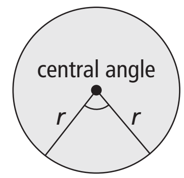
10.1 Exploring Angles in a Circle

chord
- a line segment with both endpoints on the circle



An *endpoint* is on the edge of the circle.

central angle
- an angle created by 2 radii



Radii is the plural of radius.

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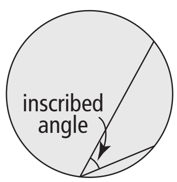
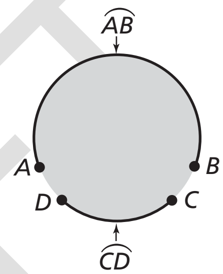
inscribed angle
- an angle formed by 2 chords that have a common endpoint



arc (of a circle)
- a part of the circumference of the circle

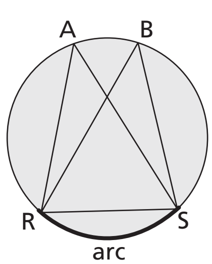


Link the Ideas

Use this information to help you solve circle problems.

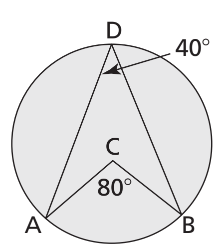
Inscribed Angles
- If 2 inscribed angles share the same arc, they are congruent.
- example: ∠RAS = ∠RBS because the share the same arc, RS.

Congruent means equal.



∠RAS = ∠RBS

Central and Inscribed Angles
- The measure of the central angle is twice the measure of the inscribed angle that shares the same endpoints on the same arc.
- example: central ∠ACB = 2 × inscribed ∠ADB
  80° = 2 × 40°



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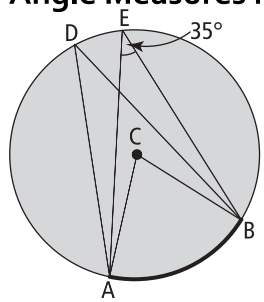
Working Example 1: Determine Angle Measures in a Circle

Point C is the centre of the circle.
∠AEB = 35º

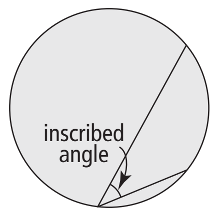


a) What is the measure of ∠ADB? Justify your answer.

Show how you know.

Solution

∠ADB is an inscribed angle.



∠ADB = ∠AEB because the angles share the same ______________, AB.

∠AEB measures _______°. So, ∠ADB measures _______°.

b) What is the measure of ∠ACB? Justify your answer.

Solution

∠ACB is a _______________________ angle.
(*inscribed* or *central*)

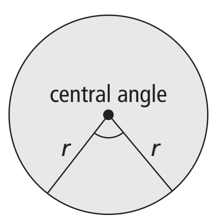
A central angle is twice the measure of an inscribed angle that shares the same endpoints.

∠ACB = 2 × ∠AEB

= 2 × _______°

= _______°

So, ∠ACB is _______°.



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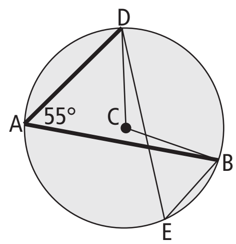
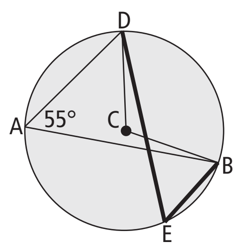
Show You Know

Point C is the centre of the circle.
∠DAB = 55º



a) What is the measure of ∠DEB? Show how you know.



∠DEB is an ____________________ angle.
(*inscribed* or *central*)

∠DEB = ∠DAB because they share the same ____________.

∠DAB is ______°. So, ∠DEB is ______°.

b) What is the measure of ∠DCB? Show how you know.

∠DCB is a ____________________ angle.

∠DCB = ______ × ∠______

= ______ × ______°

= ______°

So, ∠DCB is ______°.

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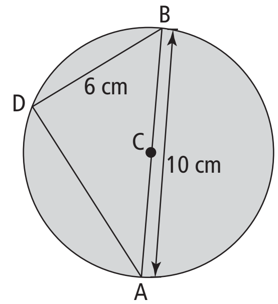
Working Example 2: Use Central and Inscribed Angles to Recognize Relationships

Point C is the centre of the circle.
diameter AB = 10 cm
chord BD = 6 cm



a) What is the measure of ∠ADB? Justify your answer.

Solution

∠ACB is a central angle. A straight angle measures ________°.

Since AB is a straight line, the central angle ∠ACB = ________°.
∠ACB is twice the measure of the inscribed angle ∠ADB because they share the same arc, AB.

∠ADB = ∠ACB ÷ 2

= ________ ÷ 2

= ________°

So, ∠ADB is ________°.

An inscribed angle using the endpoints of a diameter is a right angle.

b) What is the length of chord AD? Justify your answer.

Solution

∠ADB = 90°, so ΔABD is a right triangle.
Use the Pythagorean relationship to find the length of chord AD.

AD and BD are the legs and AB is the hypotenuse.

$$AD^2 + BD^2 = AB^2$$

$6^2 = 6 \times 6$

$$AD^2 + 6^2 = \boxed{}^2$$

AD^2 + ________ = 100

AD^2 + ________ – ________ = 100 – ________ Subtract 36 from both sides.

AD^2 = ________

$$AD = \sqrt{\boxed{}}$$

AD = ________

The length of chord AD is ________ cm.

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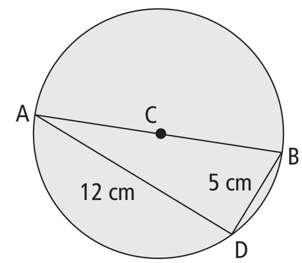
Show You Know

Point C is the centre of the circle.
The central angle is ∠ACB.
AB is the diameter.
chord AD = 12 cm
chord BD = 5 cm



a) What is the measure of ∠ADB? Justify your answer.

inscribed ∠ = central ∠ ÷ 2

∠ADB = ∠________ ÷ 2

= ________°

So, ∠ADB is ________°.

b) What is the length of diameter AB?

$$AD^2 + \boxed{\quad}^2 = AB^2$$

$$\boxed{\quad}^2 + \boxed{\quad}^2 = AB^2$$

________ + ________ = AB^2

________ = AB^2

$$\sqrt{\boxed{\quad}} = AB$$

________ = AB

The length of diameter AB is ________ cm.

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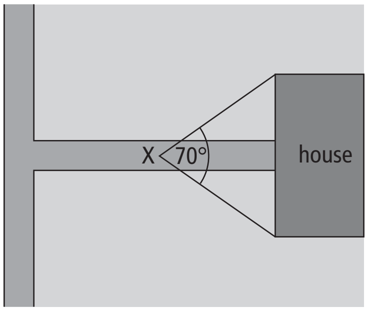
Working Example 3: Use Central and Inscribed Angles to Solve Problems

Jamie photographed his house using a lens with a 70° field of view.
He wants to take another photo, but he only has a lens with a 35° field of view.
Where could he stand to take a photo of the whole house?

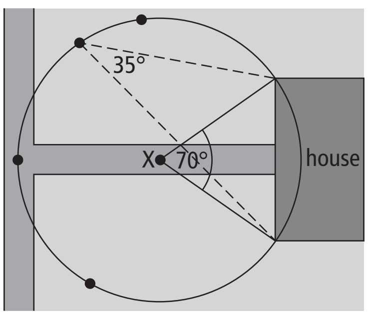


Literacy Link

field of view
- the area you can see through the camera

Solution

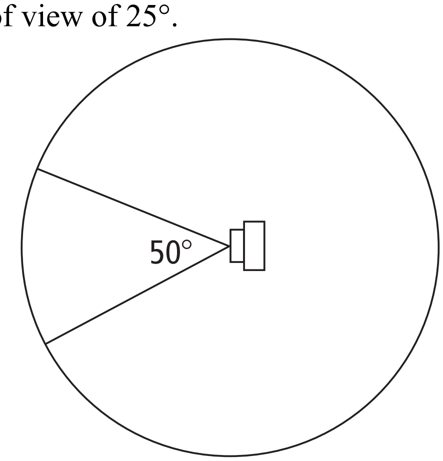
The diagram shows an inscribed angle where Jamie could stand.



Draw another place where Jamie could stand.
❒ Draw a chord from the side of the house to a point on the circle. Label the point A.
❒ Draw another chord from the opposite side of the house to point A. This is an inscribed angle.

Show You Know

A camera has a field of view of 50°. A flashlight has a field of view of 25°.
Where could you put the flashlight so it will cover the same field of view as the camera?
Show your answer on the diagram.



Write 1 reason why you chose this location.

____

____

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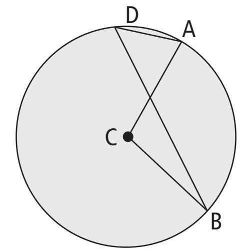
Check Your Understanding

Communicate the Ideas

1. In the diagram, ∠BDA measures half of ∠BCA. Explain why this is true.



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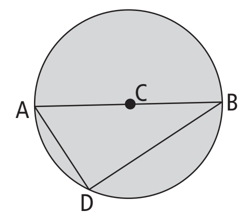
2. Manny drew the diameter of a circle. Then, he drew an inscribed angle that had the same endpoints as the diameter. What is the measure of the inscribed angle? How do you know?



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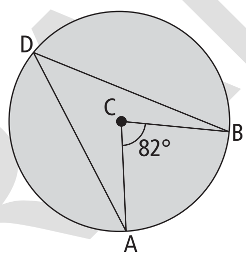
Practise

3. What is the measure of ∠ADB?

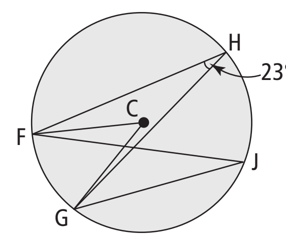


∠ADB = ∠ ________ ÷ ________

= ________ ÷ ________

= ________°

4. **a)** What is the measure of ∠FJG? Give 1 reason for your answer.



∠FJG is an __________________________ angle.

∠FJG = ∠FHG because they share the same ________________.

∠FHG is ________°. So, ∠FJG is ________°.

b) What is the measure of ∠FCG? Justify your answer.

∠FCG is a __________________________ angle.

∠FCG = ________ × ∠________

Central angle = 2 × inscribed angle

= ________ × ________°

= ________°

So, ∠FCG is ________°.

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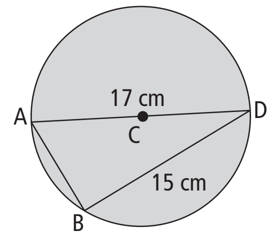
5. Point C is the centre of the circle.
diameter AD = 17 cm
chord BD = 15 cm



a) What is the measure of ∠ABD?

∠ABD = ________ ÷ ________

= ________ ÷ ________

= ________°

So, ∠ADB is ________°.

b) What is the length of chord AB?

Use the Pythagorean relationship.

$$AB^2 + BD^2 = AD^2$$

$$AB^2 + \boxed{}^2 = \boxed{}^2$$

AB^2 + ________ = ________

AB^2 + ________ – ________ = ________ – ________

AB^2 = ________

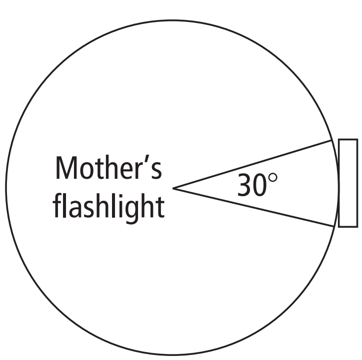
$$AB = \sqrt{\boxed{}}$$

AB = ________

The length of AB is ________ cm.

6. All the lights are out, so Jacob and his mother are using flashlights to find the electrical panel.
Jacob's flashlight shines light through an angle of 15º.
His mother's flashlight shines light through an angle of 30º.
On the diagram, show where Jacob should stand so both flashlights shine on the electrical panel.

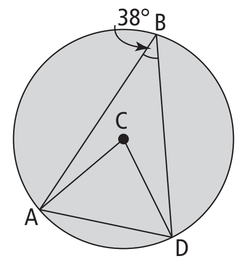
Use an inscribed angle.



Name: ______________________________ Date: ____________

Apply

7. Point C is the centre of the circle.
$\angle ABD = 38^{\circ}$

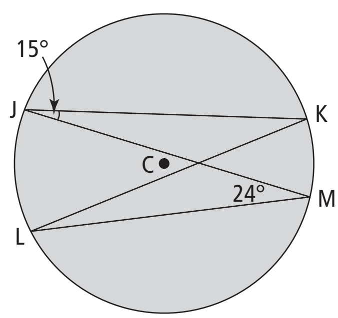


a) What is the measure of $\angle ACD$? Justify your answer.

b) What type of triangle is ΔACD? Circle ISOSCELES or EQUILATERAL.
Give 1 reason for your answer.

____

8. Point C is the centre.
$\angle KJM = 15^{\circ}$
$\angle JML = 24^{\circ}$



What is the measure of each of the following angles?

a) $\angle KLM$

∠KLM shares the same arc as ∠KJM.

b) $\angle JKL$

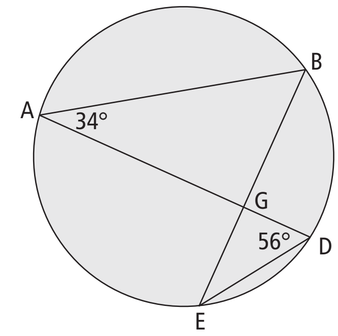
c) $\angle JCL$

d) $\angle KCM$

Draw the angles in the diagram.

Name: ______________________________ Date: ____________

9. In the diagram, ∠BAD = 34° and ∠ADE = 56°.



a) What is the measure of ∠ABE?

Use arc AE.

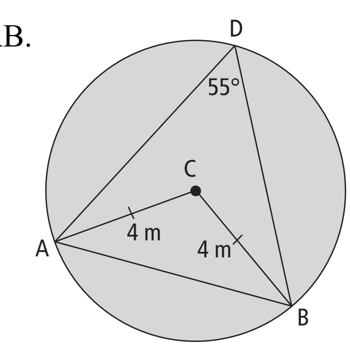
Sentence: ______________________________

b) What is the measure of ∠AGB?

The sum of the angles in a triangle = 180°

Sentence: ______________________________

10. Amanda wants to use the Pythagorean relationship to find the length of AB. Will this work? Give 1 reason for your answer.



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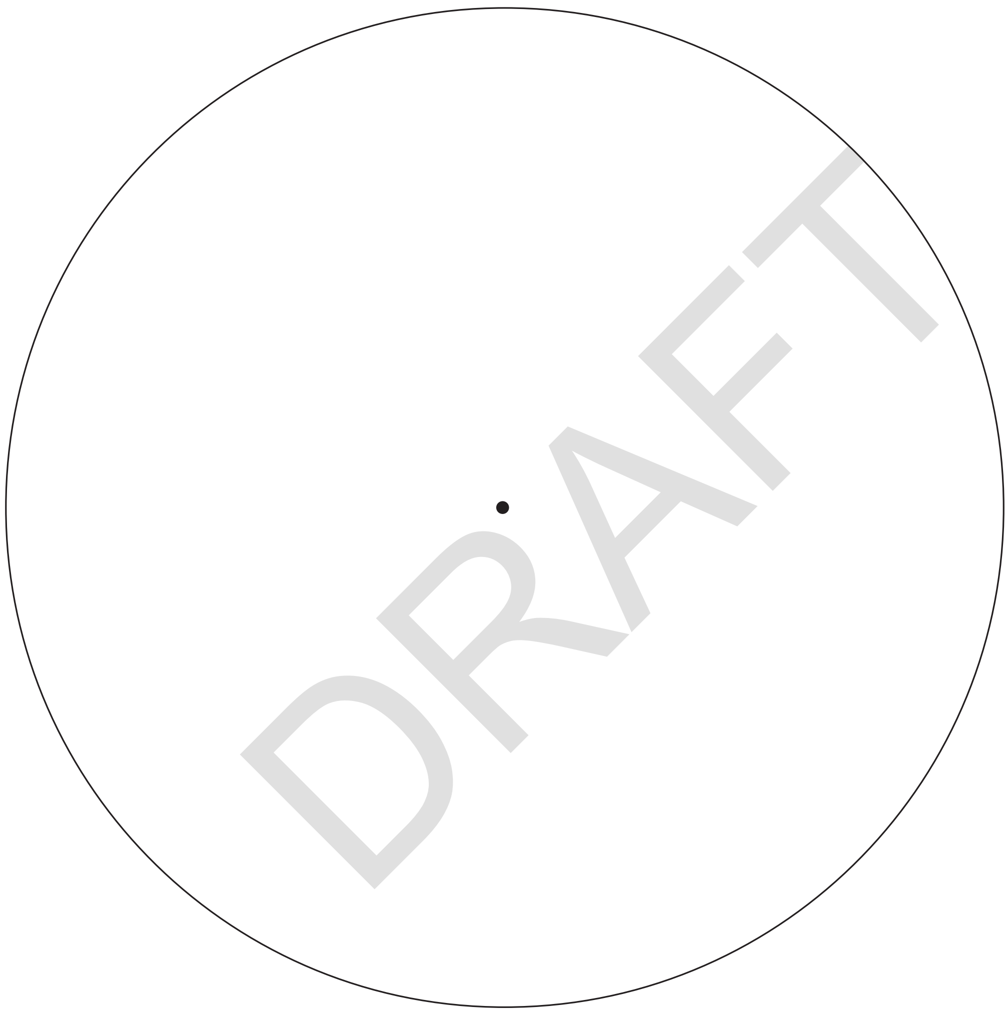
Name: ______________________________ Date: ____________

Math Link

a) Design a piece of art using this circle.
Use only inscribed angles and central angles.
Include:
- at least 3 inscribed angles
- at least 2 central angles



b) Colour 1 central angle blue and 1 inscribed angle red. How are they related?

____

____

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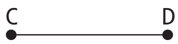
____

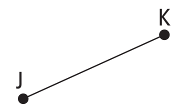
Name: ____ Date: ____________

10.2 Warm Up

1. Find the midpoint of each line segment.

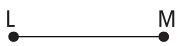
Midpoint means middle or halfway.

a) 

b) 

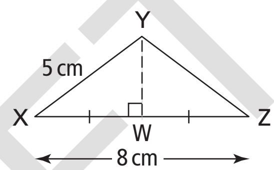
2. Draw a perpendicular bisector of each line segment.

Find the midpoint and draw a perpendicular line.

a) 

b) 

3. Find the height of the isosceles triangle.



XW = ________ cm

$$a^2 + b^2 = c^2$$
$$XW^2 + WY^2 = XY^2$$

$$\boxed{}^2 + WY^2 = 5^2$$

________ + WY^2 = ________

________ – ________ + WY^2 = ________ – ________

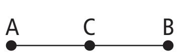
WY^2 = ________

$$WY = \sqrt{\boxed{}}$$

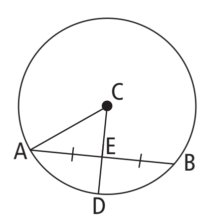
WY = ________

The height of the triangle is ________ cm.

4. Calculate the length of the line segment using the midpoints.

a) 

If AC = 10 cm, then AB = ________ cm.

b) 

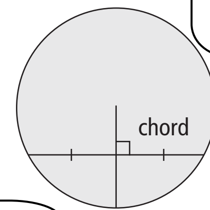
If AB = 9 cm, then AE = ________ cm.

Name: ____ Date: ____________

10.2 Exploring Chord Properties

The tick marks show that the sections are equal.

Link the Ideas



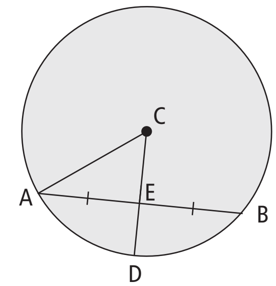
Perpendicular Bisector of a Chord

- A perpendicular line from the centre of a circle to a chord bisects the chord.

Bisect means to divide into 2 equal pieces.

Working Example 1: Bisect a Chord With a Radius

Radius CD bisects chord AB.
chord AB = 8 cm
radius = 5 cm
What is the length of line segment CE? Justify your answer.

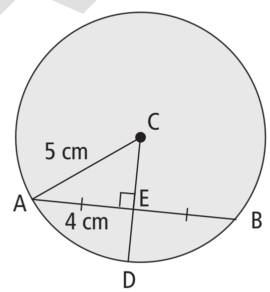


Solution

CD is a radius that bisects chord ________. So, CD is perpendicular to AB.

A perpendicular bisector makes a ________° angle, so ∠AEC is ________°.
CD divides AB in half, so AE = EB.

AB = 8 cm. So, AE and EB each measure ________ cm.
radius AC = 5 cm
Label the length of AC on the diagram.



Since ∠ACE is 90° and you know 2 side lengths,

use the __________________________ relationship
to find the unknown side length.

$$CE^2 + AE^2 = AC^2$$

$$CE^2 + 4^2 = \boxed{}^2$$

$$CE^2 + \_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_$$

$$CE^2 + \_\_\_\_\_\_\_\_ - \_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_ - 16$$

$$CE^2 = \_\_\_\_\_\_\_\_$$

$$CE = \sqrt{\boxed{}}$$

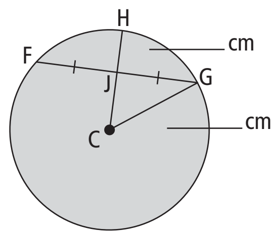
$$CE = \_\_\_\_\_\_\_\_$$

The length of CE is ________ cm.

Name: ____ Date: ______________

Show You Know

Radius CH bisects chord FG.
radius = 10 cm
chord FG = 12 cm
What is the length of CJ?



CH is a radius that bisects chord _______.

GJ = _______ cm

∠GJC = _______° because CH is a _______________________ bisector.
Label the measure of ∠GJC and the lengths of CG and GJ on the diagram.

$$CJ^2 + GJ^2 = CG^2$$

$$CJ^2 + \boxed{}^2 = \boxed{}^2$$

CJ^2 + _______ = _______

CJ^2 + _______ – _______ = _______ – _______

CJ^2 = _______

$$CJ = \sqrt{\boxed{}}$$

CJ = _______

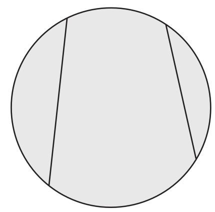
The length of CJ is _______ cm.

Name: ______________________________ Date: ____________

Working Example 2: Use Chord Properties to Solve Problems

Louise wants to drill a hole for an umbrella in a circular table.
How can she find the centre?

Solution



Step 1: Draw 2 chords on the circle.

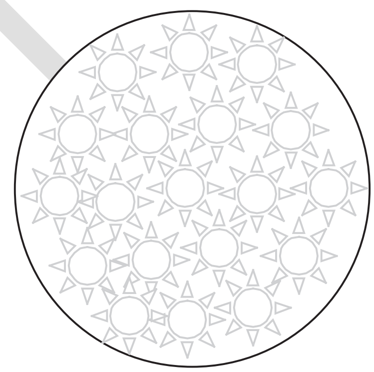
Step 2: ❒ Find the midpoint (middle) of each chord.
Use a ruler or fold the paper.

Step 3: ❒ Use a right triangle ruler to draw the perpendicular bisector of each chord.

Step 4: ❒ Put a dot where the 2 perpendicular bisectors cross. This is the centre of the circle.

Show You Know

Mark wants to plant a tree in the centre of this flowerbed.
Explain how he can find the centre using circle properties.
Draw an example on the circle.



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Check Your Understanding

Communicate the Ideas

1. The diameter of the circle bisects line AB.

a) What do you know about $\angle ADC$?

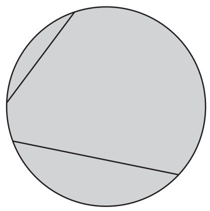
____

b) What do you know about AD and DB?

____

Name: ____________________ Date: __________

2. Explain how to find the centre of the circle using these 2 chords.



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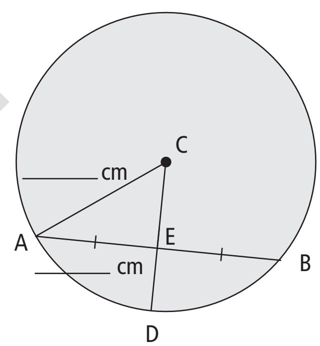
Practise

3. CD bisects chord AB.
The radius of the circle is 15 cm.
Chord AB measures 24 cm.
What is the length of CE?



Label the diagram with the measurements you know.

Formula → $CE^2 + \boxed{}^2 = \boxed{}^2$

Substitute → $CE^2 + \boxed{}^2 = \boxed{}^2$

Solve → CE^2 + ________ = ________

CE^2 + ________ − ________ = ________ − ________

CE^2 = ________

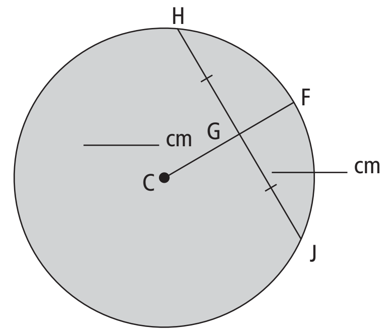
$CE = \sqrt{\boxed{}}$

CE = ________

The length of CE is ________ cm.

Name: ____ Date: ____________

4. The radius CF bisects chord HJ.
CG measures 4 mm.
Chord HJ measures 14 mm.
What is the radius of the circle to the nearest tenth of a millimetre (1 decimal place)?



Draw a line from C to J.
Write the measurements on the diagram.

Formula →

Substitute →

Solve →

The radius of the circle is _______ mm.

5. Hannah wants to draw a circle at the centre of her trampoline.
Explain how she can find the centre of her trampoline.
Use the diagram to help you.

____

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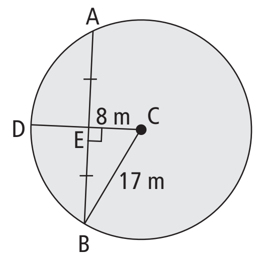
Name: ______________________________ Date: ____________

Apply

6. The radius of the circle is 17 m.
The radius CD is perpendicular to the chord AB.
CE measures 8 m.
What is the length of chord AB?
Are AE and BE equal? Circle YES or NO.



First, find the length of BE.

Formula →

Substitute →

Solve →

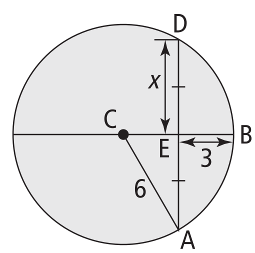
AB = 2 × BE

= 2 × _______

= _______

Sentence: ____

7. Find the length of *x*.
Round your answer to the nearest tenth (1 decimal place).
Use ΔCAE.



CA = _______ cm

CB = CA. Both are radii.

CE = _______ − _______

= _______

Use the Pythagorean relationship to calculate the length of EA.

Formula →

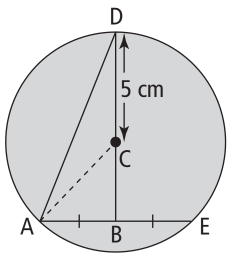
Substitute →

Solve →

The length of *x* is _______.

Name: ____ Date: ____________

8. If you know that the radius CD is 5 cm and BC is 3 cm, what is the area of ΔABD?



CA is also the radius, so the length is ______ cm. *Label* CA on the diagram.

BC = ______ cm

ΔABC is a ______________________ triangle. Find the length of AB.

Formula →

Substitute →

Solve →

Area of ΔABD:

Formula→ $A = b \times h \div 2$

h = DC + BC
= ___ + ___
= ___

Substitute →

Solve →

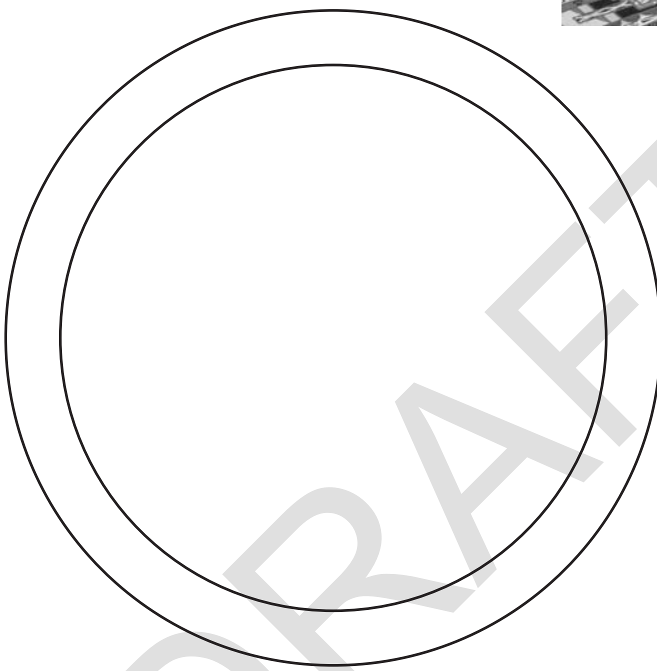
Sentence: ____

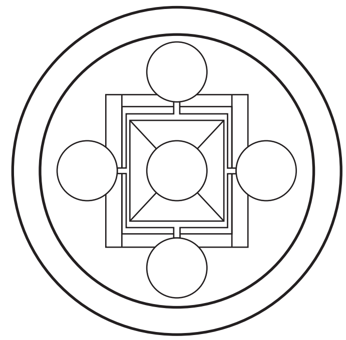
Name: ______________________________ Date: ______________

Math Link

A mandala is a piece of art framed inside a circle. The North American Plains Indians and Tibetan Buddhists create mandalas.

a) Create a mandala using the example as a guide by following the pattern.





b) You want to display your mandala. How much room will you need?

❒ Find the centre using 2 chords and the perpendicular bisector of each. Mark it with a black dot.

❒ What is the radius? ________ cm

❒ What is the diameter? ________ cm

❒ Calculate the circumference.

$C = \pi \times d$

$= \_\_\_\_\_\_\_\_ \times \_\_\_\_\_\_\_\_$

$= \_\_\_\_\_\_\_\_$

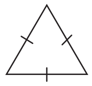
You will need about ________ cm to display your mandala.

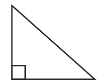
Name: ______________________________ Date: ____________

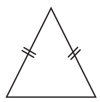
10.3 Warm Up

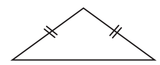
1. Name the triangles using the words from the box.

right triangle
isosceles triangle (2 equal sides)
equilateral triangle (3 equal sides)

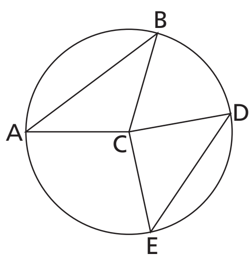
a)  ________

b)  ________

c)  ________

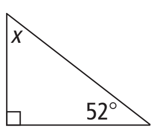
d)  ________

2. List the chords in the circle.



____

3. Find the measure of the unknown angle in each triangle.

a) 

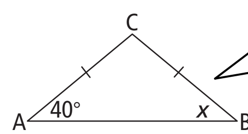
Sum of the angles in a triangle = 180°

x + ________° + ________° = 180°

x + ________° = 180°

x + ________° − ________° = 180° − ________°

x = ________°

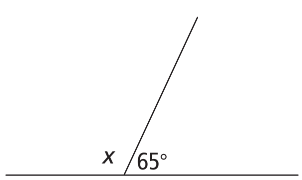
b) 

The 2 bottom angles in an isosceles triangle are equal.

x + ________° + ________° = 180°

4. Find the measure of the unknown angle in these supplementary angles.

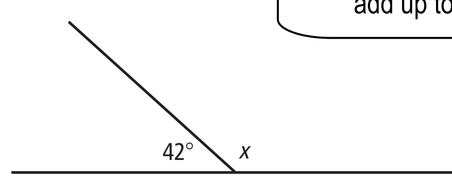
Supplementary angles add up to 180°.

a) 

$x + 65° = 180°$

$x + 65° – 65° = 180° – 65°$

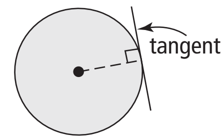
x = ________°

b) 

Name: ______________________________ Date: ____________

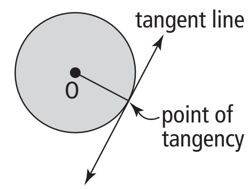
10.3 Tangents to a Circle

tangent (to a circle)
- a line that touches a circle at exactly 1 point



FOLDABLES™ Study Tool

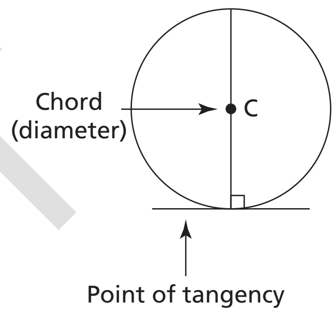
point of tangency
- the point where the tangent line touches the circle



Link the Ideas

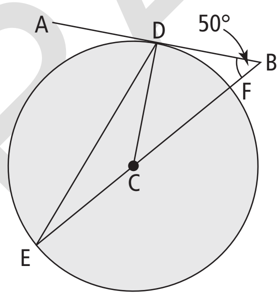
Tangent to a Circle
- A tangent to a circle is perpendicular (at a 90° angle) to the radius at the point of tangency (where it touches the circle).

Tangent Chord Relationship
- If you draw a chord from the point of tangency through the centre of the circle, this chord is the diameter.



Working Example 1: Determine Angle Measures in a Circle With a Tangent Line

AB is tangent to the circle at point D.
BE contains the diameter FE.
∠ABE = 50°



Remember, CF, CD, and CE are all radii.

a) What is the measure of ∠BDC? Justify your answer.

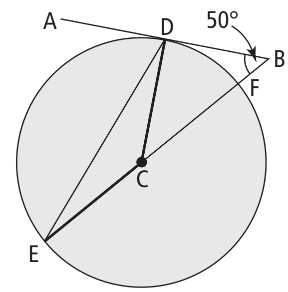
Solution

Radius CD is tangent to the circle at point ________.
So, CD is perpendicular to line segment AB.

∠BDC is _______°.

Name: ____ Date: ____________

b) What is the measure of the central angle ∠DCE? Justify your answer.



Solution

The sum of the angles in a triangle is ______°.

In ΔBCD, ∠CBD + ∠BDC + ∠DCB = ______°

______° + ______° + ∠DCB = ______°

______° + ∠DCB = ______°

∠DCB = ______° – ______°

∠DCB = ______°

∠ECB is a straight angle that measures ______°.

∠DCB and ∠DCE make a straight angle.

∠DCE + ∠DCB = 180°

∠DCE + ______° = 180°

∠DCE = 180° − 40°

∠DCE = ______°

c) What type of triangle is ΔCDE? Justify your answer.

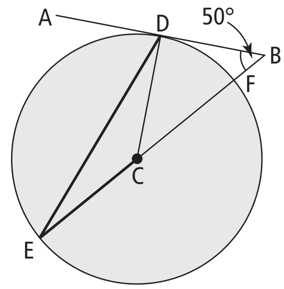
Solution

CD and CE are both radii of the circle, so they are equal.

A triangle with 2 equal sides is a(n) ____________________ triangle.
(*equilateral*, *isosceles*, or *scalene*)

Name: ____ Date: ____________

d) What is the measure of ∠DEC? Justify your answer.



Solution

Method 1: Use Angles in a Triangle

The sum of the angles in a triangle is ________°.

∠DCE = ________°.

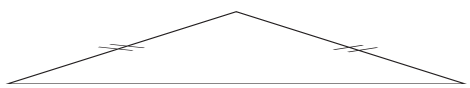
∠DCE + ∠DEC + ∠CDE = 180°

140° + ∠DEC + ∠CDE = 180°

140° – ________° + ∠DEC + ∠CDE = 180° – ________°

∠DEC + ∠CDE = ________°

ΔCDE is an isosceles triangle, so ∠DEC and ∠CDE are equal.



So, ∠DEC = ________° ÷ 2

∠DEC = ________°

Method 2: Use Inscribed Angles

∠DEF and ∠DEC are the same angle, so ∠DEF = ________.
∠DEF is an inscribed angle and ∠FCD is the central angle. They share the same arc, DE.

∠DEF = ∠FCD ÷ 2

Inscribed angle = central angle ÷ 2

∠DEF = 40° ÷ 2

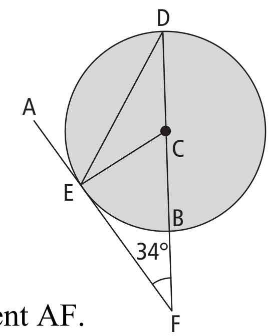
∠DEF = ________°

So, ∠DEC is ________°.

Name: ____ Date: ____________

Show You Know

Line segment AF is tangent to the circle at point E.
Line segment DF contains the diameter DB.
$\angle CFE = 34°$



a) What is the measure of $\angle CEF$? Show how you know.

AF is tangent to the circle at point ______.

Radius CE is ____________________ to the line segment AF.

So, $\angle CEF =$ ______°.

b) What is the measure of $\angle ECF$? Show how you know.
Use ΔCEF.

$\angle CEF + \angle$______ $+ \angle$______ $= 180°$

______° + ______° + $\angle$______ = ______°

$\angle$______ = ______°

c) What is the measure of $\angle EDF$? Show how you know.

$\angle EDF$ is equal to $\angle EDB$.

$\angle$______ is an inscribed angle and $\angle ECB$ is the central angle.

$\angle EDC = \angle ECB \div 2$

$\angle EDC =$ ______° $\div 2$

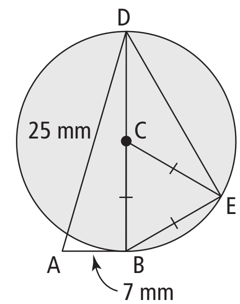
$\angle EDC =$ ______°

Therefore, $\angle EDF$ is ______°.

Name: ______________________________ Date: ____________

Working Example 2: Use the Tangent Chord Relationship

AB is tangent to the circle at point B.
BD is a diameter of the circle.
AB = 7 mm
AD = 25 mm
ΔBCE is an equilateral triangle.

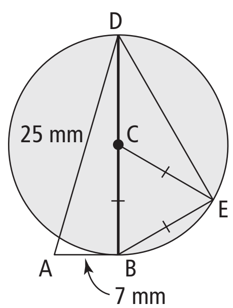


a) What is the length of diameter BD? Justify your answer.

Solution

Since AB is tangent to the circle at point B, ∠ABD is ________°.
ΔABD is a right triangle.

Use the __________________________ relationship to find BD.



$$AB^2 + BD^2 = AD^2$$

$$\boxed{}^2 + \boxed{}^2 = \boxed{}^2$$

$$\underline{} + \boxed{}^2 = \underline{}$$

$$\underline{} - \underline{} + \boxed{}^2 = \underline{} - \underline{}$$

$$\boxed{}^2 = \underline{}$$

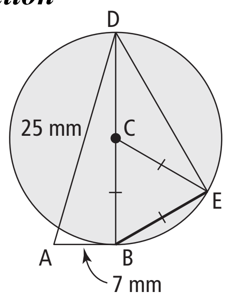
$$\underline{} = \sqrt{\boxed{}}$$

$$\underline{} = \underline{}$$

The length of BD is ________ mm.

b) What is the length of chord BE? Justify your answer.

Solution



ΔBCE is an equilateral triangle. So, BE is the length of a radius.

diameter BD = ________ mm

BC is the radius of the circle, which is half the diameter.

BC = BD ÷ 2

BC = ________ ÷ 2

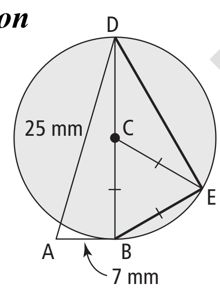
BC = ________

BC = BE = CE

Therefore, BE = ________ mm.

c) What is the measure of the inscribed angle∠BED?

Solution



∠BCD = ________°. It is the diameter and the central angle.

∠BED is an inscribed angle, so it is ________________ the size of the central angle.

∠BED = ∠BCD ÷ 2

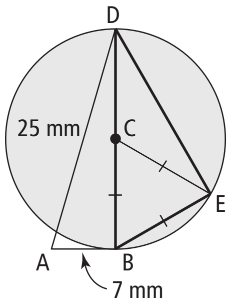
∠BED = ________° ÷ 2

∠BED = ________°

Therefore, ∠BED is ________°.

d) What is the length of chord DE? Round your answer to the nearest millimetre. Justify your answer.

Solution



Find the length of DE using the ____________________ relationship in ΔBDE.

$$DE^2 + BE^2 = BD^2$$

$$\boxed{}^2 + 12^2 = 24^2$$

$$\boxed{}^2 + \underline{} = \underline{}$$

$$\boxed{}^2 + \underline{} - \underline{} = \underline{} - \underline{}$$

$$\boxed{}^2 = \underline{}$$

$$\underline{} = \sqrt{\boxed{}}$$

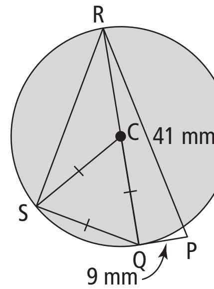
$$\underline{} = \underline{}$$

The length of DE is ______ mm, to the nearest mm.

Name: ______________________________ Date: ____________

Show You Know

PQ is tangent to the circle at point Q.
QR is a diameter of the circle.
PQ = 9 mm; PR = 41 mm
ΔQCS is an equilateral triangle.



a) What is the length of diameter QR? Justify your answer.

PQ is ____________________ to QR,

so $\angle$PQR is ______°

ΔRQP is a right triangle.

$$QR^2 + QP^2 = RP^2$$

The length of diameter QR is ______ mm.

b) What is the length of chord QS? How do you know?

Diameter QR = ______ mm

Radius QC = ______

ΔQCS is an equilateral triangle, so all sides are equal.

Therefore, if QC is ______ mm,

then QS is ______ mm.

c) What is the length of RS? Show how you know.

$\angle$RCQ is the central angle.
$\angle$RSQ is an inscribed angle, so $\angle$RSQ = ______°.
ΔRSQ is a right triangle.

$$RS^2 + \boxed{}^2 = \boxed{}^2$$

The length of RS is ______ mm.

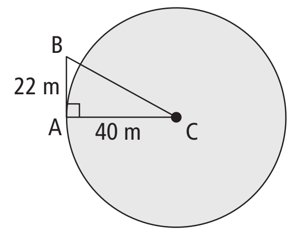
Name: ______________________________ Date: ____________

Working Example 3: Solve Problems With Tangents to Circles

A speed skater is practising on a circular track with a radius of 40 m.
He falls and slides 22 m off the track in a line tangent to the circle.
How far is he from the centre of the rink?

Solution

In the diagram, the skater fell at point A and slid to point B.



Since AB is ______________________ to the circle,
it is perpendicular to the radius AC.
Use the Pythagorean relationship to find the length of BC.
BC shows how far the skater is from the centre of the rink.

$$AB^2 + AC^2 = BC^2$$

$$\boxed{}^2 + \boxed{}^2 = BC^2$$

$$\_\_\_\_\_\_ + \_\_\_\_\_\_ = BC^2$$

$$\_\_\_\_\_\_ = BC^2$$

$$\sqrt{\boxed{}} = BC$$

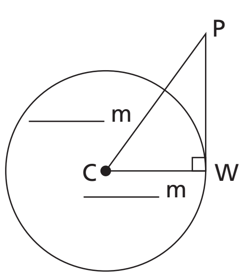
$$\_\_\_\_\_\_ \approx BC$$

The speed skater is approximately ______ m from the centre of the rink.

Show You Know

Callan is flying his model airplane. The wire breaks just before he lands it.
The control wire is 10 m long. The plane lands 74 m from Callan.
How far did the plane travel after the wire broke?
Round your answer the nearest tenth of a metre (1 decimal place).

Label the diagram.



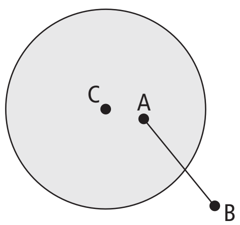
The plane travelled ____________ m after the wire broke.

Name: ______________________________ Date: ____________

Check Your Understanding

Communicate the Ideas

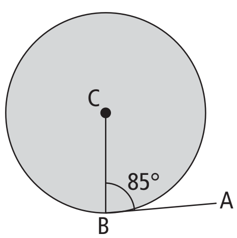
1. Elliot says that AB is tangent to the circle because it touches the circle at 1 point.
Is he correct? Circle YES or NO.
Give 1 reason for your answer.



____

____

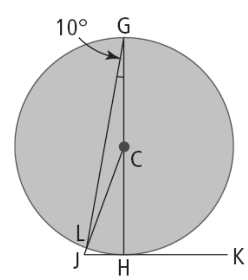
2. If BC is the radius, is AB tangent to the circle? Circle YES or NO.
Give 1 reason for your answer.



____

____

3. Line segment JK is tangent to the circle at point H.
GH is the diameter and ∠CGL = 10°.



a) ΔCGL is an ____________________ triangle.
(equilateral *or* isosceles)

Give 1 reason for your answer.

____

b) What is the measure of ∠HCL?

∠HCL and ∠HGL have the same arc, ________.

∠HCL is the ____________________ angle.

∠HGL is the ____________________ angle.

∠HCL = ∠HGL × ________

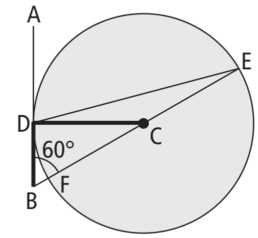
= ________

Name: ____ Date: ____________

Practise

4. AB is tangent to the circle at point D.
BE contains the diameter EF.
∠ABE = 60°

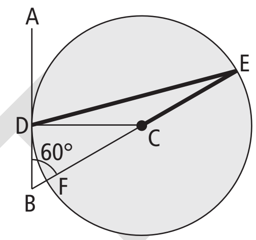
a) What is the measure of ∠BDC? Justify your answer.



Radius DC is ________________________ to tangent AB.

So, ∠BDC is _______°.

b) What is the measure of ∠DCE? Justify your answer.



The sum of the angles in a triangle is _______°.

∠BDC + ∠DBC + ∠DCB = _______°

_______° + _______° + ∠DCB = _______°

∠DCB = _______°

∠DCB and ∠DCE make a straight angle.

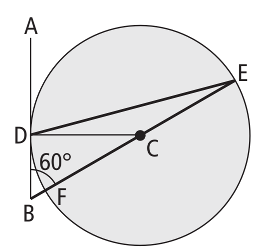
∠DCB + ∠DCE = 180°

_______° + _______° = 180°

∠DCE = _______

c) What type of triangle is ΔCDE? ________________________

d) What is the measure of ∠DEC? How do you know?



Use the arc DF. ∠DEF is an ________________________ angle.

∠DCF is the ________________________ angle.

If ∠DCF measures _______°, then ∠DEF is half of that.

∠DEF = ∠DCF ÷ _______

∠DCB = ∠DCF

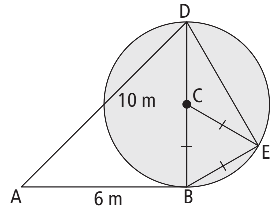
= _______° ÷ _______

= _______°

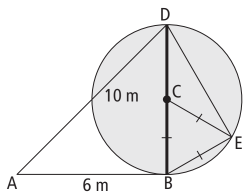
∠DEF = ∠DEC, so ∠DEC is _______°.

Name: ____ Date: ____________

5. AB is tangent to the circle at point B.
BD is a diameter of the circle.
AB = 6 m
AD = 10 m
ΔBCE is an equilateral triangle.



a) What is the length of diameter BD? Justify your answer.



∠ABD is _______° because AB

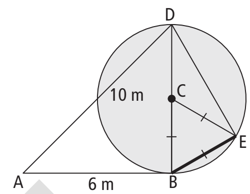
is __________________________ to BD.

Formula →

Substitute →

Solve →

b) What is the length of chord BE? Justify your answer.



ΔBCE is an equilateral triangle.

diameter BD = ________ m

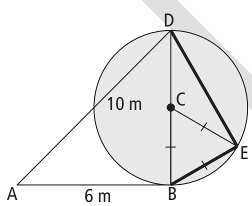
BC = BD ÷ ________

radius BC = ________ ÷ ________

BC = BE = CE

So, BE = ________ m.

c) What is the measure of the inscribed angle∠BED?



∠BCD is ________°.
∠BED is an inscribed angle.

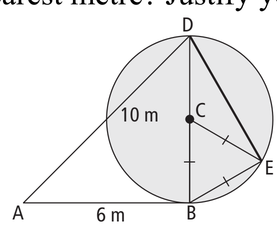
∠BED = ∠________ ÷ ________

∠BED = ________ ÷ ________

∠BED = ________

So, ∠BED is ________°.

d) What is the length of chord DE to the nearest metre? Justify your answer.



Use ΔDEB.

Formula →

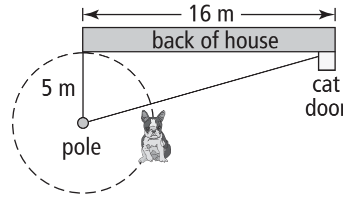
Substitute →

Solve →

The length of DE is ________ m.

Name: ______________________________ Date: ____________

6. A dog is on a leash tied to a pole in the backyard.
The leash is 5 m long.
The back of the house is tangent to the circle at the edge of the house.



a) What is the distance from the pole to the cat door?

Formula →

Substitute →

Solve →

The distance from the pole to the cat door is ________ m.

b) How close can the dog get to the cat door?

Find the distance from the edge of the circle to the cat door.

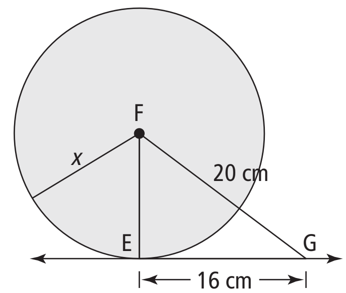
The radius is from the centre of the circle to any point on the edge of the circle.

Sentence: ____

Name: ____ Date: ____________

Apply

7. Find the length of *x* in the diagram.
Line *l* is tangent to the circle.
Write your answer to the nearest tenth (1 decimal place).



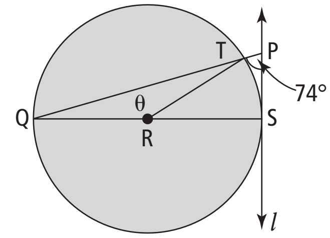
x is the same length as side ______ of ΔFEG.

ΔFEG is a ______________________ triangle.

Sentence: ____

Name: ____ Date: ____________

8. Find the measure of ∠QRT.
SP is tangent to the circle at point S.
RS is perpendicular to SP.
∠SPQ = 74º



ΔPSQ is a ____________________ triangle, so ∠PSQ is ______°.

The 3 angles in a triangle add up to ______°.

∠PQS + ______ + ______ = ______°

∠PQS is an inscribed angle to the central angle ∠TRS.

So, ∠TRS = ∠PQS × ______

∠TRS = ______°

∠QRS = ______

∠QRS is a straight angle.

∠QRT + ∠TRS = ______°

∠QRT + ______ = ______°

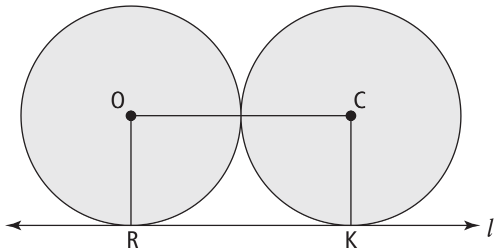
∠QRT – ______ = ______° – ______°

∠QRT = ______°

Sentence: ____.

Name: ____ Date: ____________

9. The circles are exactly the same size.
Line l is tangent to both circles.
The radius is 5 cm.
What is the perimeter of the rectangle? Label the diagram to show your explanation.



Sentence: ____

Math Link

1. Design a piece of art using at least 1 circle and at least 1 tangent.

2. Find the measures of the following from your design. 

Chords: Radii: Diameters: Tangent Lines:

Name: ______________________________ Date: ____________

Chapter Review

Key Words
For #1 to #6, unscramble the letters. Use the clues to help you.

1. ICBNEIRSD EALNG ____________ ____________
an angle formed by 2 chords that have a common endpoint (2 words)

2. CTAENRL LANGE ____________ ____________
an angle created by 2 radii of the circle (2 words)

3. RUIADS ____________
a line from the centre to the edge of the circle

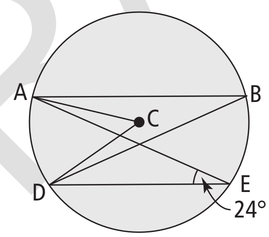
4. CRHDO ____________
a line segment that has both endpoints on the circle

5. PUDINEECARPL BOIESTCR ____________ ____________
a line that divides a line segment in half at 90º to it (2 words)

6. TGNENAT ____________
a line that touches a circle at exactly 1 point

10.1 Exploring Angles in a Circle, pages xx–xx

7. Find the measure of each angle.



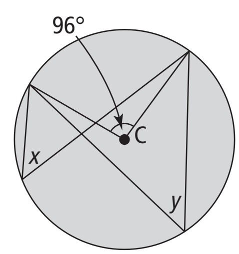
a) $\angle$ABD = ________°

b) $\angle$ACD

$\angle$ACD = 2 × ________

= ________

8. What are the measures of the unknown angles *x* and *y*?



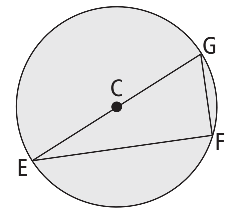
a) $\angle x$ = ________ ÷ 2

= ________

b) $\angle y$

Name: ____ Date: ____________

9. What is the measure of ∠EFG?



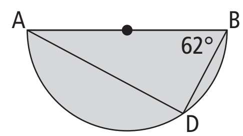
Central angle ∠ECG is a straight angle, so it measures _______°.

∠EFG = ∠ECG ÷ _______

= _______ ÷ _______

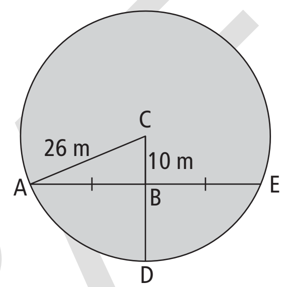
= _______

10. What is the measure of ∠BAD?



10.2 Exploring Chord Properties, pages xx-xx

11. What is the length of chord AE?



ΔABC is a right triangle.

$$AB^2 + BC^2 = AC^2$$

$\boxed{}^2 + \boxed{}^2 = \boxed{}^2$

AE = AB × 2

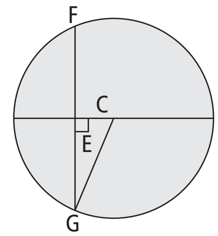
= _______ × 2

= _______

AE is _______ m.

Name: ____ Date: ____________

12. Chord FG measures 18 cm.
The diameter measures 22 cm.
What is the length of EC?



ΔCEG is a right triangle.

EG = _______

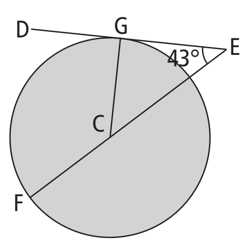
radius CG = _______

$r = d \div 2$

$EG^2 + EC^2 = CG^2$

10.3 Tangents to a Circle, pages xx-xx

13. What is the measure of ∠FCG if DE is tangent to the circle?



If DE is tangent to the circle, then ∠EGC is _______º.
In ΔECG, ∠GEC + ∠EGC + ∠ECG = 180º

43º + _______º + ∠EGC = 180º

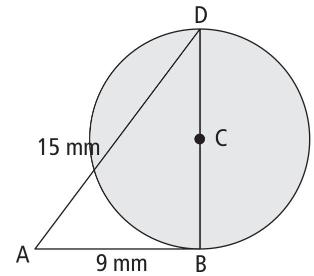
∠ECG + ∠FCG = 180º, because ∠ECG is a ________________________.

_______º + ∠FCG = 180º

The measure of ∠FCG is _______º.

Name: ____ Date: ____________

14. If AB is tangent to the circle at B, what is the length of the radius?



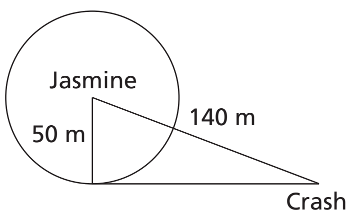
Find the length of DB using the Pythagorean relationship.

$AB^2 + DB^2 = AD^2$

diameter DB = ________ mm

radius DC = ________ mm

15. Jasmine was flying a remote-control airplane when it lost signal at a point tangent to the circle. It flew along this tangent until it crashed. How far did the plane travel before it crashed? Round your answer to 1 decimal.



Use the __________________________ relationship to find the distance.

$\boxed{}^2 + \boxed{}^2 = \boxed{}^2$

Sentence: ____

Name: ____ Date: ____________

Practice Test

For #1 and #2, choose the best answer.

1. Which statement is true?

A A central angle is smaller than an inscribed angle with the same end points.

B Two inscribed angles are never equal in size.

C An inscribed angle that has the same endpoints as the diameter is always 90º.

D If a bisector of a chord passes through the centre, the bisector is not perpendicular to the chord.

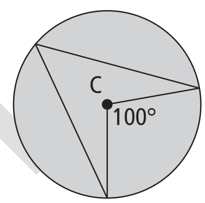
2. What is the measure of the inscribed angle?

A 25°

B 50º

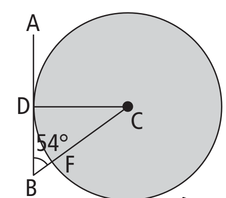
C 100º

D 200º



Complete the statement in #3.

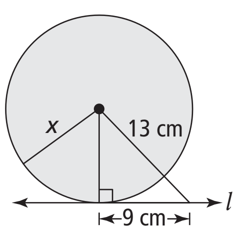
3. If AB is tangent to the circle, the measure of ∠BCD is ________º.



The angles in a triangle add up to 180º.

Short Answer

4. What is the length of radius x?
Round your answer to the nearest tenth of a centimetre (1 decimal place).



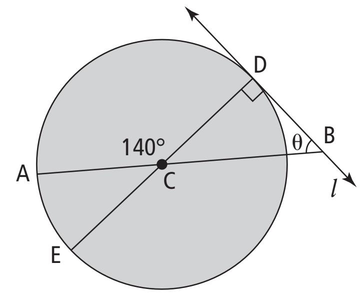
Use the ________________________ relationship to find the distance.

$\square^2 + \square^2 = \square^2$

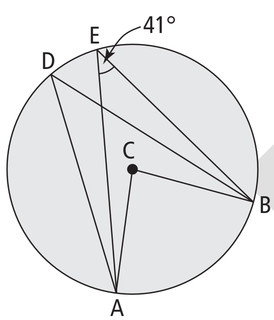
Name: ____ Date: ____________

5. Find the measure of ∠DBC if DB is tangent to the circle.

First, find the measure of ∠DCB.



6.



a) What is the measure of ∠ADB? How do you know?

____

____

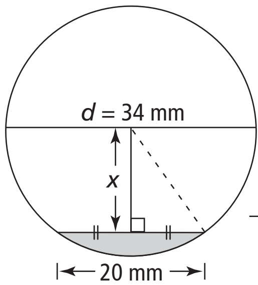
b) What is the measure of ∠ACB? How do you know?

____

____

Name: ______________________________ Date: ______________

7. This diagram shows the water level inside a pipe.
The diameter of the pipe is 34 mm.
What is the distance from the centre of the pipe to the water level x?



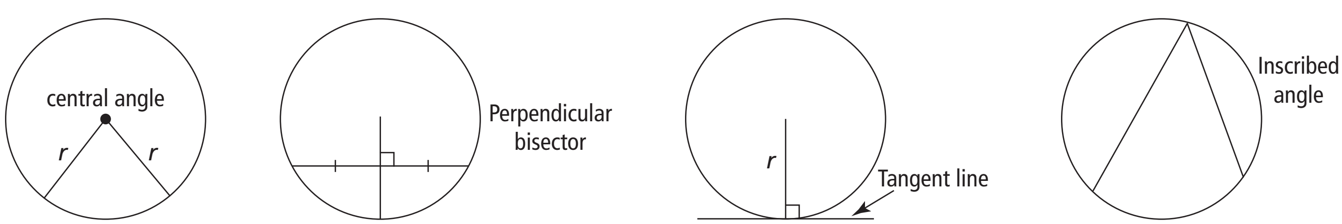
______ mm

$\boxed{}^2 + \boxed{}^2 = \boxed{}^2$

Sentence: ____

Math Link: Wrap It Up!

Design a piece of art or a logo using at least 2 circles.
Use each circle property at least once:



Use your designs from 1 of the Math Links on pages xx, xx, or xx. Add any missing properties.

Name: ______________________________ Date: ______________

Key Word Builder

Match the key words with the correct definition. Then, circle them in the word search.

1. a part of the circumference of a circle ____________________
2. an angle created by 2 radii of a circle (2 words) ____________________
3. a line segment that has both endpoints on a circle ____________________
4. the distance around a circle ____________________
5. the distance across a circle, through the centre ____________________
6. an angle created by 2 chords that have a common endpoint (2 words) ____________________
7. the point in the middle of a line ____________________
8. a line that divides a line segment in half and is at a 90º to it (2 words) ____________________
9. formula used to find the unknown length of a right triangle ____________________
10. half the distance across the circle starting at the centre ____________________
11. means more than 1 radius ____________________
12. a line that touches a circle at exactly 1 point ____________________

arc	central angle	chord	radius	circumference
diameter	inscribed angle	radii	midpoint	perpendicular bisector
Pythagorean relationship	tangent			

A	T	I	M	S	M	N	E	A	A	P	I	G	S	A	N	R	L	E	T	G	P	H
U	E	N	R	A	L	H	I	I	H	E	I	S	U	E	E	I	I	E	I	A	I	D
T	C	R	E	E	P	I	R	U	I	R	C	I	C	U	R	L	I	D	R	R	B	M
T	G	A	I	N	E	E	C	E	A	P	A	C	E	C	R	R	A	T	R	C	U	E
E	U	A	N	E	E	H	T	D	U	E	R	M	R	C	A	T	I	A	C	E	I	A
P	Y	T	H	A	G	O	R	E	A	N	R	E	L	A	T	I	O	N	S	H	I	P
G	R	A	E	I	A	S	N	A	R	D	C	S	R	A	F	C	C	G	R	A	E	M
P	O	D	R	P	C	E	P	H	C	I	R	C	U	M	F	E	R	E	N	C	E	N
R	R	E	N	S	R	P	R	I	H	C	N	P	C	I	R	E	G	N	O	C	I	R
I	C	L	L	R	E	O	U	R	O	U	B	N	I	P	R	C	N	T	N	O	G	S
E	B	S	O	O	E	S	D	D	R	L	E	A	I	E	I	A	B	O	P	S	G	N
I	I	N	S	C	R	I	B	E	D	A	N	G	L	E	R	H	C	U	R	P	N	D
I	P	C	C	E	N	C	E	N	T	R	A	L	A	N	G	L	E	D	C	R	H	E
S	P	M	E	R	I	R	F	H	D	B	R	R	P	S	A	R	R	S	I	E	S	O
A	A	R	E	N	A	I	E	E	D	I	A	M	E	T	E	R	N	D	R	D	E	I
I	A	R	P	A	I	I	T	L	C	S	D	M	E	H	S	C	C	R	U	R	T	I
R	D	P	U	R	P	N	A	T	A	E	I	E	T	P	A	T	D	G	O	P	F	E
A	R	D	U	S	R	T	N	O	H	C	U	E	S	T	C	O	O	R	L	N	R	S
L	M	T	M	I	D	P	O	I	N	T	S	E	N	C	A	E	I	C	C	E	E	T
Y	T	T	N	N	C	R	I	C	U	O	D	R	R	R	E	I	I	N	A	D	P	N
G	R	R	O	S	R	U	A	P	R	R	A	D	I	I	R	I	E	H	N	C	T	L
B	U	D	N	L	I	C	A	A	T	D	R	G	M	G	A	B	A	M	A	T	C	O

Challenges

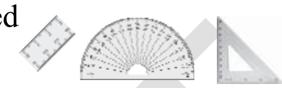
Dream Catcher

Many Aboriginal peoples know the legend of the Dream Catcher. According to the legend, the good dreams go through the web and the bad dreams get tangled in the web and disappear.

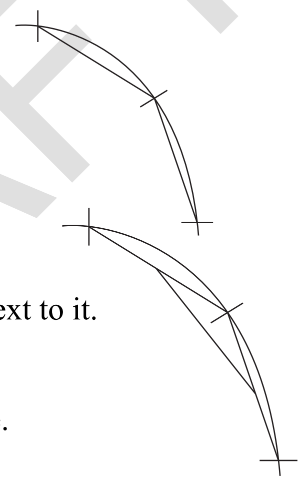
A Dream Catcher looks like a spider web with 8 points connected to the ring.
You be the artist.

Materials
- Dream Catcher BLM
- 1 ruler, protractor, and right triangle per student
- coloured pencils

1. Using Dream Catcher BLM, draw 8 equally spaced markings on the circle.



❐ Draw a diameter on the circle.
❐ Find the perpendicular bisector of the diameter.
❐ Bisect each angle you create.



2. Draw the first row of webbing by joining each point on the circle to the point next to it with a straight line.

3. Draw the second row of webbing by connecting the midpoint of each chord to the midpoint of the chord next to it.

4. Use 2 colours to show a central and an inscribed angle. Label each angle measure.

5. Continue drawing the rows of webbing until you get about 5 cm from the centre.

How many rows did you draw? ________

6. How is your drawing similar to an actual Dream Catcher?

____

____

____

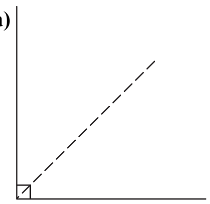
Answers

Get Ready, pages xx–xx

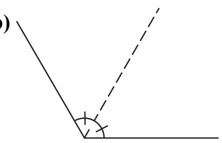
1. a) 15.7 cm **b)** 11.618 cm

2. Estimates may vary. **a)** 25°, 25° **b)** 100°, 105°

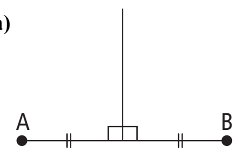
3. a)



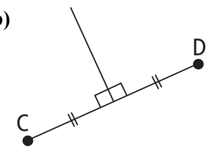
b)



4. a)



b)



Math Link, page x

2. b) diameter

3. b) centre

4. a) Estimates may vary. Example: 90° **b)** 90° **c)** Answers will vary. Example: My estimate was the same. **d)** 360°

5. equilateral; the sides are all the same length and the angles are equal

6. Answers will vary. Examples: Oakley, Starbucks Coffee ®

10.1 Warm Up, page x

1. a) AC, BC, FC, EC, DC **b)** AE, BD

2. a) 13 cm **b)** 5 cm

3. a) 36 **b)** 100 **c)** 4 **d)** 7 **e)** 90 **f)** 45

10.1 Exploring Angles in a Circle, pages xx–xx

Working Example 1: Show You Know

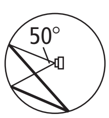
a) 55° **b)** 110°

Working Example 2: Show You Know

a) 90° **b)** 13 cm

Working Example 3: Show You Know

Answers may vary.



The inscribed angle is half the central angle since it shares the same arc.

Communicate the Ideas

1. ∠BCA is a central angle and shares the same arc, AB, with ∠BDA .

2. 90° because the inscribed angle is half the central angle (180 ÷ 2 = 90).

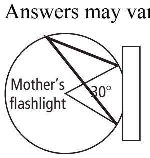
Practise

3. 41°

4. a) 23° **b)** 46°

5. a) 90° **b)** 8 cm

6. Answers may vary.



7. a) 76° **b)** ISOSCELES; AC and CD are both radii, so they are equal.

8. a) 15° **b)** 24° **c)** 48° **d)** 30°

9. a) 56° **b)** 90°

10. Answers will vary. No. The inscribed angle is 110°, so Δ ADB is not a right triangle.

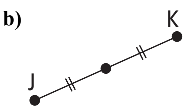
10.1 Math Link, page x

a) Answers will vary. **b)** The central angle is twice the inscribed angle.

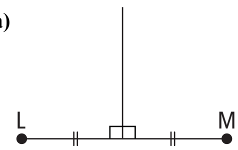
10.2 Warm Up, page x

1. a)

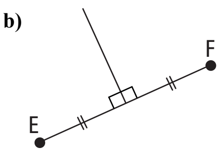
b)



2. a)



b)



3. 3 cm

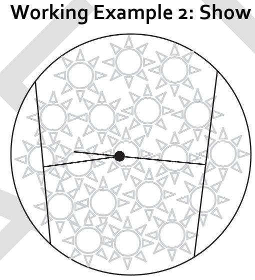
4. a) 5 cm **b)** 4.5 cm

10.2 Exploring Chord Properties, pages xx–xx

Working Example 1: Show You Know

8 cm

Working Example 2: Show You Know



Draw 2 chords. Draw the perpendicular bisectors of each chord. The point where the perpendicular bisectors meet is the centre.

Communicate the Ideas

1. a) ∠ADC is 90°. **b)** AD and DB are equal.

2. Draw 2 chords. Find the midpoint of each chord. Draw the perpendicular bisector of each chord. Mark with a dot the point where the perpendicular bisectors meet.

3. 9 cm

4. 8.1 mm

5. Draw 2 chords. Draw the perpendicular bisectors of each chord. The point where the perpendicular bisectors meet is the centre.

Apply

6. 30 m

7. 5.2 cm

8. 16 cm^2

10.2 Math Link, page x

Answers will vary.

10.3 Warm Up, page x

1. a) equilateral **b)** right **c)** isosceles **d)** isosceles

2. AB, ED

3. a) 38° **b)** 100°

4. a) $x = 115°$ **b)** $x = 138°$

10.3 Tangents to a Circle, pages xx–xx

Working Example 1: Show You Know

a) 90° **b)** 56° **c)** 28°

Working Example 2: Show You Know

a) 40 mm **b)** 20 mm **c)** 34.6 mm

Working Example 3: Show You Know

73.3 m

Communicate the Ideas

1. No. The tangent must be outside the circle.

2. No. ∠CBA would be 90° if AB was tangent.

Practise

3. a) Isosceles. CG and CJ are both radii, so they are equal. **b)** 20°

4. a) 90° **b)** 150° **c)** isosceles **d)** 15°

5. a) 8 m **b)** 4 m **c)** 90° **d)** 7 m

6. a) 15.8 m **b)** 10.8 m

Apply

7. 12 cm

8. 148°

9. 30 cm

10.3 Math Link, page x

Answers will vary.

Chapter Review, pages xx–xx

1. inscribed angle **2.** central angle **3.** radius **4.** chord **5.** perpendicular bisector **6.** tangent

7. a) 24° **b)** 48°

8. a) 48° **b)** 48°

9. 90°

10. 18°

11. 48 m

12. 6.3 cm

13. 133°

14. 6 mm

15. 130.8 m

Practice Test, pages xx–xx

1. C **2.** B **3.** 36° **4.** 9.4 cm **5.** 50° **6. a)** 41°. Inscribed angles with the same arc are equal. **b)** 82°. The measure of the central angle is twice the measure of the inscribed angle on the same arc.

7. 13.7 mm

Math Link: Wrap It Up!, page x

Answers will vary.

Key Word Builder, page x

1. arc **2.** central angle **3.** chord **4.** circumference **5.** diameter **6.** inscribed angle **7.** midpoint **8.** perpendicular bisector **9.** Pythagorean relationship **10.** radius **11**. radii **12.** tangent

Challenges, page x

Answers will vary.