Version 01

Linear Measure

Apprenticeship and Workplace Mathematics (Grade 10/Literacy Foundations Level 7)

OPEN SCHOOL BC

Course History

New, March 2012

Project Partners

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- Calgary Board of Education
- Edmonton Public Schools
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Table of Contents

Viewing Your PDF Learning Package

This PDF Learning Package is designed to be viewed in Acrobat. If you are using the optional media resources, you should be able to link directly to the resource from the pdf viewed in Acrobat Reader. The links may not work as expected with other pdf viewers.

Download Adobe Acrobat Reader:
http://get.adobe.com/reader/

Section Organization

This section on Linear Measure is made up of several lessons.

Lessons

Lessons have a combination of reading and hands-on activities to give you a chance to process the material while being an active learner. Each lesson is made up of the following parts:

Essential Questions

The essential questions included here are based on the main concepts in each lesson. These help you focus on what you will learn in the lesson.

Focus

This is a brief introduction to the lesson.

Get Started

This is a quick refresher of the key information and skills you will need to be successful in the lesson.

Activities

Throughout the lesson you will see three types of activities:

- Try This activities are hands-on, exploratory activities.
- Self-Check activities provide practice with the skills and concepts recently taught.
- Mastering Concepts activities extend and apply the skills you learned in the lesson.

You will mark these activities using the solutions at the end of each section.

Explore

Here you will explore new concepts, make predictions, and discover patterns.

Bringing Ideas Together

This is the main teaching part of the lesson. Here, you will build on the ideas from the Get Started and the Explore. You will expand your knowledge and practice your new skills.

Lesson Summary

This is a brief summary of the lesson content as well as some instructions on what to do next.

At the end of each section you will find:

Solutions
This contains all of the solutions to the Activities.

Appendix
Here you will find the Data Pages along with other extra resources that you need to complete the section. You will be directed to these as needed.

Glossary
This is a list of key terms and their definitions.

Throughout the section, you will see the following features:

Icons
Throughout the section you will see a few icons used on the left-hand side of the page. These icons are used to signal a change in activity or to bring your attention to important instructions.

AWM online resource (optional)
This indicates a resource available on the internet. If you do not have access, you may skip these sections.

Solutions

My Notes

The column on the outside edge of most pages is called "My Notes". You can use this space to:

- write questions about things you don't understand.
- note things that you want to look at again.
- draw pictures that help you understand the math.
- identify words that you don't understand.
- connect what you are learning to what you already know.
- make your own notes or comments.

Materials and Resources

There is no textbook required for this course.

You will be expected to have certain tools and materials at your disposal while working on the lessons. When you begin a lesson, have a look at the list of items you will need. You can find this list on the first page of the lesson, right under the lesson title.

In general, you should have the following things handy while you work on your lessons:

- a scientific calculator
- a ruler
- a geometry set
- Data Pages (found in the appendix)

Linear Measure

If you've been around new building sites, you probably noticed wooden survey stakes stuck in the ground. Survey stakes are used to lay out property lines and foundation perimeters, and to mark heights for grading and excavation.

Photo by Jonathan Larsen © 2010

Survey stakes are placed in position by surveyors who take careful measurements of distance and depth. What they measure depends on the building plans set out by engineers and architects.

Estimation and measuring are important skills in all kinds of work and activities, ranging from sewing to construction. In this section you will learn more about measurement and estimation, and you will learn how both imperial and SI units can be used for both. Be prepared to be active as you work through this section!

In this section you will:

- solve problems that involve SI and imperial linear measurements, including decimal and fractional measurements.

Lesson A
Estimating and Measuring Length and Distance

To complete this lesson, you will need:

- a ruler or tape measure that shows imperial and SI units
- Data Pages

In this lesson, you will complete:

- 5 activities

Essential Questions

- How can you estimate length and distance for common imperial and SI units?
- How can you estimate the dimensions of two-dimensional and three-dimensional objects?
- How can you determine the perimeter of two-dimensional objects?

My Notes

Focus

Photo by Jean Morrison © 2010

Justina is designing a small greenhouse for her yard. She has gone over to her neighbour's yard for some ideas. She likes the look of her neighbour's greenhouse, but she's not sure the design is large enough for her needs.

Unfortunately, Justina did not bring her tape measure with her, so she can't take precise measurements. Instead, Justina walks the length and width of the greenhouse. She estimates that the greenhouse is about five metres long and three metres wide. Justina goes inside the greenhouse and discovers there is a lot of head room, even for her. Justina is taller than many of her friends.

How would *you* estimate the dimensions of the greenhouse in the photograph?

Get Started

My Notes

You may have studied two systems of measurement. Do you remember the names of the two measurement systems?

_____

_____

In the following activity you will review the common imperial units of **linear measure**.

Activity 1
Try This

Use a tape measure or ruler to measure out each of these common units of length:

- one inch
- one foot
- one yard

1. What common objects would be about:

   a. one inch in length?

   _____

   b. one foot in length?

   _____

   c. one yard in length?

   _____

My Notes

2. How could these common objects help you estimate lengths?

_____

_____

_____

_____

3. Do you remember the relationships between inches, feet, and yards?

_____

_____

_____

_____

Turn to the solutions at the end of the section and mark your work.

Explore

How good are you at estimating lengths? In the next activity, you will test your estimating skills using SI and imperial units.

Before you start the activity, do you remember what "SI" stands for?

_____

SI stands for *Système International*, or the International System of Weights and Measures. SI is sometimes referred to as the metric system.

Activity 2
Try This

My Notes

You will need a tape measure marked with both imperial and SI units.

Step 1: For each item in the table on the next page, estimate its length in both SI and imperial units. Record your estimates in the table.

Be sure to use appropriate units for each instance. For example, you wouldn't express the distance around a house in inches; instead, you would measure such a distance in feet or yards.

Step 2 : Use a measuring tape to measure each item in the table on the next page in both SI and imperial units. Record your measurements in the table.

Step 3: In the last column of the table, comment on how accurate your estimates were. If your estimate was much too large or small, how could you have refined your estimate? For example, for the length of your room, could you have walked around the room and made a better estimate based on how many steps you took?

	SI Estimate	SI Measurement	Imperial Estimate	Imperial Measurement	Comment
Distance Around Your Head					
Your Height					
Length of Your Arm					
Average Length of Your Stride					
Distance You Cover Walking Ten Steps					
Length of Your Room					
Width of Your Thumb					
Width of Your Small Finger					
Thickness of a Dime					
Length of Your Foot					
Height of Your Room					
Width of Your Yard					

Turn to the solutions at the end of the section and mark your work.

Bringing Ideas Together

My Notes

In the Explore section you polished your estimation skills. You probably used an object or a part of your body to estimate lengths. In other words, you used a **referent**. For instance, you may have paced off the width of your yard to estimate the distance in yards. Or you might have used your height to estimate the height of your room. You may even have used the width of your thumb to estimate the length of your foot. You used referents in Module 1 to explore SI and imperial units.

Activity 3
Self-Check

1. What referents could you use for the units of measure in the table below? A common referent for the inch is given as an example.

Unit	Referent
1 in	width of a thumb
1 ft	
1 yd	
1 mm	
1 cm	
1 m	

My Notes

2. Use your referents from question 1 to estimate the dimensions of the following common items. Give your answers in SI and imperial units.

   a. The height of a table.

   _____

   b. The length, width, and height of a refrigerator.

   _____

   c. The length, width, and height of a car or truck.

   _____

   d. The length, width, and thickness of a magazine.

   _____

Turn to the solutions at the end of the section and mark your work.

Distance Around an Object

Often you will need to find the distance around an object in order to solve a problem. The distance around an object is called its **perimeter**. Knowing the perimeter is essential in tasks such as hanging wallpaper, fencing, installing baseboards, and framing pictures.

Perimeter is a linear measure. Therefore, when you measure the perimeter of an object, you use units of length, such as metres or feet.

The applet, *Perimeter*, shows how to calculate the perimeter for a shape that is not regular. Go to *Perimeter (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/glossary/Division03/Perimeter/index.html)* and select [PLAY] to watch the animation.

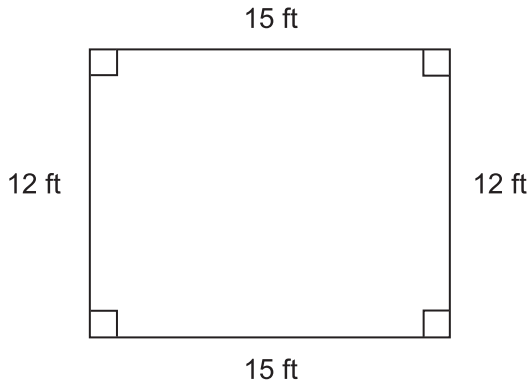
My Notes

Example 1

Photo by bhowe © 2010

Maxine is planning a rectangular patio for her backyard. She has room for a patio that measures 15 ft long × 12 ft wide. Maxine has decided that the patio will be built using interlocking bricks, but she wants a wooden frame around the perimeter. What is the total length of framing that Maxine will need?

Solution



The perimeter, P, is the length of the four sides added together:

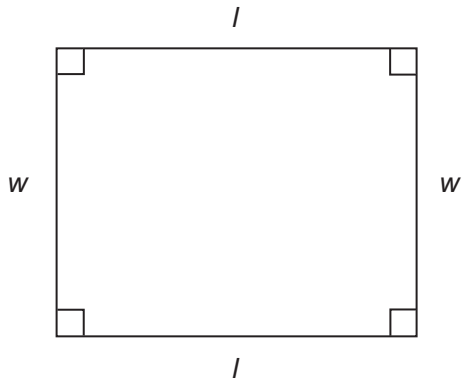
$$P = 15 \text{ ft} + 12 \text{ ft} + 15 \text{ ft} + 12 \text{ ft}$$
$$= 54 \text{ ft}$$

Maxine will need 54 ft of framing for her patio.

My Notes

Some Perimeter Formulas

You may already be familiar with the perimeter formulas for rectangles and squares, but let's review them briefly.



If l = length, and w = width, then the perimeter of a rectangle is

$$P = l + w + l + w$$
$$= 2\,l + 2\,w$$

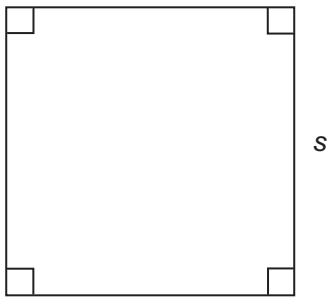
This represents 2 lengths plus 2 widths.

Go to *Perimeter and Area (Rectangle)* (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/glossary/Division03/Rectangle/index.html). This demonstration applet provides examples of perimeter calculations for rectangles. Move the l- and w-slider to change the length and width of the rectangle.

Make a rectangle the size of Maxine's patio from Example 1. Did you get the same perimeter?

My Notes

A square is a special kind of rectangle. All the sides of a square are the same length.



If s = length of each side, then the perimeter for a square is

$$P = s + s + s + s$$
$$= 4s$$

This represents 4 times the length of each side.

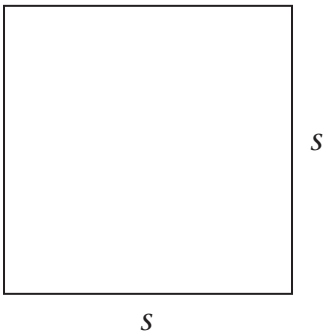
Go to *Perimeter and Area (Square)* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/glossary/Division03/Square/index.html)*. This demonstration applet provides examples of perimeter calculations for squares. Move the s-slider to change the side length of the square.

Go to your Data Pages and look at "Geometric Formulae." Find the formula for the perimeter of a rectangle. Notice that the formula for the perimeter of a square is not in the table. Why do you think it's been left out?

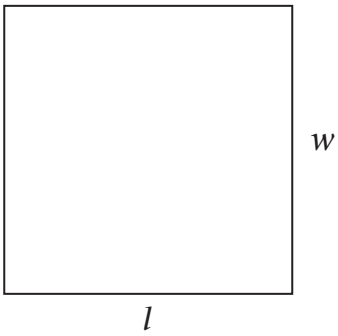
_____

_____

A square is a type of rectangle. You can use the formula for perimeter of a rectangle for both squares and rectangles.



$P = 4s$



$P = 2l + 2w$

My Notes

When you're finding the perimeter of squares, you may use either formula. Remember, you should be familiar with the Data Pages since they will be available to you during the module tests and during the Provincial Examination.

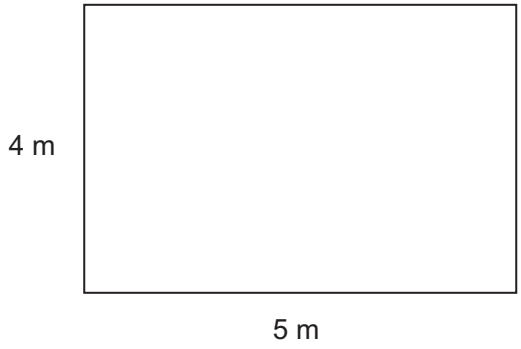
Using Perimeter Formulas

The following examples show how formulas can help you solve problems that involve perimeters.

Example 2

Paula wants to purchase a decorative wallpaper border for her living room. The room is rectangular and measures 4 m by 5 m. How much border will Paula need to buy?

Solution



You are given $w = 4$ m and $l = 5$ m.

$P = 2l + 2w$
$= 2\ (5) + 2\ (4)$
$= 10 + 8$
$= 18$

Substitute the values $w = 4$ m and $l = 5$ m given in the diagram.

Paula will need to buy 18 m of wallpaper border.

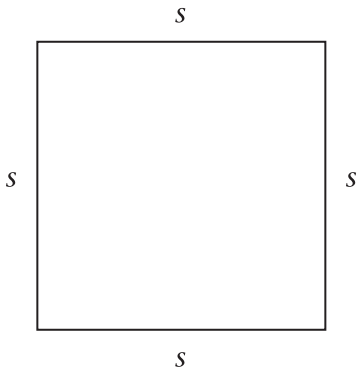
My Notes

Example 3

The perimeter of a square tile is 4 ft. How long is each side?

Solution

This example is a little different than the others we've seen. Here you are given the perimeter and asked to find the length of the sides.



$P = 4s$ — Substitute the known length of the perimeter.

$4 \text{ ft} = 4s$

$\frac{4 \text{ ft}}{4} = \frac{4s}{4}$ — Divide both sides by 4 to isolate s.

$1 \text{ ft} = s$ OR $s = 1 \text{ ft}$ — Both equations mean the same thing.

Each side of the tile is 1 ft in length.

Perimeters of Other Shapes

If a shape is not rectangular or square, you will need to work with the sides separately. The formula for the perimeter of a triangle is given on your Data Pages. Please record it here:

_____

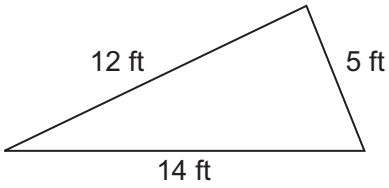
For all other shapes, simply add together the lengths of all the sides.

My Notes

Example 4

A triangular flowerbed measures 12 ft × 5 ft × 14 ft. Luc wants to put a decorative border around the flowerbed. What length of decorative border will he need?

Solution



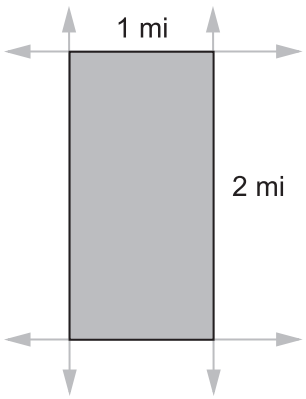
$P = a + b + c$
$= 12 \text{ ft} + 5 \text{ ft} + 14 \text{ ft}$
$= 31 \text{ ft}$

A total of 31 ft of decorative border is needed.

Activity 4
Self-Check

1. In farming areas in Western Canada, north-south roads are normally one mile apart, and east-west roads are two miles apart. These roads divide the land into a plot.

   How far would you drive to go around such a plot once?



My Notes

2. A road-maintenance worker is replacing the white reflective tape on the border of a stop sign. If the sign is 10 inches on one side, how much tape will she need for the sign? Express your answer in feet and inches.

Photo by Stacie Stauff Smith Photography © 2010

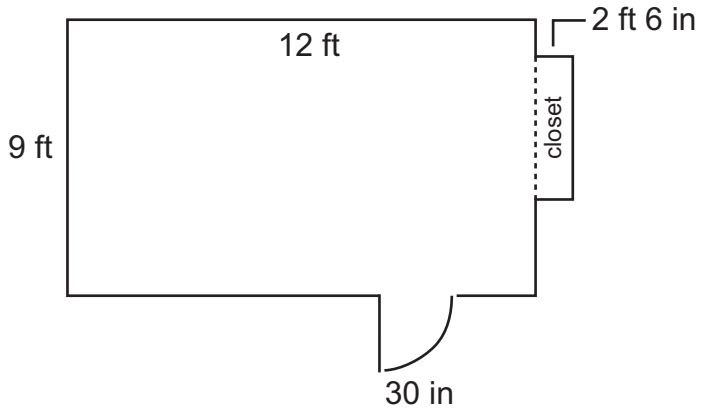
3. The perimeter of a rectangular picture is 50 cm. If the width of the picture is 10 cm, what is the length of the picture?

Turn to the solutions at the end of the section and mark your work.

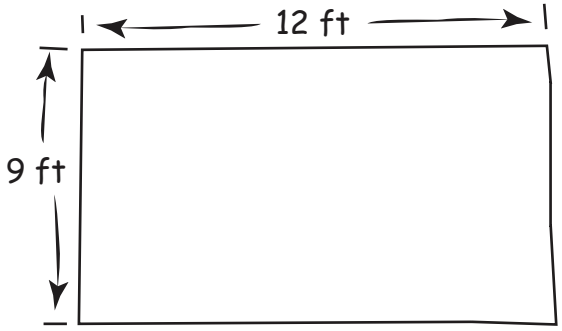
My Notes

Activity 5
Mastering Concepts

A floor plan for a guest room is shown in the diagram. The guest room still needs baseboards installed. Jacob is helping his mother determine the length of baseboard needed.



Jacob suggests finding the perimeter of the following figure to estimate the length of baseboard needed.



Jacob's mother suggests that he needs to adjust his estimate to account for the 30-in doorway, because no baseboard will be needed for the doorway. She also comments that the closet sticks out from the rest of the room by 2 ft 6 in, and will also need to have baseboards installed.

After their discussion, Jacob and his mother feel ready to purchase the right length of baseboard for the guest room. Please answer the following questions.

1. Specifically, how does the doorway affect the length of baseboard needed?

_____

_____

_____

_____

2. How does the closet affect the length of baseboard needed?

_____

_____

_____

_____

_____

_____

3. Baseboard at the local building supply store sells for $0.86 per linear foot. How much would it cost to install baseboards in the guest room according to the floor plan?

My Notes

Turn to the solutions at the end of the section and mark your work.

My Notes

Lesson Summary

The Inuit created stone figures on the arctic landscape. These stone figures, or inukshuks, were created for many reasons—to point the way for travellers, to indicate a good hunting or fishing area, to mark a place of respect, or as a memorial. This tradition was common to all peoples of the circumpolar region.

Look at the height of the children standing on the base of the inukshuk in the photograph. From this photograph what would you estimate the height of the inukshuk to be?

Photo by debr22pics © 2010

You discovered that your skill in estimating length and distance depends on connecting SI and imperial system linear units with common items called referents. The referents you choose might be the length of your thumb for an inch, or a long stride for a metre. Referents are personal. Your referents are probably different from someone else's.

You used linear measure to find perimeters. You explored the basic formulas for the perimeters of rectangles and squares. You also found the perimeters of a few other shapes. In Lesson D of this section, you will apply what you know about perimeter to more involved problem situations.

Lesson B
Measuring Diameters

To complete this lesson, you will need:

- a ruler or tape measure that shows imperial and SI units
- several blank sheets of letter-sized paper
- various circular objects, such as jar lids or cans of various sizes
- several metres of string, ribbon, or yarn
- a calculator
- your Data Pages

In this lesson, you will complete:

- 7 activities

Essential Questions

- What are the various parts of a circle?
- How can you measure the inside and outside diameter of a circular object?

My Notes

Focus

Photo by Mikhall Olykainen © 2010

Photo by Albo003 © 2010

Potters create lids for some of their dishes. How do they know how big to make the lid so that it fits on the container?

The potter would need to measure the diameter of the opening in the pot, and make sure that he or she makes the lid the appropriate size. What measurement tool might the potter use?

In this lesson we'll investigate some basic properties of circles. Then we'll explore a variety of methods and tools that can be used to measure circular objects.

Get Started

In Lesson A you worked with squares, rectangles, triangles and other shapes with straight edges. Measuring the sides of such shapes is fairly easy to do; but how might you measure a curved length?

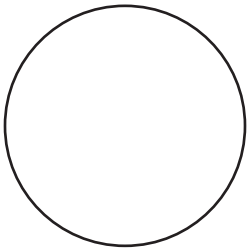
The circle is one common shape that has a curved edge. In the following activity, you will review what you know about circles.

Activity 1
Try This

My Notes

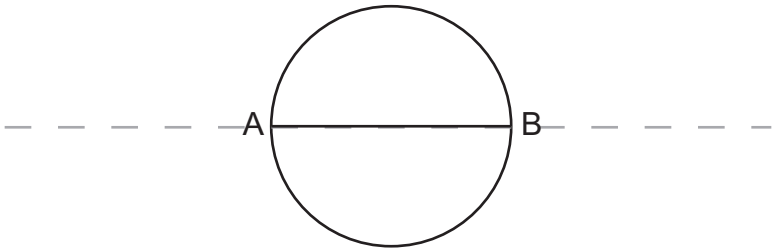
If possible, work with a partner to complete this activity.

Step 1: With a pen or pencil, trace the outline of a circular object, such as the lid of a jar, on a blank piece of paper.



The distance around this circle is called the circle's **circumference**.

Step 2: Hold the paper up to the light. Fold the paper in two, so that the circle is divided into two halves. When you open your sheet of paper, you will see a crease dividing your circle into two **semicircles**. Label the points A and B where the crease cuts the circle.



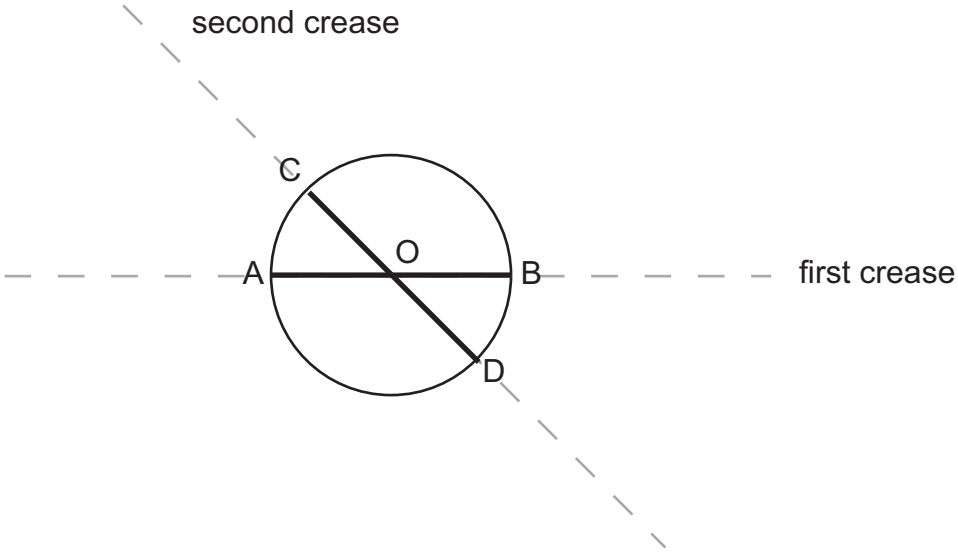
Step 3: Take your pen or pencil, and trace over the crease from point A to point B. Line segment AB ($\overline{AB}$), which divides the circle into halves, is called a **diameter**.

Did You Know?

We use the symbol $\overline{AB}$ to represent the line segment AB.

My Notes

Step 4: Fold the paper a second time to form a second diameter. Label this diameter $\overline{CD}$. Label the point where $\overline{CD}$ crosses $\overline{AB}$, O.



The **centre** of the circle, O, is where the two diameters intersect. A **radius** is a segment that joins the centre of the circle to a point on the circumference of the circle. Each of the segments $\overline{OA}$, $\overline{OB}$, $\overline{OC}$, and $\overline{OD}$ are radii.

Step 5: Label the following items on your diagram:

- the centre
- a radius
- a diameter
- the circumference

Keep your diagram as a reference tool to use throughout the rest of the lesson.

Turn to the solutions at the end of the section and mark your work.

My Notes

Circles Around Us

Circles can be found all around us. The following video, *Circles*, shows us several different settings where circles can be found. The video also describes some properties of circles.

Go to *Circles (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/mod2_circles.html)* and watch this video.

Pi and the Formula for Circumference

The ratio of a circle's circumference to its diameter is always the same; it's a bit larger than 3. Because this ratio does not depend on the size of the circle, the value of this ratio can be represented by one symbol; the Greek letter pi (π). Mathematicians use the symbol because it is impossible to exactly express the value of the ratio with a decimal number. The symbol, π, represents the exact

value of the ratio, $\frac{\text{circumference}}{\text{diameter}}$, for all circles.

To see an animation that shows the relationship between the circumference and the diameter of a circle, go to *A Circle Unrolled (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/glossary/Division03/pi/index.html)*.

We can summarize the relationship between a circle's diameter and circumference as follows:

$$\pi = \frac{C}{d},$$

where

C = circumference
d = length of the diameter
π = 3.141 592 653 589 793 238 462 643 383 279 502 884 197 . . .

The value of π is a non-terminating, non-repeating decimal number. This means that you can't write a long-enough decimal representation to give its exact value.

My Notes

Did You Know?

Many people try memorizing digits of π in 2004, Daniel Tammet recited 22 514 digits of π. It took him over five hours to complete this task, and he did it without making a single mistake!

Have a look at your Data Pages. In the table, "Geometric Formulae" please find the formula(s) for the circumference of a circle. Record the formula(s) here:

_____

_____

The diameter and radius of a circle are related:

$d = 2r$

$r = \frac{1}{2} d$

You should have noticed that there are two formulas for circumference. You may use either formula to determine the circumference of a circle. Choose the one that works best with the information you are given in a particular question.

Example 1

Photo by Pierdelune © 2010

The Temple of Hercules—near Rome, Italy—was built in the second century BCE. This temple has a diameter of 14.8 m.

a. Estimate the temple's circumference.

b. Use your calculator to determine the circumference—correct to the nearest tenth of a centimetre.

c. How can you tell if your answer to part b is reasonable?

Solution

a. The circumference is about three times the length of the diameter.

$3 \times 15 \text{ m} = 45 \text{ m}$

So, the circumference is approximately 45 m.

b. You know that $d = 14.8$ m. You want to determine the value of C.

Since the diameter was given, use the formula for circumference that contains d.

$C = \pi d$
$= \pi(14.8 \text{ m})$
$= 46.49557 \ldots \text{ m}$

On your calculator:

[π] [×] [1] [4] [.] [8]

Round your answer to one decimal place.

My Notes

If your calculator does not have a pi key, use 3.1416 for pi in your calculation.

My Notes

Therefore, $C \approx 46.5$ m.

Remember, ≈ means "approximately equal to."

The circumference of the temple is approximately 46.5 m.

c. The answer is reasonable, since the estimate in part a was 45 m.

Activity 2
Self-Check

Practise working with the formulas for the circumference of a circle.

1. The diameter of a circular element on an electric stove is 25 cm.

   a. What is the element's radius?

   b. Estimate the circumference of the element.

   c. Calculate the circumference of the element to the nearest centimetre.

2. The radius of a two-dollar coin is 14 mm. What is its circumference to the nearest millimetre?

My Notes

Turn to the solutions at the end of the section and mark your work.

Explore

You've seen that circles and circular shapes are all around us. From the wheels of cars to cans of soup, circular objects are part of our everyday lives. Circles provide a particular challenge to measurement. How do we measure the curved surface of a circle? How do we measure the diameter of a circular object if we don't know the centre point of the circle?

Let's explore a few ways that we can measure the parts of a circle using tools you probably have around the house.

- Activity 3 will guide you through a method that involves tracing, folding and measuring using a ruler.
- Activity 4 will guide you through a method that involves measuring the circumference of a circular object and then calculating the length of the diameter and radius.

My Notes

Activity 3
Try This

To complete this activity you will need two circular objects, such as jar lids or cans, as well as a measuring tape or ruler with SI and imperial units.

Use the table below to record your measurements as you work through this activity.

Object	Radius (mm)	Radius (in)	Diameter (mm)	Diameter (in)

Step 1: Select the first object (it doesn't matter which you choose). Set the object on a blank piece of paper. Trace around the object with a pen or pencil. Use the paper-folding method described in Get Started to label the diameter and radius of the circle that you traced onto the paper.

Step 2: Using a ruler or tape measure, measure the diameter and radius of the object (to the nearest millimetre). Record these measurements in the table.

Step 3: Using a ruler or tape measure, measure, to the nearest sixteenth of an inch, the diameter and radius of the object. Record these measurements in the table.

Step 4: Repeat steps 1–3 for the second object. When you have filled out the table, answer the following questions.

Questions:

My Notes

1. How did you find the centre of each circle?

_____

_____

_____

_____

2. What tool(s) did you use to measure the diameters and radii?

_____

_____

3. How accurate do you think your measurements of each object's diameter and radius are? Explain your answer. (Hint: Was the accuracy of your measurement affected by the tool and/or method you used?)

_____

_____

_____

_____

_____

_____

_____

_____

Turn to the solutions at the end of the section and mark your work.

My Notes

Activity 4
Self-Check

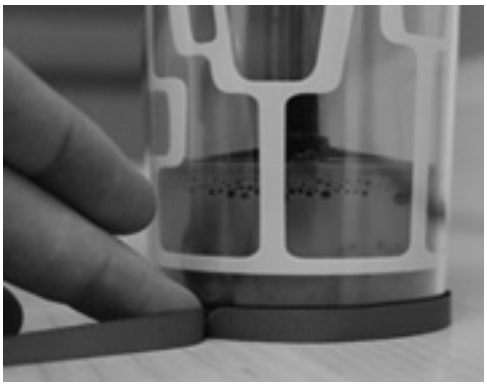
To complete this activity, you will need two circular objects, such as jar lids or cans, as well as a string, a measuring tape or ruler and a calculator. Please use different objects from those you used in Activity 3.

Use the table below to record your measurements as you work through this activity. Be sure to enter the unit you used in the second column.

Object	Circumference ( )

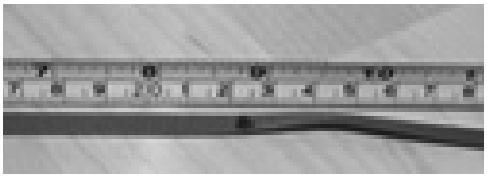
Select the first object (it doesn't matter which you choose). Determine the circumference using the following procedure:

- Carefully wrap a length of string around the object.
- Cut the string to match the circumference as precisely as you can.



Reproduced with permission from Alberta Education.

- Lay the cut length of string along your ruler or tape measure to measure the string.
- Record this measurement in the table.



Reproduced with permission from Alberta Education.

Repeat the above procedure for the second object.

My Notes

Please answer the following questions:

1. Rearrange the formula below to solve for the length of the diameter (d).

   $C = \pi d$

2. Use the formula you found in question 1 to find the diameters of your two objects. Remember, you measured the circumference of these objects already. Round your answers to the nearest whole unit.

Object 1	Object 1

My Notes

3. Rearrange the formula below to solve for the length of the radius (r).

   $C = 2\pi r$

4. Use the formula you found in question 3 to find the radii of your two objects. Remember, you measured the circumference of these objects already. Round your answers to the nearest whole unit.

Object 1	Object 1

5. How accurate do you think your measurements of each object's diameter and radius are? Explain your answer. (Hint: Was the accuracy of your measurement affected by the tool and/or method you used?)

_____

_____

_____

_____

_____

_____

_____

_____

Turn to the solutions at the end of the section and mark your work.

My Notes

Bringing Ideas Together

In Explore you tried two methods of measuring the diameter (and radius) of a circle. The two methods used a ruler or tape measure, which are a common measuring devices.

Your ruler's level of precision is to the nearest tenth of a centimetre, or, one millimetre. This is good enough for most everyday measurements. However, for some jobs like constructing engines for cars or airplanes, measurements must be more precise. Without precise measurements, engines will not run efficiently or last long, and some will not function at all.

My Notes

Technicians or engineers who build engines use various measuring instruments, including the Vernier calliper and the micrometer. These instruments can have either SI or imperial units—some even have both! In this lesson we'll look at instruments calibrated in SI units.

Photo by Andrjuss © 2010

Photo by rekemp © 2010

Vernier Callipers

The diagram below shows a Vernier calliper.

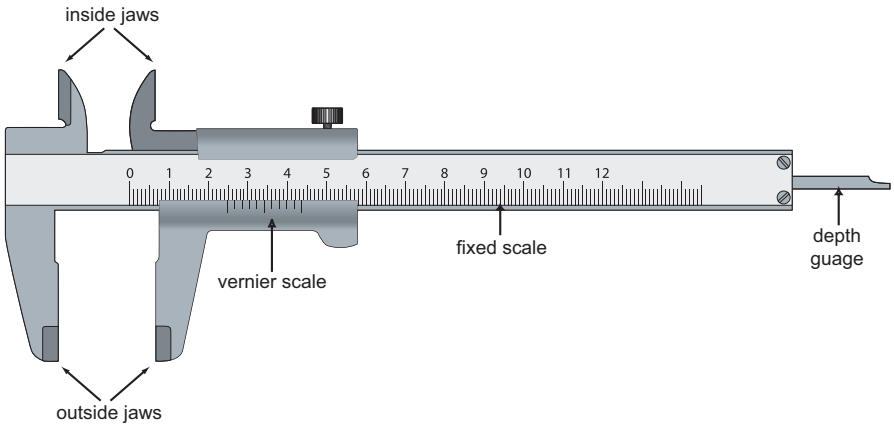


Photo by AlexanderZam © 2010

The Vernier calliper includes three devices for measuring:

- The *outside jaws* are used to measure outer dimensions of objects; for example, the outer diameter of a pipe.
- The *inside jaws* are used to measure inner dimensions of objects; for example, the inner diameter of a pipe.
- The *stem* or *depth gauge* is used to measure depths of objects; for example, the depth of a small container.

My Notes

The Vernier calliper has two scales: a moving (Vernier) scale and a fixed scale. Look closely at these two scales in the picture. The fixed scale is divided into millimetres or, in other words, 0.1 cm divisions. The moving (Vernier) scale shows 0.1-millimetre divisions or, in other words, 0.01 cm divisions.

To read a Vernier calliper, follow this procedure:

Step 1: Close the jaws of the calliper snugly around the object you wish to measure. (If you are using the inside jaws, place them inside the object and open them so that they fit snugly against the inside of the object.)

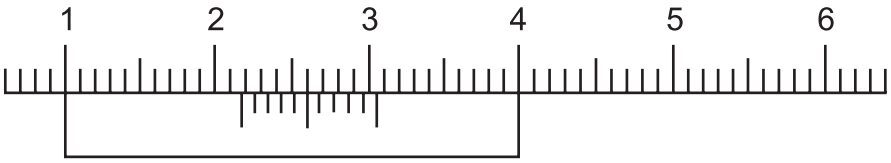
Step 2: Check where the first line on the moving scale lands. It will point to a place on the fixed scale. This position determines the first digits of the reading.

Step 3: Find the last digit of the reading by examining which line on the moving scale aligns best with a line on the fixed scale. The line on the moving scale determines this last digit.

The following example will help you read the measurements taken with a Vernier calliper.

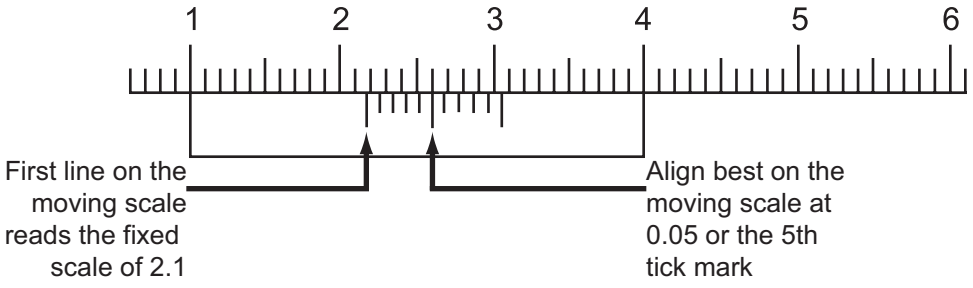
Example 2

Read the following Vernier calliper measurement.



Solution

Refer to the diagram below as you read the following procedure.



My Notes

- First read the fixed scale using the first line on the moving scale as a pointer. This line points to a place beyond 2.1 cm.
- Now find the line on the moving scale that most closely aligns with a line on the fixed scale. The moving scale has 10 divisions, and each division represents 0.01 cm. The line that best matches is the fifth line on the moving scale; that is 0.05 cm.

Therefore, the reading of the calliper = 2.1 + 0.05 = 2.15 cm.

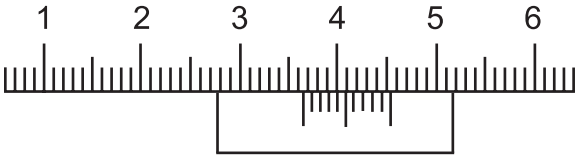
To see an animation of a Vernier calliper in action, go to the *AWM Website (http://www.openschool.bc.ca/courses/math/awm10/mod2.html)* and select *Vernier Calliper Animation*.

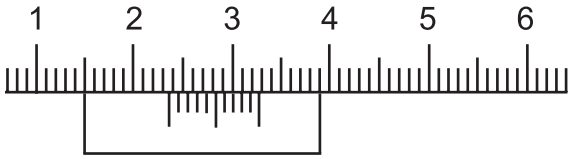
If you've never used a Vernier calliper before, try this! Go to *Vernier Calliper (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/calipers/html/Vern.APPLET/index.html)*. Follow the instructions and try to read a few different measurements.

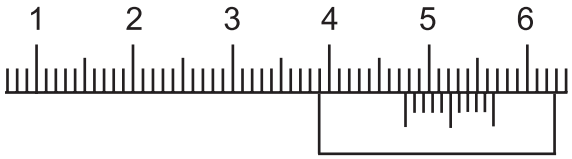
Activity 5
Self-Check

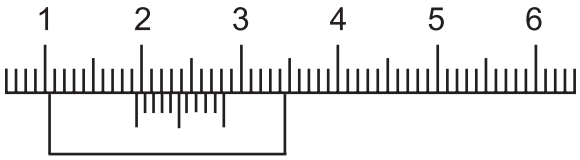
Read the following Vernier calliper measurements. The scales have been enlarged for easier reading. The calliper is calibrated in SI units.

1.



2. 

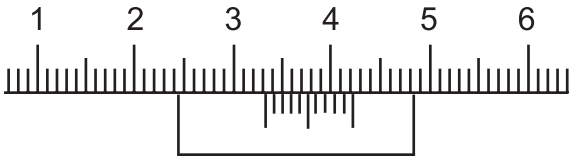
3. 

4. 

My Notes

My Notes

5.



Turn to the solutions at the end of the section and mark your work.

Micrometers

The micrometer is even more precise than the Vernier calliper. It measures even smaller lengths, such as the diameters of pipes, rods, nuts and bolts, washers and nails.

The following diagram shows a micrometer.

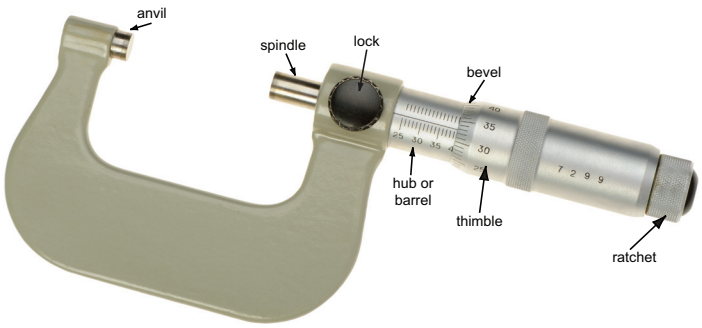


Photo by Galushko Sergey © 2010

The object to be measured is placed between the anvil and the spindle. You can then rotate the drum, using the ratchet, until the object is secure and you hear three clicks.

My Notes

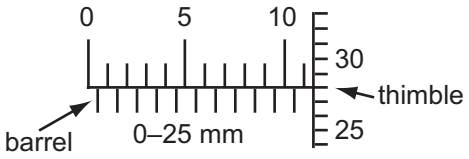
The fixed scale on the barrel is divided into 25 main divisions, each representing 0.1 cm (1 mm). Each main division is divided in half. These subdivisions each represent 0.05 cm (0.5 mm).

The moving scale on the thimble is broken into 50 divisions. One complete rotation of the thimble represents 50 × 0.01 = 0.50 mm. Therefore each division on the thimble represents 0.001 cm (0.01 mm).

Look at the following examples to learn how to read the scales on a micrometer.

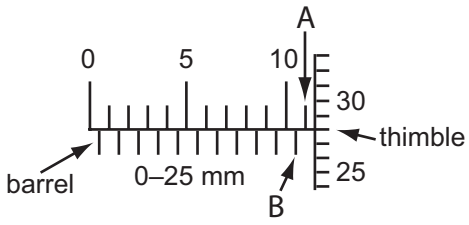
Example 3

Read the following micrometer measurement.



Solution

Refer to the following diagram as you read the procedure below.



Step 1: Read the fixed scale on the barrel.

- The measure of the last mark showing on the upper scale (indicated by arrow A).
- Check the lower scale. The last mark showing on the lower scale (indicated by arrow B) is to the left of arrow A. In this case the number read from the barrel is read as 11 mm.

Step 2: Read the moving scale on the thimble.

- The thimble reading is 0.28 mm.

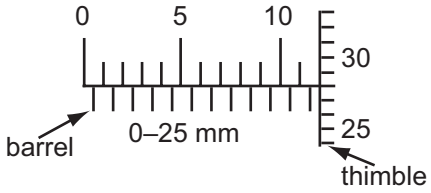
My Notes

Step 3: Add the barrel reading to the thimble reading to get your final measurement.

- 11 mm + 0.28 mm = 11.28 mm

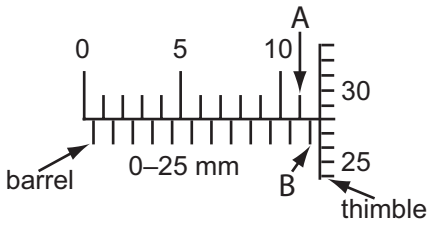
Example 4

Read the following micrometer measurement.



Solution

Refer to the following diagram as you read the procedure below.



Step 1: Read the fixed scale on the barrel.

- The measure of the last mark showing on the upper scale (indicated by arrow A).
- Check the lower scale. The last mark showing on the lower scale (indicated by arrow B) is to the right of arrow A. In this case, 0.5 is added to 11 mm giving a barrel reading of 11.5 mm.

Step 2: Read the moving scale on the thimble.

- The thimble reading is 0.28 mm.

Step 3: Add the barrel reading to the thimble reading to get your final measurement.

- 11.5 mm + 0.28 mm = 11.78 mm

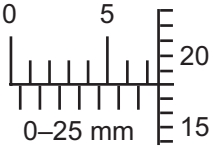
To see an animation of a micrometer in action, go to *Micrometer Animation (http://www.openschool.bc.ca/courses/math/awm10/mod2.html)*.

My Notes

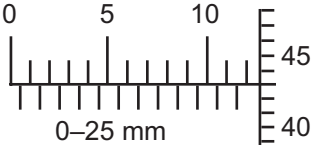
Activity 6
Self-Check

Read the following micrometer measurements. The scales have been enlarged for easier reading. The micrometer is calibrated in SI units.

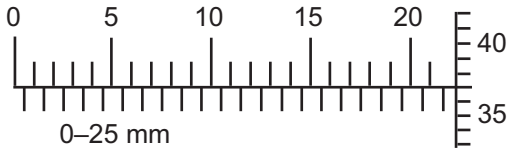
1.

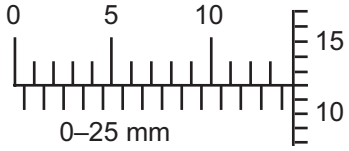


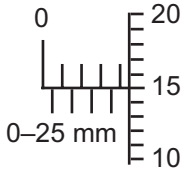
2.



My Notes

3. 

4. 

5. 

Turn to the solutions at the end of the section and mark your work.

Activity 7
Mastering Concepts

My Notes

Photo by Vasilieff © 2010

is a potter. He is planning to make a teapot similar to the one in the photograph. He wants to make sure that the lid fits the pot properly. Describe the tools(s) and procedure he should use.

Turn to the solutions at the end of the section and mark your work.

My Notes

Lesson Summary

Photo by Dmitry Kalinovsky © 2010

Machinists, engineers, and automotive technicians all use tools such as the Vernier calliper and the micrometer to precisely measure small distances. These tools are especially helpful in measuring the diameters of circular objects. Larger versions of the calliper can be used in pottery, woodworking and other applications where precision is important.

For most everyday measurements, the ruler is a great tool! In this lesson you measured the length of curved surfaces using a string and a ruler. You also looked at the parts of the circle and worked briefly with circumference. You'll apply these skills in Lesson D of this section when we work on solving more complex perimeter problems.

Lesson C
Locating Midpoints

To complete this lesson, you will need:

- a ruler or tape measure showing both imperial and SI units
- a compass for drawing circles
- several blank sheets of paper
- a set square from a geometry set
- a calculator

In this lesson, you will complete:

- 4 activities

Essential Questions

- How can you determine the midpoint of a linear measurement?
- How can you find the midpoint of a rectangle?

My Notes

Focus

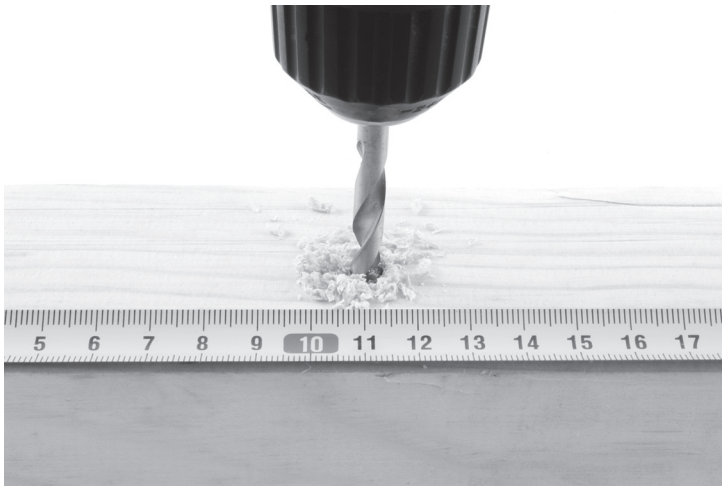


Photo by mashe © 2010

Jeff has designed a playhouse for his younger brother and sister. Jeff intends to bolt the frame of the playhouse together, but he has run into a problem. Jeff needs to drill a hole into a ceiling beam to attach a light. If the hole is not centred, the light will be off-centre in the room.

How will Jeff centre the hole he needs to drill into the beam? How can he be sure that he has located the midpoint of the beam?

Get Started

How good is your eye? Can you pinpoint the middle of an object just by looking at it?

Option A: If you have access, use the online media to complete this activity.

Go to *Find the Middle* (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/math10_findmiddle.html) to test your midpoint-finding skills!

Option B: You will need:

- Masking tape or sticky note

1. Choose a wall in your room.

2. Standing next to the wall, guess where the middle is. Mark this spot, using a small bit of tape or a sticky note.

3. Now, stand back and view your wall from the other side of the room. Does the marked spot look like it's in the middle?

Did you find it easy or difficult to spot the middle of an object just by looking at it?

A guess-and-check approach does not always get you to the middle. Even if you stood back from your wall and the marked point looked like it was in the middle, it might be a little off. What other method might you use to find the exact middle of an object? Record your ideas here:

My Notes

My Notes

Explore

In Get Started, you tried to spot the middle of such objects as a wall, a triangular flowerbed and the top of a circular table. For each of these, you had to look at the shape of the object and determine the centre point. This centre point is often referred to as the **midpoint**.

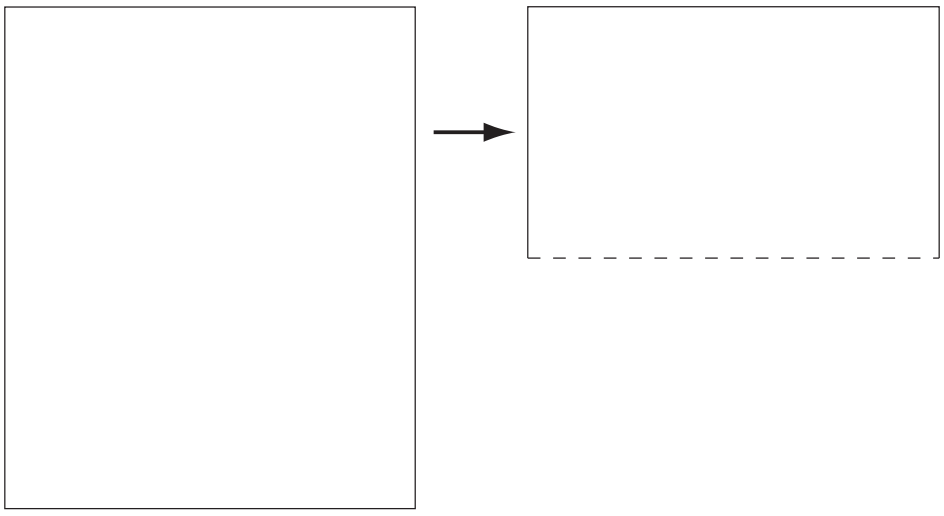
In the next activity, we'll explore some ways to find the midpoint of an object that are more methodical and reliable than just "eyeballing it."

Activity 1
Try This

For this activity you will need a sheet of printer paper, a ruler or tape measure and a pen.

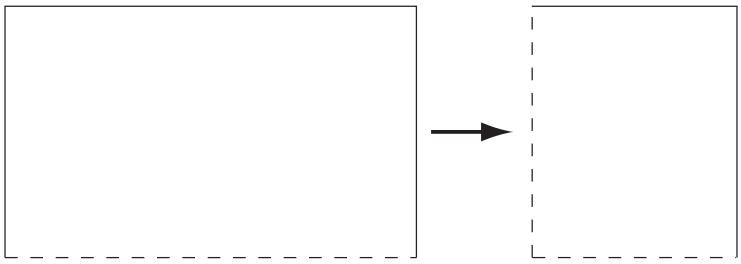
Part A: Folding to Find the Midpoint

Step 1: Take a blank sheet of standard-sized paper, like the paper commonly used in computer printers (8 ½ in × 11 in). Fold the sheet of paper in half from top to bottom.

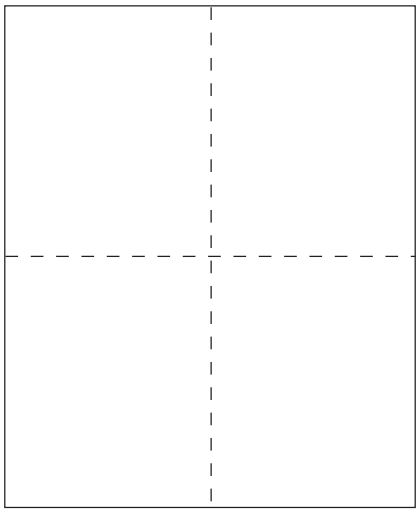


My Notes

Step 2: Fold the paper in half again, this time from left to right.



Step 3: Unfold the paper. You will see two creases in the paper.



The midpoint of the page is the point where the two folds intersect. Please keep your folded page handy as you answer the questions below, and as you move on to Part B of this activity.

Questions:

1. How far is the midpoint of the sheet from the edges of the sheet? Use your ruler or tape measure to measure these distances along the **vertical** and **horizontal** creases.

_____

_____

_____

_____

My Notes

2. What do you notice about these measurements compared to the dimensions of the piece of paper?

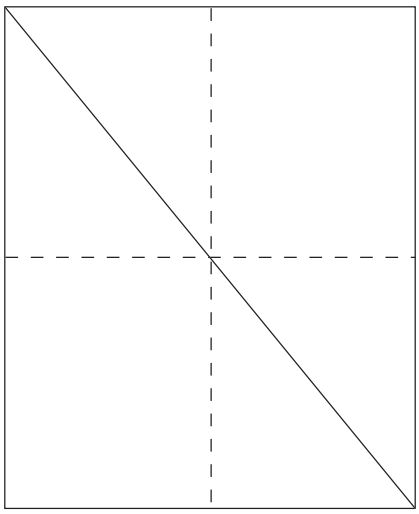
3. How could folding help you to find the midpoint of a small object?

4. What are the limitations of the folding technique?

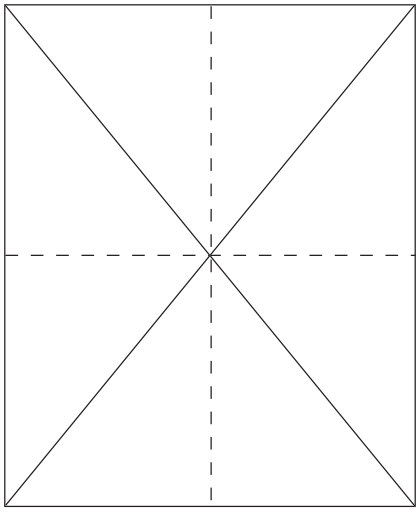
Part B: Using Diagonals to Find the Midpoint

My Notes

Step 1: Have your folded page from Part A out. Lay a ruler or straight edge from one corner of the sheet to the opposite corner. Use your pen to draw this **diagonal**.



Step 2: Use your straight edge to draw in the second diagonal.



My Notes

Questions:

1. What do you notice about the two diagonals?

_____

_____

_____

_____

2. Suggest a way that you could find the centre of a large, rectangular wooden board. (Folding wood to find the middle would not be an option.)

_____

_____

_____

_____

Turn to the solutions at the end of the section and mark your work.

Dividing Lengths in Half

The folding that you did in Part A of Activity 1 is essentially the same as dividing the side-lengths in half and then drawing lines across the page. To find the midpoint of a rectangle without folding, you could use the following procedure:

Step 1. Measure the side-lengths.

Step 2. Calculate the midpoint of each side-length by dividing it by 2.

Step 3. Mark the midpoint of each side-length.

Step 4. Draw a line from each midpoint to its opposite midpoint.

Step 5. Mark the midpoint at the point where the two lines intersect.

My Notes

Finding the midpoint of a dimension of an object involves dividing a measurement in half—this is the same as dividing by 2. When you work with measurements in SI, you can use decimals. However, when you work with imperial measurements, you'll often use fractions. Let's practise dividing fractions.

Example 1

What is $\frac{3}{4} \div 2$?

Write your answer as a fraction, and as a decimal.

Solution

$$\begin{aligned}\frac{3}{4} \div 2 &= \frac{3}{4} \times \frac{1}{2} \\ &= \frac{3}{8} \\ &= 3 \div 8 \\ &= 0.375\end{aligned}$$

Or if you have access, you can see the solution to this example at *Dividing Fractions* (*http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/dividing_fractions.htm*).

Example 2

Find $5\frac{1}{2} \div 2$?

Solution

$$5\frac{1}{2} \div 2 = \frac{11}{2} \div 2$$

Convert the mixed number to an improper fraction.

$$= \frac{11}{2} \times \frac{1}{2}$$

Dividing by 2 is the same as multiplying by $\frac{1}{2}$.

$$= \frac{11}{4}$$

$$= 2\frac{3}{4}$$

Leave your answer as a mixed number.

My Notes

Activity 2
Self-Check

The following questions could be encountered in carpentry, sewing, or in many other occupations.

1. $\frac{1}{2} \div 2$

2. $7\frac{1}{4} \div 2$

3. $9\frac{1}{4} \div 2$

My Notes

Turn to the solutions at the end of the section and mark your work.

Bringing Ideas Together

So far in this lesson, you've looked at ways to find the midpoint of an object, and you've practised dividing fractions. Let's work through an example that involves finding the midpoint.

Example 3

A two-by-four board is 92 ½ inches long. Where should this board be marked in order to cut it into two shorter two-by-four boards of equal lengths? Express your answer as a mixed number.

Solution

$$\begin{aligned} 92\frac{1}{2} \div 2 &= \frac{185}{2} \div 2 \\ &= \frac{185}{2} \times \frac{1}{2} \\ &= \frac{185}{4} \\ &= 46\frac{1}{4} \end{aligned}$$

The stud should be marked 46 ¼" from one end in order to cut it into two equal lengths.

My Notes

Other Divisions

Some situations require you to divide a length into multiple parts. For example, you might need to cut a length of wood into four equal pieces for a construction project, or a piece of ribbon into five half-inch lengths for a sewing project. Let's look at two examples before you move on to the next activity.

Example 4

An interior designer cuts a 24 m rope into 30 equal pieces. How long is each piece?

Solution

Divide the length of the rope by the number of pieces.

24 m ÷ 30 = 0.8 m

Each piece of rope is 0.8 m long.

Example 5

Melissa is a jeweller and she needs to cut several half-inch pieces of metal wire. The length of metal wire measures 10 ¼ inches before Melissa makes any cuts. How many pieces can Melissa cut from the metal wire?

Solution

To find out how many pieces Melissa can cut, divide the length of the wire by the length of the cut pieces.

$$10\frac{1}{4}\text{ in} \div \frac{1}{2}\text{ in} = \frac{41}{4}\text{ in} \div \frac{1}{2}\text{ in}$$

$$= \frac{41}{4}\text{ in} \times \frac{2}{1\text{ in}}$$

When you write the reciprocal of ½ in, the units also move to the denominator.

$$= \frac{82}{4}$$

$$= 20\frac{2}{4}$$

Reduce the fraction to lowest terms.

$$= 20\frac{1}{2}$$

The answer is 20 ½ pieces.

Melissa can cut 20 pieces of wire that are each ½ in long. She will have half a piece left over—or ¼ in of leftover wire.

Activity 3
Self-Check

My Notes

1. Masie wants to drill halfway through a 2 × 4 piece of lumber, which is 1 ½ in thick. How deep should she drill?

2. Where should a board 85 ½ in long be cut to obtain two equal lengths?

My Notes

3. Randy wants to drill a hole in the centre of a drawer front. If the front of the drawer measures 30 cm by 15 cm, where is the centre located from the edges of the drawer front?

4. Alex has a piece of ribbon that measures 5 feet in length. He needs to cut several 8 ½ -inch pieces for a project he's working on. How many pieces can he cut from the length of ribbon?

Turn to the solutions at the end of the section and mark your work.

Activity 4
Mastering Concepts

My Notes

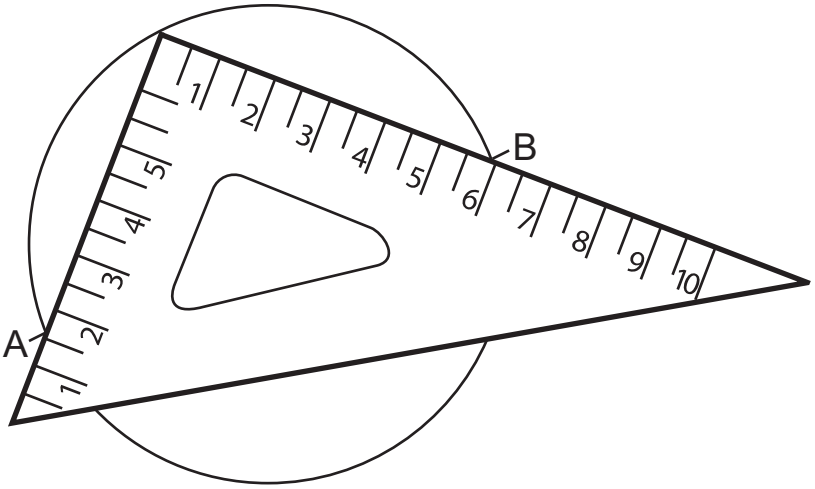
In Lesson B you traced circles and used a folding technique to find the centre. But what if folding was not an option? In this activity you will explore a method of finding the centre of a circular disk. This is the same method carpenters use.

Note: We don't often use the term "midpoint" when we're talking about circles. Instead, we use the terms "centre" or "centre-point."

Step 1: On a blank sheet of paper, draw a circle by tracing the bottom of a cylindrical shape, like a soup can, glass, or jar lid, or using a compass from your geometry set.

Step 2: Place a *set square* from a geometry set, or simply the square corner of another sheet of paper or a book, on the circle. The right angle of the square should be touching the circumference of the circle. Mark where the edges of the square cross the circle and label the marks A and B. Join points A and B.

A "set square" is a tool, often a clear plastic triangle, with one corner set at a 90° angle.



Step 3: Place the square on the circle in a new position so that the right angle of the square is still placed somewhere on the circumference. Mark where the edges of the square cross the circle using letters C and D. Join points C and D.

My Notes

Questions:

1. What is segment AB? How can you check your answer by paper-folding?

2. How did using the set square a second time help you to locate the centre of the circle?

3. Explain, in your own words, how a carpenter might use a carpenter's square to locate the centre of a wooden, circular disk.

4. Identify situations where you might need to find the centre of a circular object.

_____

_____

_____

_____

_____

_____

Turn to the solutions at the end of the section and mark your work.

My Notes

My Notes

Lesson Summary

Photo by Konstantin Gushcha © 2010

You have likely heard the saying "Measure twice and cut once." If you have applied your carpentry skills to build a project, you know how accurate that advice is. Carpenters routinely use the skills you explored in this lesson to make accurate cuts and avoid waste.

In this lesson you explored some different methods of locating the midpoints of rectangles, and even looked at the method carpenters use to locate the centre of a circle. You practised your skills with dividing fractions as you worked with imperial measurements of length.

Lesson D
Linear Problems

To complete this lesson, you will need:

- a ruler or tape measure that shows imperial and SI units
- a large suitcase
- a calculator
- Data Pages

In this lesson, you will complete:

- 4 activites

Essential Questions

- How do you solve perimeter, circumference, and size problems based on linear dimensions?
- How can you determine if your answers to linear measurement problems are reasonable?

My Notes

Focus

Photo by Konstantin Gushcha © 2010

Taking your surf board to Hawaii could be a little tricky, but some airlines actually allow it!

The air traveller in the photograph will be checking more than two bags prior to his flight. Airlines in Canada have restrictions on the number and weight of bags travellers can check. Airlines also limit the linear dimensions of each checked bag. The total of the length, width, and height cannot exceed 158 cm. You will be assessed a surcharge if you exceed the limits for the number, weight, or linear dimensions of checked baggage.

Surcharges for extra pieces, or for overweight and oversized items, can be pricey. Baggage restrictions are just one type of **linear measurement** problem you will encounter in this lesson.

Get Started

In the following activity you will review the formulas for perimeter and circumference.

My Notes

Activity 1
Self-Check

Match the formulas on the right to the descriptions on the left.

Descriptions	Formulas
1. _____ This formula is used to calculate the circumference of a circle when the diameter is known.	A. $C = 2\pi r$
2. _____ This formula is used to calculate the perimeter of a rectangle.	B. $P = a + b + c$
3. _____ This formula is used to calculate the perimeter of a square.	C. $P = 2l + 2w$
4. _____ This formula is used to calculate the circumference of a circle when the radius is known.	D. $C = \pi d$
5. _____ This formula is used to calculate the perimeter of a triangle.	E. $P = 4s$

Turn to the solutions at the end of the section and mark your work.

Finding Formulas

The formulas in the matching activity should be familiar to you. Take out your Data Pages and look for these formulas. Make sure you understand these formulas and feel comfortable using them.

Explore

As mentioned in the Focus, most airlines place restrictions on the size and number of baggage items that you can fly with. In the following activity you will explore linear measurement restrictions airlines set on checked baggage.

My Notes

Activity 2
Self-Check

Please answer the following questions. You will need a measuring tape to complete this activity.

Canadian airlines restrict the size of checked baggage. Bags with a total length, width, and height measurement of more than 158 cm are assessed a surcharge.

1. Suppose you are in Florida, and the measuring tape you have only shows inches. What is the 158-cm limit in inches? Round your answer to the nearest inch.

2. Find the biggest suitcase or bag in your house or school (a hockey-equipment bag would work too). Measure the dimensions of the suitcase or bag. Does the sum of the length, width and height of the suitcase you measured exceed the airline limit?

My Notes

3. Complete the following table by indicating the maximum each missing measurement could be without exceeding the airline's size limit.

Length	Width	Height
80 cm	40 cm	
30 in		10 in
	1 ft 6 in	8 in

Turn to the solutions at the end of the section and mark your work.

Bringing Ideas Together

In Explore you examined one type of linear measurement problem. In the examples and activities that follow, you will meet a wide variety of measurement problems. Let's work through a couple of examples together.

Example 1

Bill's front door has a semicircular window like the one in the picture.

a. Without knowing the exact measurements of the window, how could you estimate the window's perimeter?

b. If the bottom of the window is 68 cm wide, calculate the perimeter, correct to the nearest centimetre.

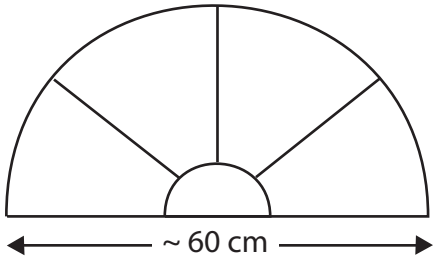
Photo by Jenson © 2010

My Notes

Solution

a. You probably have some idea of how wide a door is. It's reasonable to estimate that the average door is about one metre wide. From the picture it looks like the widest part of the window—the bottom edge—takes up just over half of the door's width. So, let's estimate that the window is about 60 cm wide.

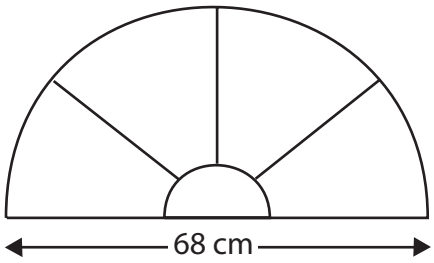
To find the perimeter of the window, you must add the length of the semicircular curve to the 60 cm base of the window. The length of the semi-circular curve is one-half the circumference of a circle with the same diameter.



- Find the approximate circumference of a circle with a diameter of 60 cm: 3 × 60 cm = 180 cm
- Find the circumference of half the circle: 180 cm ÷ 2 = 90 cm
- Find the approximate perimeter of the window: 90 cm + 60 cm = 150 cm

The perimeter of the window in Bill's door is probably about 150 cm.

b. Now that we know the actual width of the window, use the same steps you used to estimate.



- Find the circumference of a circle with a diameter of 68 cm:
  $C = \pi d$
  $C = \pi(68 \text{ cm})$
  $C = 213.6283 \ldots \text{ cm}$
- Find the circumference of half the circle: 213.6283 . . . cm ÷ 2 = 106.8141 . . . cm
- Find the perimeter of the window: 106.8141 . . . cm + 68 cm = 174.8141 . . . cm

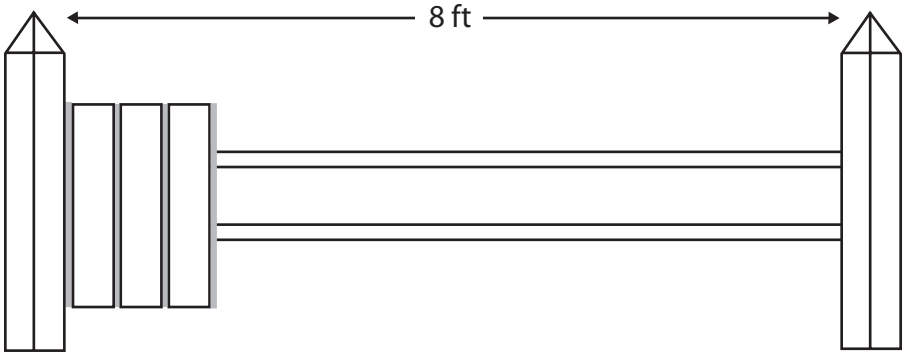
My Notes

Rounding to the nearest centimetre, the perimeter of the window in Bill's door is 175 cm.

Considering that the window was actually 8 cm larger than our estimate, the answer we calculated seems reasonable.

Example 2

Tracey is building a fence. The fence posts are 8 ft apart. Tracey will nail vertical spruce fence boards, which are 5 ½ in wide, across the 8-ft gap.

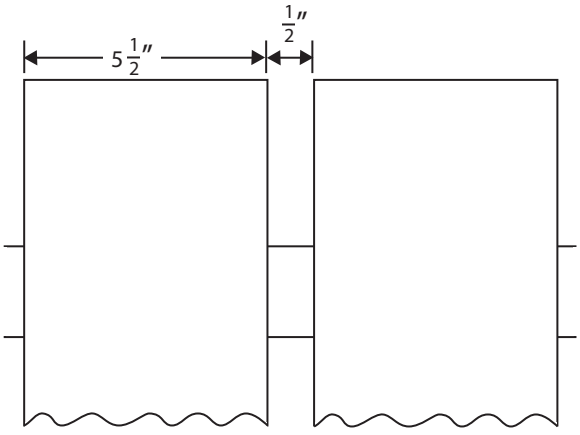


a. How many boards will Tracey use if she wants about a ½-in space between boards?

b. How much space must Tracey allow on each side of her boards, if the boards are evenly spaced across the 8-ft gap?

Solution

a.



My Notes

Each fence board plus a gap is:

$$5\frac{1}{2}+\frac{1}{2}=6 \text{ in}$$

Two boards would be:

6 in + 6 in = 12 in, or 1 ft

So, Tracey needs two boards for every foot of the 8 ft gap between posts.

2 × 8 = 16 boards

b. Tracey will use 16 boards, each with a width of 5 ½ in.

$$\begin{aligned}16\times5\frac{1}{2}\text{ in} &= \frac{16}{1}\times\frac{11}{2}\text{ in}\\ &= \frac{176}{2}\text{ in}\\ &= 88\text{ in}\end{aligned}$$

The boards will cover a width of 88 in.

There is 8 ft of space between the posts. Convert this to inches.

8 ft = (8 × 12) in

= 96 in

So, the boards will cover 88 in of the 96 in space. Let's find out the total for all the gaps between the boards.

96 in – 88 in = 8 in

Tracey must allow for 17 gaps because there is a gap between each of the 16 boards as well as between the first board and the post, and the last board and the post.

So, the gap between boards must be:

$$8\text{ in}\div17=\frac{8}{17}\text{ in}$$

This answer is reasonable, since the gap must be slightly less than ½ in.

My Notes

Note: $\frac{8}{17}$ in is difficult to measure using a measuring tape. Tracy would need to look for a fraction that is close to $\frac{8}{17}$ that she can find on her imperial tape measure.

$\frac{8}{17}$ in $= 0.4705 \ldots$ in

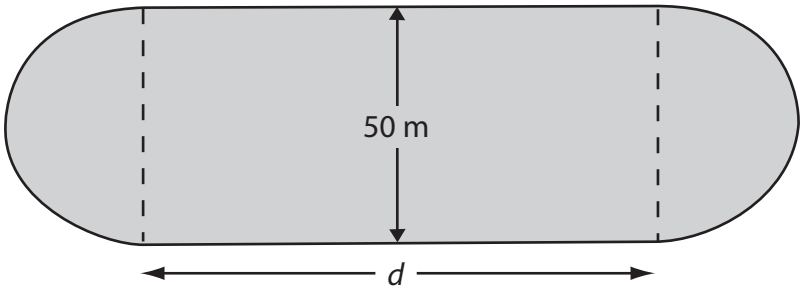
$\frac{15}{32}$ in $= 0.4687 \ldots$ in

So, $\frac{8}{17}$ in $\approx \frac{15}{32}$ in

Tracey can use her imperial tape measure to gap the fence boards since $\frac{15}{32}$ in can be found on the tape measure.

Example 3

The following diagram shows the layout of a running track.



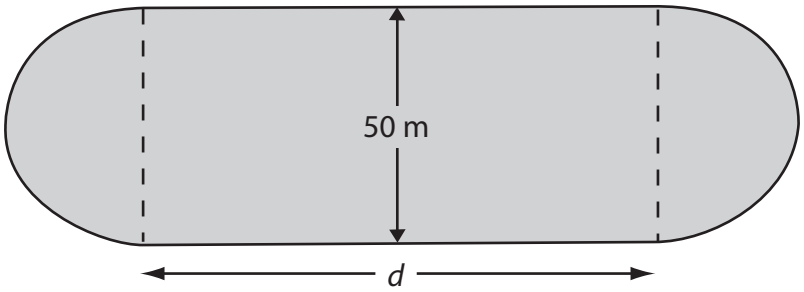
The ends of the track are semicircles, 50 m in diameter. The perimeter of the track is 400 m.

a. Estimate the length d of each straight side, if the perimeter of the track is 400 m. Note that in this question, d does not represent diameter.

b. Determine d to the nearest tenth of a metre.

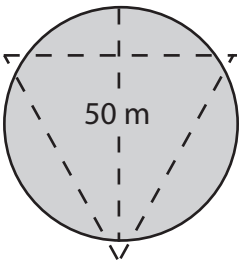
My Notes

Solution



a. Estimate the length d of each straight side.

The two ends of the track form a circle. The distance around a circle is approximately three times the diameter.



$$3 \times 50 \text{ m} \approx 150 \text{ m}$$

The total track length is 400 m. The rounded ends are 150 m.

$$400 \text{ m} - 150 \text{ m} \approx 250 \text{ m}$$

$$250 \text{ m} \div 2 \approx 125 \text{ m}$$

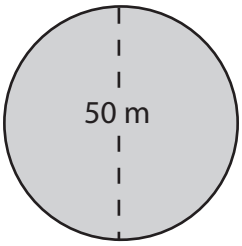
The length of each side, d, is approximately 125 m.

b. Determine d to the nearest tenth of a metre.

$C = \pi d$

$C = \pi \times 50 \text{ m}$

$C = 157 \text{ m}$



$400 \text{ m} - 150 \text{ m} = 243 \text{ m}$

$243 \text{ m} \div 2 = 121.5 \text{ m}$

If you have access, you can view the animated solution at *Running Track Solution (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/track/m10_3_m3_020.htm)*.

Activity 3
Self-Check

My Notes

Solve the following linear measurement problems.

1. The diameter of a golf ball is 4.3 cm.

   a. Estimate the number of times the ball will roll to travel 10 m.

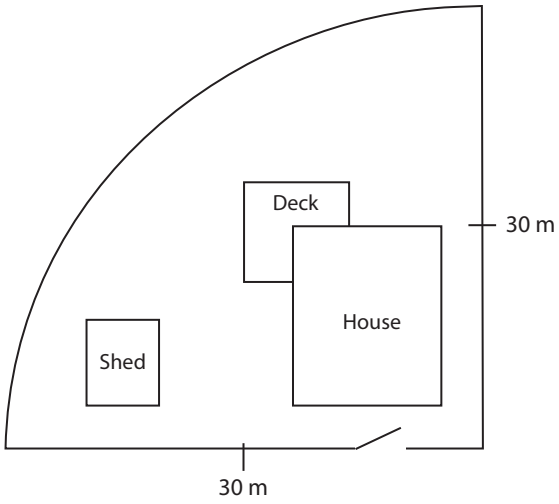
Photo by FloridaStock © 2010

   b. Now calculate the number of times the ball will roll to travel 10 m. Round to a whole number of rotations.

My Notes

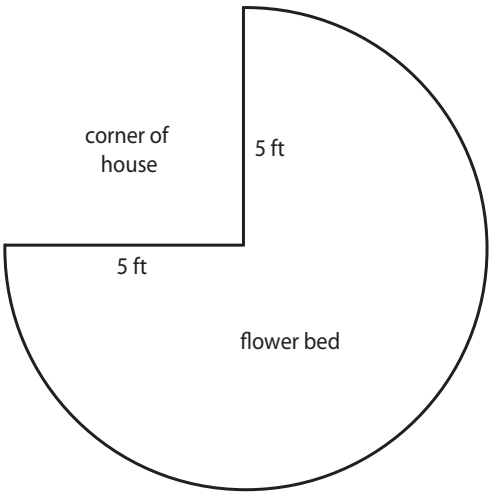
2. A residential property has the shape of one quarter of a circular disk.

   As a way of keeping his two dogs on the property, the owner plans to place a chain-link fence along the edge of the property. The chain link fence costs approximately $8.00 per metre. What is the cost of fencing the property? Round your answer to the nearest dollar.



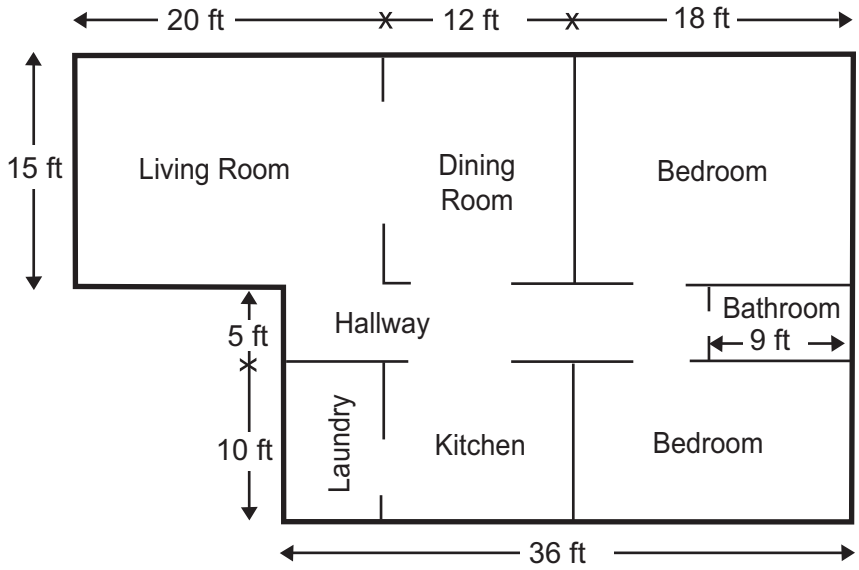
3. Jan has prepared a flower bed at one corner of her house. The flower bed is shaped as in the diagram.

   What is the perimeter of the flower bed? Round your answer to one decimal place. But first estimate your answer.



My Notes

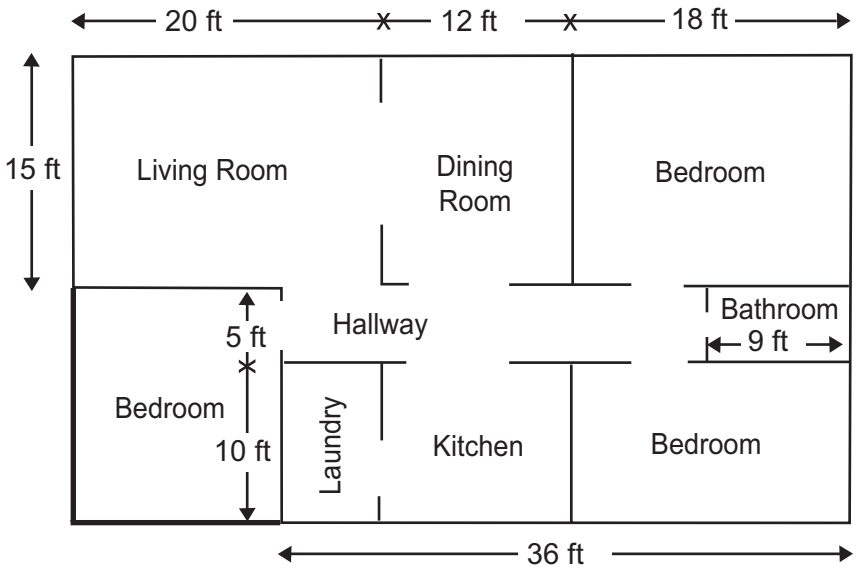
4. The following are plans the Popowich family received from their building contractor for their new house.



a. What is the perimeter of their house according to these plans?

My Notes

b. After the Popowich family looked over the plans, the family considered adding an extra bedroom to the house according to this revision to the plans. What is the perimeter of their house according to the revised plans?



5. Lumber sold as 1 × 6 boards actually have a thickness of ¾ in and a width of 5 ½ in. The height of a stack of 1 × 6 boards is 1 ft 6 ¾ in. How many boards are there in the stack?

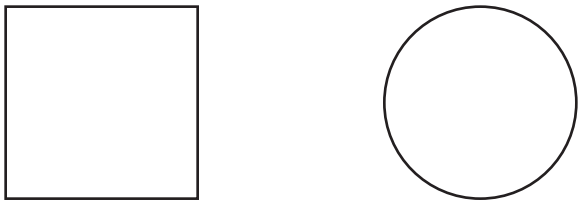
My Notes

Turn to the solutions at the end of the section and mark your work.

My Notes

Activity 4
Mastering Concepts

A 1-m length of wire is bent into a square. Another 1-m length of wire is bent into a circle.



The diagram is not drawn to scale.

Determine which is larger, the side length of the square or the diameter of the circle. First use an estimation technique. Then base your answer on a more precise calculation.

Turn to the solutions at the end of the section and mark your work.

Lesson Summary

My Notes

Photo by Evok20 © 2010

There are restrictions on parcels that can be sent through the mail or by courier. One of these restrictions is based on the linear dimensions of the package. The maximum size for one company is based on the following formula:

$$\text{size} = \text{length} + (2 \times \text{width}) + (2 \times \text{height})$$

Determining whether your shipment is below the maximum allowable is just one example of the linear problems you might encounter in everyday situations.

In addition to problem situations involving parcel or baggage size, you explored problems involving perimeter and circumference. These problems involved both SI and imperial units.

Linear Measure— Appendix

TABLE OF CONVERSIONS

1 inch	≈	2.54 centimetres
1 foot	≈	30.5 centimetres
1 foot	≈	0.305 metres
1 foot	=	12 inches
1 yard	=	3 feet
1 yard	≈	0.915 metres
1 mile	=	1760 yards
1 mile	≈	1.6 kilometres
1 kilogram	≈	2.2 pounds
1 litre	≈	1.06 US quarts
1 litre	≈	0.26 US gallons
1 gallon	≈	4 quarts
1 British gallon	≈	$\frac{6}{5}$ US gallon

FORMULAE

Temperature

$$C = \frac{5}{9}(F - 32)$$

Trigonometry

(Put your calculator in Degree Mode)

- Right triangles

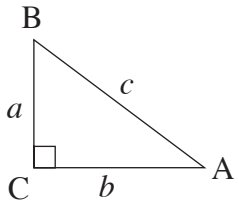
Pythagorean Theorem

$$a^2 + b^2 = c^2$$

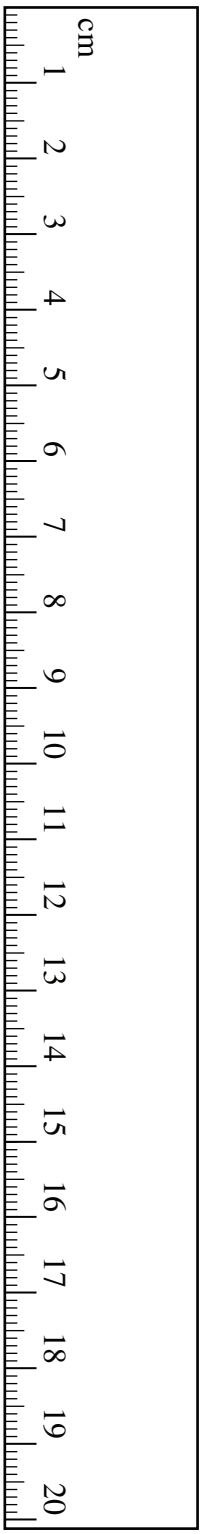
$$\sin A = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos A = \frac{\text{adjacent}}{\text{hypotenuse}}$$

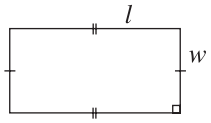
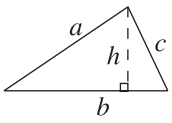
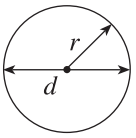
$$\tan A = \frac{\text{opposite}}{\text{adjacent}}$$



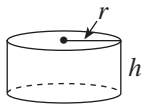
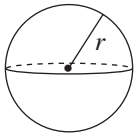
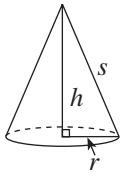
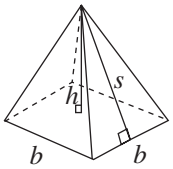
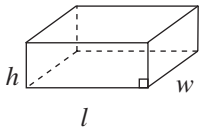
GEOMETRIC FORMULAE

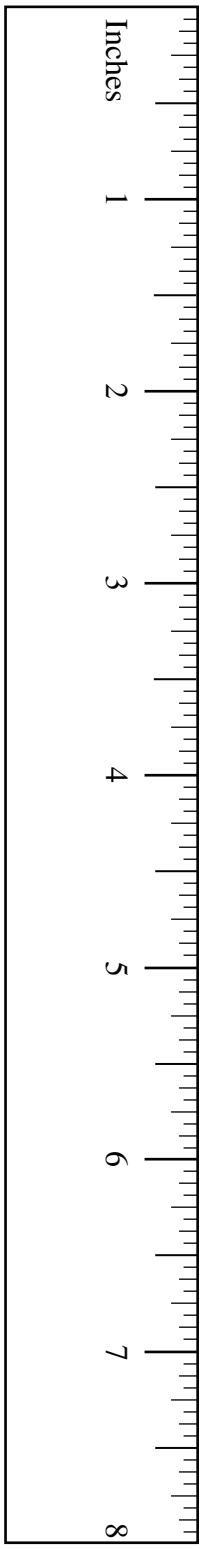


Key Legend	
l = length	P = perimeter
w = width	C = circumference
b = base	A = area
h = height	SA = surface area
s = slant height	V = volume
r = radius	
d = diameter	

Geometric Figure	Perimeter	Area
Rectangle 	$P = 2l + 2w$ **or** $P = 2(l + w)$	$A = lw$
Triangle 	$P = a + b + c$	$A = \frac{bh}{2}$
Circle 	$C = \pi d$ **or** $C = 2\pi r$	$A = \pi r^2$

Note: Use the value of π programmed in your calculator rather than the approximation of 3.14.

Geometric Figure	Surface Area
Cylinder 	$A_{top} = \pi r^2$ $A_{base} = \pi r^2$ $A_{side} = 2\pi rh$ $SA = 2\pi r^2 + 2\pi rh$
Sphere 	$SA = 4\pi r^2$ **or** $SA = \pi d^2$
Cone 	$A_{side} = \pi rs$ $A_{base} = \pi r^2$ $SA = \pi r^2 + \pi rs$
Square-Based Pyramid 	$A_{triangle} = \frac{1}{2} bs$ (for each triangle) $A_{base} = b^2$ $SA = 2bs + b^2$
Rectangular Prism 	$SA = wh + wh + lw + lw + lh + lh$ **or** $SA = 2(wh + lw + lh)$
General Right Prism	SA = the sum of the areas of all the faces
General Pyramid	SA = the sum of the areas of all the faces



Note: Use the value of **π** programmed in your calculator rather than the approximation of 3.14.

Canada Pension Plan Contributions / **Cotisations au Régime de pensions du Canada**

Weekly (52 pay periods a year) / Hebdomadaire (52 périodes de paie par année)

Pay Rémunération From - De	To - À	CPP RPC	Pay Rémunération From - De	To - À	CPP RPC	Pay Rémunération From - De	To - À	CPP RPC	Pay Rémunération From - De	To - À	CPP RPC
358.11 -	358.31	14.40	372.66 -	372.85	15.12	387.20 -	387.40	15.84	401.75 -	401.94	16.56
358.32 -	358.51	14.41	372.86 -	373.05	15.13	387.41 -	387.60	15.85	401.95 -	402.14	16.57
358.52 -	358.71	14.42	373.06 -	373.25	15.14	387.61 -	387.80	15.86	402.15 -	402.35	16.58
358.72 -	358.91	14.43	373.26 -	373.46	15.15	387.81 -	388.00	15.87	402.36 -	402.55	16.59
358.92 -	359.11	14.44	373.47 -	373.66	15.16	388.01 -	388.20	15.88	402.56 -	402.75	16.60
359.12 -	359.32	14.45	373.67 -	373.86	15.17	388.21 -	388.41	15.89	402.76 -	402.95	16.61
359.33 -	359.52	14.46	373.87 -	374.06	15.18	388.42 -	388.61	15.90	402.96 -	403.15	16.62
359.53 -	359.72	14.47	374.07 -	374.26	15.19	388.62 -	388.81	15.91	403.16 -	403.36	16.63
359.73 -	359.92	14.48	374.27 -	374.47	15.20	388.82 -	389.01	15.92	403.37 -	403.56	16.64
359.93 -	360.12	14.49	374.48 -	374.67	15.21	389.02 -	389.21	15.93	403.57 -	403.76	16.65
360.13 -	360.33	14.50	374.68 -	374.87	15.22	389.22 -	389.42	15.94	403.77 -	403.96	16.66
360.34 -	360.53	14.51	374.88 -	375.07	15.23	389.43 -	389.62	15.95	403.97 -	404.16	16.67
360.54 -	360.73	14.52	375.08 -	375.27	15.24	389.63 -	389.82	15.96	404.17 -	404.37	16.68
360.74 -	360.93	14.53	375.28 -	375.48	15.25	389.83 -	390.02	15.97	404.38 -	404.57	16.69
360.94 -	361.13	14.54	375.49 -	375.68	15.26	390.03 -	390.22	15.98	404.58 -	404.77	16.70
361.14 -	361.34	14.55	375.69 -	375.88	15.27	390.23 -	390.43	15.99	404.78 -	404.97	16.71
361.35 -	361.54	14.56	375.89 -	376.08	15.28	390.44 -	390.63	16.00	404.98 -	405.17	16.72
361.55 -	361.74	14.57	376.09 -	376.28	15.29	390.64 -	390.83	16.01	405.18 -	405.38	16.73
361.75 -	361.94	14.58	376.29 -	376.49	15.30	390.84 -	391.03	16.02	405.39 -	405.58	16.74
361.95 -	362.14	14.59	376.50 -	376.69	15.31	391.04 -	391.23	16.03	405.59 -	405.78	16.75
362.15 -	362.35	14.60	376.70 -	376.89	15.32	391.24 -	391.44	16.04	405.79 -	405.98	16.76
362.36 -	362.55	14.61	376.90 -	377.09	15.33	391.45 -	391.64	16.05	405.99 -	406.18	16.77
362.56 -	362.75	14.62	377.10 -	377.29	15.34	391.65 -	391.84	16.06	406.19 -	406.39	16.78
362.76 -	362.95	14.63	377.30 -	377.50	15.35	391.85 -	392.04	16.07	406.40 -	406.59	16.79
362.96 -	363.15	14.64	377.51 -	377.70	15.36	392.05 -	392.24	16.08	406.60 -	406.79	16.80
363.16 -	363.36	14.65	377.71 -	377.90	15.37	392.25 -	392.45	16.09	406.80 -	406.99	16.81
363.37 -	363.56	14.66	377.91 -	378.10	15.38	392.46 -	392.65	16.10	407.00 -	407.19	16.82
363.57 -	363.76	14.67	378.11 -	378.31	15.39	392.66 -	392.85	16.11	407.20 -	407.40	16.83
363.77 -	363.96	14.68	378.32 -	378.51	15.40	392.86 -	393.05	16.12	407.41 -	407.60	16.84
363.97 -	364.16	14.69	378.52 -	378.71	15.41	393.06 -	393.25	16.13	407.61 -	407.80	16.85
364.17 -	364.37	14.70	378.72 -	378.91	15.42	393.26 -	393.46	16.14	407.81 -	408.00	16.86
364.38 -	364.57	14.71	378.92 -	379.11	15.43	393.47 -	393.66	16.15	408.01 -	408.20	16.87
364.58 -	364.77	14.72	379.12 -	379.32	15.44	393.67 -	393.86	16.16	408.21 -	408.41	16.88
364.78 -	364.97	14.73	379.33 -	379.52	15.45	393.87 -	394.06	16.17	408.42 -	408.61	16.89
364.98 -	365.17	14.74	379.53 -	379.72	15.46	394.07 -	394.26	16.18	408.62 -	408.81	16.90
365.18 -	365.38	14.75	379.73 -	379.92	15.47	394.27 -	394.47	16.19	408.82 -	409.01	16.91
365.39 -	365.58	14.76	379.93 -	380.12	15.48	394.48 -	394.67	16.20	409.02 -	409.21	16.92
365.59 -	365.78	14.77	380.13 -	380.33	15.49	394.68 -	394.87	16.21	409.22 -	409.42	16.93
365.79 -	365.98	14.78	380.34 -	380.53	15.50	394.88 -	395.07	16.22	409.43 -	409.62	16.94
365.99 -	366.18	14.79	380.54 -	380.73	15.51	395.08 -	395.27	16.23	409.63 -	409.82	16.95
366.19 -	366.39	14.80	380.74 -	380.93	15.52	395.28 -	395.48	16.24	409.83 -	410.02	16.96
366.40 -	366.59	14.81	380.94 -	381.13	15.53	395.49 -	395.68	16.25	410.03 -	410.22	16.97
366.60 -	366.79	14.82	381.14 -	381.34	15.54	395.69 -	395.88	16.26	410.23 -	410.43	16.98
366.80 -	366.99	14.83	381.35 -	381.54	15.55	395.89 -	396.08	16.27	410.44 -	410.63	16.99
367.00 -	367.19	14.84	381.55 -	381.74	15.56	396.09 -	396.28	16.28	410.64 -	410.83	17.00
367.20 -	367.40	14.85	381.75 -	381.94	15.57	396.29 -	396.49	16.29	410.84 -	411.03	17.01
367.41 -	367.60	14.86	381.95 -	382.14	15.58	396.50 -	396.69	16.30	411.04 -	411.23	17.02
367.61 -	367.80	14.87	382.15 -	382.35	15.59	396.70 -	396.89	16.31	411.24 -	411.44	17.03
367.81 -	368.00	14.88	382.36 -	382.55	15.60	396.90 -	397.09	16.32	411.45 -	411.64	17.04
368.01 -	368.20	14.89	382.56 -	382.75	15.61	397.10 -	397.29	16.33	411.65 -	411.84	17.05
368.21 -	368.41	14.90	382.76 -	382.95	15.62	397.30 -	397.50	16.34	411.85 -	412.04	17.06
368.42 -	368.61	14.91	382.96 -	383.15	15.63	397.51 -	397.70	16.35	412.05 -	412.24	17.07
368.62 -	368.81	14.92	383.16 -	383.36	15.64	397.71 -	397.90	16.36	412.25 -	412.45	17.08
368.82 -	369.01	14.93	383.37 -	383.56	15.65	397.91 -	398.10	16.37	412.46 -	412.65	17.09
369.02 -	369.21	14.94	383.57 -	383.76	15.66	398.11 -	398.31	16.38	412.66 -	412.85	17.10
369.22 -	369.42	14.95	383.77 -	383.96	15.67	398.32 -	398.51	16.39	412.86 -	413.05	17.11
369.43 -	369.62	14.96	383.97 -	384.16	15.68	398.52 -	398.71	16.40	413.06 -	413.25	17.12
369.63 -	369.82	14.97	384.17 -	384.37	15.69	398.72 -	398.91	16.41	413.26 -	413.46	17.13
369.83 -	370.02	14.98	384.38 -	384.57	15.70	398.92 -	399.11	16.42	413.47 -	413.66	17.14
370.03 -	370.22	14.99	384.58 -	384.77	15.71	399.12 -	399.32	16.43	413.67 -	413.86	17.15
370.23 -	370.43	15.00	384.78 -	384.97	15.72	399.33 -	399.52	16.44	413.87 -	414.06	17.16
370.44 -	370.63	15.01	384.98 -	385.17	15.73	399.53 -	399.72	16.45	414.07 -	414.26	17.17
370.64 -	370.83	15.02	385.18 -	385.38	15.74	399.73 -	399.92	16.46	414.27 -	414.47	17.18
370.84 -	371.03	15.03	385.39 -	385.58	15.75	399.93 -	400.12	16.47	414.48 -	414.67	17.19
371.04 -	371.23	15.04	385.59 -	385.78	15.76	400.13 -	400.33	16.48	414.68 -	414.87	17.20
371.24 -	371.44	15.05	385.79 -	385.98	15.77	400.34 -	400.53	16.49	414.88 -	415.07	17.21
371.45 -	371.64	15.06	385.99 -	386.18	15.78	400.54 -	400.73	16.50	415.08 -	415.27	17.22
371.65 -	371.84	15.07	386.19 -	386.39	15.79	400.74 -	400.93	16.51	415.28 -	415.48	17.23
371.85 -	372.04	15.08	386.40 -	386.59	15.80	400.94 -	401.13	16.52	415.49 -	415.68	17.24
372.05 -	372.24	15.09	386.60 -	386.79	15.81	401.14 -	401.34	16.53	415.69 -	415.88	17.25
372.25 -	372.45	15.10	386.80 -	386.99	15.82	401.35 -	401.54	16.54	415.89 -	416.08	17.26
372.46 -	372.65	15.11	387.00 -	387.19	15.83	401.55 -	401.74	16.55	416.09 -	416.28	17.27

Employee's maximum CPP contribution for the year 2009 is $2,118.60

La cotisation maximale de l'employé au RPC pour l'année 2009 est de 2 118,60 $

Employment Insurance Premiums — Cotisations à l'assurance-emploi

Insurable Earnings Rémunération assurable From - De	To - À	EI premium Cotisation d'AE	Insurable Earnings Rémunération assurable From - De	To - À	EI premium Cotisation d'AE	Insurable Earnings Rémunération assurable From - De	To - À	EI premium Cotisation d'AE	Insurable Earnings Rémunération assurable From - De	To - À	EI premium Cotisation d'AE
333.24 -	333.81	5.77	374.86 -	375.43	6.49	416.48 -	417.05	7.21	458.10 -	458.67	7.93
333.82 -	334.39	5.78	375.44 -	376.01	6.50	417.06 -	417.63	7.22	458.68 -	459.24	7.94
334.40 -	334.97	5.79	376.02 -	376.58	6.51	417.64 -	418.20	7.23	459.25 -	459.82	7.95
334.98 -	335.54	5.80	376.59 -	377.16	6.52	418.21 -	418.78	7.24	459.83 -	460.40	7.96
335.55 -	336.12	5.81	377.17 -	377.74	6.53	418.79 -	419.36	7.25	460.41 -	460.98	7.97
336.13 -	336.70	5.82	377.75 -	378.32	6.54	419.37 -	419.94	7.26	460.99 -	461.56	7.98
336.71 -	337.28	5.83	378.33 -	378.90	6.55	419.95 -	420.52	7.27	461.57 -	462.13	7.99
337.29 -	337.86	5.84	378.91 -	379.47	6.56	420.53 -	421.09	7.28	462.14 -	462.71	8.00
337.87 -	338.43	5.85	379.48 -	380.05	6.57	421.10 -	421.67	7.29	462.72 -	463.29	8.01
338.44 -	339.01	5.86	380.06 -	380.63	6.58	421.68 -	422.25	7.30	463.30 -	463.87	8.02
339.02 -	339.59	5.87	380.64 -	381.21	6.59	422.26 -	422.83	7.31	463.88 -	464.45	8.03
339.60 -	340.17	5.88	381.22 -	381.79	6.60	422.84 -	423.41	7.32	464.46 -	465.02	8.04
340.18 -	340.75	5.89	381.80 -	382.36	6.61	423.42 -	423.98	7.33	465.03 -	465.60	8.05
340.76 -	341.32	5.90	382.37 -	382.94	6.62	423.99 -	424.56	7.34	465.61 -	466.18	8.06
341.33 -	341.90	5.91	382.95 -	383.52	6.63	424.57 -	425.14	7.35	466.19 -	466.76	8.07
341.91 -	342.48	5.92	383.53 -	384.10	6.64	425.15 -	425.72	7.36	466.77 -	467.34	8.08
342.49 -	343.06	5.93	384.11 -	384.68	6.65	425.73 -	426.30	7.37	467.35 -	467.91	8.09
343.07 -	343.64	5.94	384.69 -	385.26	6.66	426.31 -	426.87	7.38	467.92 -	468.49	8.10
343.65 -	344.21	5.95	385.27 -	385.83	6.67	426.88 -	427.45	7.39	468.50 -	469.07	8.11
344.22 -	344.79	5.96	385.84 -	386.41	6.68	427.46 -	428.03	7.40	469.08 -	469.65	8.12
344.80 -	345.37	5.97	386.42 -	386.99	6.69	428.04 -	428.61	7.41	469.66 -	470.23	8.13
345.38 -	345.95	5.98	387.00 -	387.57	6.70	428.62 -	429.19	7.42	470.24 -	470.80	8.14
345.96 -	346.53	5.99	387.58 -	388.15	6.71	429.20 -	429.76	7.43	470.81 -	471.38	8.15
346.54 -	347.10	6.00	388.16 -	388.72	6.72	429.77 -	430.34	7.44	471.39 -	471.96	8.16
347.11 -	347.68	6.01	388.73 -	389.30	6.73	430.35 -	430.92	7.45	471.97 -	472.54	8.17
347.69 -	348.26	6.02	389.31 -	389.88	6.74	430.93 -	431.50	7.46	472.55 -	473.12	8.18
348.27 -	348.84	6.03	389.89 -	390.46	6.75	431.51 -	432.08	7.47	473.13 -	473.69	8.19
348.85 -	349.42	6.04	390.47 -	391.04	6.76	432.09 -	432.65	7.48	473.70 -	474.27	8.20
349.43 -	349.99	6.05	391.05 -	391.61	6.77	432.66 -	433.23	7.49	474.28 -	474.85	8.21
350.00 -	350.57	6.06	391.62 -	392.19	6.78	433.24 -	433.81	7.50	474.86 -	475.43	8.22
350.58 -	351.15	6.07	392.20 -	392.77	6.79	433.82 -	434.39	7.51	475.44 -	476.01	8.23
351.16 -	351.73	6.08	392.78 -	393.35	6.80	434.40 -	434.97	7.52	476.02 -	476.58	8.24
351.74 -	352.31	6.09	393.36 -	393.93	6.81	434.98 -	435.54	7.53	476.59 -	477.16	8.25
352.32 -	352.89	6.10	393.94 -	394.50	6.82	435.55 -	436.12	7.54	477.17 -	477.74	8.26
352.90 -	353.46	6.11	394.51 -	395.08	6.83	436.13 -	436.70	7.55	477.75 -	478.32	8.27
353.47 -	354.04	6.12	395.09 -	395.66	6.84	436.71 -	437.28	7.56	478.33 -	478.90	8.28
354.05 -	354.62	6.13	395.67 -	396.24	6.85	437.29 -	437.86	7.57	478.91 -	479.47	8.29
354.63 -	355.20	6.14	396.25 -	396.82	6.86	437.87 -	438.43	7.58	479.48 -	480.05	8.30
355.21 -	355.78	6.15	396.83 -	397.39	6.87	438.44 -	439.01	7.59	480.06 -	480.63	8.31
355.79 -	356.35	6.16	397.40 -	397.97	6.88	439.02 -	439.59	7.60	480.64 -	481.21	8.32
356.36 -	356.93	6.17	397.98 -	398.55	6.89	439.60 -	440.17	7.61	481.22 -	481.79	8.33
356.94 -	357.51	6.18	398.56 -	399.13	6.90	440.18 -	440.75	7.62	481.80 -	482.36	8.34
357.52 -	358.09	6.19	399.14 -	399.71	6.91	440.76 -	441.32	7.63	482.37 -	482.94	8.35
358.10 -	358.67	6.20	399.72 -	400.28	6.92	441.33 -	441.90	7.64	482.95 -	483.52	8.36
358.68 -	359.24	6.21	400.29 -	400.86	6.93	441.91 -	442.48	7.65	483.53 -	484.10	8.37
359.25 -	359.82	6.22	400.87 -	401.44	6.94	442.49 -	443.06	7.66	484.11 -	484.68	8.38
359.83 -	360.40	6.23	401.45 -	402.02	6.95	443.07 -	443.64	7.67	484.69 -	485.26	8.39
360.41 -	360.98	6.24	402.03 -	402.60	6.96	443.65 -	444.21	7.68	485.27 -	485.83	8.40
360.99 -	361.56	6.25	402.61 -	403.17	6.97	444.22 -	444.79	7.69	485.84 -	486.41	8.41
361.57 -	362.13	6.26	403.18 -	403.75	6.98	444.80 -	445.37	7.70	486.42 -	486.99	8.42
362.14 -	362.71	6.27	403.76 -	404.33	6.99	445.38 -	445.95	7.71	487.00 -	487.57	8.43
362.72 -	363.29	6.28	404.34 -	404.91	7.00	445.96 -	446.53	7.72	487.58 -	488.15	8.44
363.30 -	363.87	6.29	404.92 -	405.49	7.01	446.54 -	447.10	7.73	488.16 -	488.72	8.45
363.88 -	364.45	6.30	405.50 -	406.06	7.02	447.11 -	447.68	7.74	488.73 -	489.30	8.46
364.46 -	365.02	6.31	406.07 -	406.64	7.03	447.69 -	448.26	7.75	489.31 -	489.88	8.47
365.03 -	365.60	6.32	406.65 -	407.22	7.04	448.27 -	448.84	7.76	489.89 -	490.46	8.48
365.61 -	366.18	6.33	407.23 -	407.80	7.05	448.85 -	449.42	7.77	490.47 -	491.04	8.49
366.19 -	366.76	6.34	407.81 -	408.38	7.06	449.43 -	449.99	7.78	491.05 -	491.61	8.50
366.77 -	367.34	6.35	408.39 -	408.95	7.07	450.00 -	450.57	7.79	491.62 -	492.19	8.51
367.35 -	367.91	6.36	408.96 -	409.53	7.08	450.58 -	451.15	7.80	492.20 -	492.77	8.52
367.92 -	368.49	6.37	409.54 -	410.11	7.09	451.16 -	451.73	7.81	492.78 -	493.35	8.53
368.50 -	369.07	6.38	410.12 -	410.69	7.10	451.74 -	452.31	7.82	493.36 -	493.93	8.54
369.08 -	369.65	6.39	410.70 -	411.27	7.11	452.32 -	452.89	7.83	493.94 -	494.50	8.55
369.66 -	370.23	6.40	411.28 -	411.84	7.12	452.90 -	453.46	7.84	494.51 -	495.08	8.56
370.24 -	370.80	6.41	411.85 -	412.42	7.13	453.47 -	454.04	7.85	495.09 -	495.66	8.57
370.81 -	371.38	6.42	412.43 -	413.00	7.14	454.05 -	454.62	7.86	495.67 -	496.24	8.58
371.39 -	371.96	6.43	413.01 -	413.58	7.15	454.63 -	455.20	7.87	496.25 -	496.82	8.59
371.97 -	372.54	6.44	413.59 -	414.16	7.16	455.21 -	455.78	7.88	496.83 -	497.39	8.60
372.55 -	373.12	6.45	414.17 -	414.73	7.17	455.79 -	456.35	7.89	497.40 -	497.97	8.61
373.13 -	373.69	6.46	414.74 -	415.31	7.18	456.36 -	456.93	7.90	497.98 -	498.55	8.62
373.70 -	374.27	6.47	415.32 -	415.89	7.19	456.94 -	457.51	7.91	498.56 -	499.13	8.63
374.28 -	374.85	6.48	415.90 -	416.47	7.20	457.52 -	458.09	7.92	499.14 -	499.71	8.64

Yearly maximum insurable earnings are $42,300
Yearly maximum employee premiums are $731.79
The premium rate for 2009 is 1.73 %

Le maximum annuel de la rémunération assurable est de 42 300 $
La cotisation maximale annuelle de l'employé est de 731,79 $
Le taux de cotisation pour 2009 est de 1,73 %

Federal tax deductions
Effective January 1, 2009
Weekly (52 pay periods a year)
Also look up the tax deductions in the provincial table

Retenues d'impôt fédéral
En vigueur le 1er janvier 2009
Hebdomadaire (52 périodes de paie par année)
Cherchez aussi les retenues d'impôt dans la table provinciale

Pay Rémunération			Federal claim codes/Codes de demande fédéraux									
			0	1	2	3	4	5	6	7	8	9	10
From De	Less than Moins de		Deduct from each pay Retenez sur chaque paie										
335	-	339	44.65	15.55	12.70	7.00	1.30						
339	-	343	45.20	16.10	13.25	7.55	1.85						
343	-	347	45.80	16.65	13.80	8.10	2.45						
347	-	351	46.35	17.20	14.35	8.65	3.00						
351	-	355	46.90	17.75	14.90	9.25	3.55						
355	-	359	47.45	18.35	15.50	9.80	4.10						
359	-	363	48.00	18.90	16.05	10.35	4.65						
363	-	367	48.60	19.45	16.60	10.90	5.25						
367	-	371	49.15	20.00	17.15	11.45	5.80	.10					
371	-	375	49.70	20.55	17.70	12.05	6.35	.65					
375	-	379	50.25	21.15	18.30	12.60	6.90	1.20					
379	-	383	50.80	21.70	18.85	13.15	7.45	1.80					
383	-	387	51.40	22.25	19.40	13.70	8.00	2.35					
387	-	391	51.95	22.80	19.95	14.25	8.60	2.90					
391	-	395	52.50	23.35	20.50	14.85	9.15	3.45					
395	-	399	53.05	23.95	21.10	15.40	9.70	4.00					
399	-	403	53.60	24.50	21.65	15.95	10.25	4.60					
403	-	407	54.20	25.05	22.20	16.50	10.80	5.15					
407	-	411	54.75	25.60	22.75	17.05	11.40	5.70					
411	-	415	55.30	26.15	23.30	17.65	11.95	6.25	.55				
415	-	419	55.85	26.75	23.90	18.20	12.50	6.80	1.15				
419	-	423	56.40	27.30	24.45	18.75	13.05	7.40	1.70				
423	-	427	57.00	27.85	25.00	19.30	13.60	7.95	2.25				
427	-	431	57.55	28.40	25.55	19.85	14.20	8.50	2.80				
431	-	435	58.10	28.95	26.10	20.45	14.75	9.05	3.35				
435	-	439	58.65	29.50	26.70	21.00	15.30	9.60	3.95				
439	-	443	59.20	30.10	27.25	21.55	15.85	10.20	4.50				
443	-	447	59.80	30.65	27.80	22.10	16.40	10.75	5.05				
447	-	451	60.35	31.20	28.35	22.65	17.00	11.30	5.60				
451	-	455	60.90	31.75	28.90	23.25	17.55	11.85	6.15	.50			
455	-	459	61.45	32.30	29.50	23.80	18.10	12.40	6.75	1.05			
459	-	463	62.00	32.90	30.05	24.35	18.65	12.95	7.30	1.60			
463	-	467	62.60	33.45	30.60	24.90	19.20	13.55	7.85	2.15			
467	-	471	63.15	34.00	31.15	25.45	19.80	14.10	8.40	2.70			
471	-	475	63.70	34.55	31.70	26.05	20.35	14.65	8.95	3.30			
475	-	479	64.25	35.10	32.30	26.60	20.90	15.20	9.55	3.85			
479	-	483	64.80	35.70	32.85	27.15	21.45	15.75	10.10	4.40			
483	-	487	65.40	36.25	33.40	27.70	22.00	16.35	10.65	4.95			
487	-	491	65.95	36.80	33.95	28.25	22.60	16.90	11.20	5.50			
491	-	495	66.50	37.35	34.50	28.85	23.15	17.45	11.75	6.10	.40		
495	-	499	67.05	37.90	35.10	29.40	23.70	18.00	12.35	6.65	.95		
499	-	503	67.60	38.50	35.65	29.95	24.25	18.55	12.90	7.20	1.50		
503	-	507	68.20	39.05	36.20	30.50	24.80	19.15	13.45	7.75	2.05		
507	-	511	68.75	39.60	36.75	31.05	25.40	19.70	14.00	8.30	2.65		
511	-	515	69.30	40.15	37.30	31.65	25.95	20.25	14.55	8.90	3.20		
515	-	519	69.85	40.70	37.90	32.20	26.50	20.80	15.15	9.45	3.75		
519	-	523	70.40	41.30	38.45	32.75	27.05	21.35	15.70	10.00	4.30		
523	-	527	71.00	41.85	39.00	33.30	27.60	21.95	16.25	10.55	4.85		
527	-	531	71.55	42.40	39.55	33.85	28.20	22.50	16.80	11.10	5.45		
531	-	535	72.10	42.95	40.10	34.45	28.75	23.05	17.35	11.70	6.00	.30	
535	-	539	72.65	43.50	40.70	35.00	29.30	23.60	17.90	12.25	6.55	.85	
539	-	543	73.20	44.10	41.25	35.55	29.85	24.15	18.50	12.80	7.10	1.40	
543	-	547	73.80	44.65	41.80	36.10	30.40	24.75	19.05	13.35	7.65	2.00	
547	-	551	74.35	45.20	42.35	36.65	31.00	25.30	19.60	13.90	8.25	2.55	
551	-	555	74.90	45.75	42.90	37.25	31.55	25.85	20.15	14.50	8.80	3.10	

British Columbia provincial tax deductions
Effective January 1, 2009
Weekly (52 pay periods a year)
Also look up the tax deductions in the federal table

Retenues d'impôt provincial de la Colombie-Britannique
En vigueur le 1er janvier 2009
Hebdomadaire (52 périodes de paie par année)
Cherchez aussi les retenues d'impôt dans la table fédérale

Pay / Rémunération			Provincial claim codes/Codes de demande provinciaux										
			0	1	2	3	4	5	6	7	8	9	10
From / De	Less than / Moins de		Deduct from each pay / Retenez sur chaque paie										
	-	343	*	.00									
343	-	345	9.30	.20									
345	-	347	9.45	.35									
347	-	349	9.60	.50									
349	-	351	9.80	.65									
351	-	353	9.95	.80									
353	-	355	10.10	.95									
355	-	357	10.25	1.15	.10								
357	-	359	10.40	1.30	.25								
359	-	361	10.55	1.45	.40								
361	-	363	10.75	1.60	.60								
363	-	365	10.90	1.75	.75								
365	-	367	11.05	1.90	.90								
367	-	369	11.20	2.10	1.05								
369	-	371	11.35	2.25	1.20								
371	-	373	11.50	2.40	1.35								
373	-	375	11.70	2.55	1.55								
375	-	377	11.85	2.70	1.70								
377	-	379	12.00	2.90	1.85								
379	-	381	12.15	3.05	2.00								
381	-	383	12.30	3.20	2.15	.10							
383	-	385	12.45	3.35	2.30	.25							
385	-	387	12.65	3.50	2.50	.45							
387	-	389	12.80	3.65	2.65	.60							
389	-	391	12.95	3.85	2.80	.75							
391	-	393	13.10	4.00	2.95	.90							
393	-	395	13.25	4.15	3.10	1.05							
395	-	397	13.40	4.30	3.30	1.20							
397	-	399	13.60	4.45	3.45	1.40							
399	-	401	13.75	4.60	3.60	1.55							
401	-	403	13.90	4.80	3.75	1.70							
403	-	405	14.05	4.95	3.90	1.85							
405	-	407	14.20	5.10	4.05	2.00							
407	-	409	14.35	5.25	4.25	2.15	.10						
409	-	411	14.55	5.40	4.40	2.35	.30						
411	-	413	14.70	5.55	4.55	2.50	.45						
413	-	415	14.85	5.75	4.70	2.65	.60						
415	-	417	15.00	5.90	4.85	2.80	.75						
417	-	419	15.15	6.05	5.00	2.95	.90						
419	-	421	15.30	6.20	5.20	3.10	1.05						
421	-	423	15.50	6.35	5.35	3.30	1.25						
423	-	425	15.65	6.50	5.50	3.45	1.40						
425	-	427	15.80	6.70	5.65	3.60	1.55						
427	-	429	15.95	6.85	5.80	3.75	1.70						
429	-	431	16.10	7.00	5.95	3.90	1.85						
431	-	433	16.25	7.15	6.15	4.10	2.00						
433	-	435	16.45	7.30	6.30	4.25	2.20	.15					
435	-	437	16.60	7.45	6.45	4.40	2.35	.30					
437	-	439	16.75	7.65	6.60	4.55	2.50	.45					
439	-	441	16.90	7.80	6.75	4.70	2.65	.60					
441	-	443	17.05	7.95	6.90	4.85	2.80	.75					
443	-	445	17.20	8.10	7.10	5.05	2.95	.90					
445	-	447	17.40	8.25	7.25	5.20	3.15	1.10					
447	-	449	17.55	8.40	7.40	5.35	3.30	1.25					
449	-	451	17.70	8.60	7.55	5.50	3.45	1.40					

*You normally use claim code "0" only for non-resident employees. However, if you have non-resident employees who earn less than the minimum amount shown in the "Pay" column, you may not be able to use these tables. Instead, refer to the "Step-by-step calculation of tax deductions" in Section "A" of this publication.

*Le code de demande «0» est normalement utilisé seulement pour les non-résidents. Cependant, si la rémunération de votre employé non résidant est inférieure au montant minimum indiqué dans la colonne «Rémunération», vous ne pourrez peut-être pas utiliser ces tables. Reportez-vous alors au «Calcul des retenues d'impôt, étape par étape» dans la section «A» de cette publication.

Solutions

Section —Lesson A: Estimating and Measuring Length and Distance

Lesson A: Activity 1: Try This

1. Answers will vary.

2. You could compare the object you're measuring to one of the common objects.

3. 1 yd = 3 ft ; 1 yd = 36 in; 1 ft = 12 in

Lesson A: Activity 2: Try This

Answers will vary. Sample entries are given.

	SI Estimate	SI Measurement	Imperial Estimate	Imperial Measurement	Comment
Distance Around Your Head	50 cm		21 in		
Your Height	186 cm		6 ft 1 in		
Length of Your Arm	90 cm		2 ft 6 in		
Average Length of Your Stride	90 cm		1 yd		
Distance You Cover Walking Ten Steps	8 m		9 yd		
Length of Your Room					
Width of Your Thumb	2.5 cm		1 in		

	SI Estimate	SI Measurement	Imperial Estimate	Imperial Measurement	Comment
Width of Your Small Finger	1 cm		$\frac{1}{2}$ in		
Thickness of a Dime	1 mm		$\frac{1}{16}$ in		
Length of Your Foot	25 cm		10 in		
Height of Your Room	2.5 m		8 ft		
Width of Your Yard					

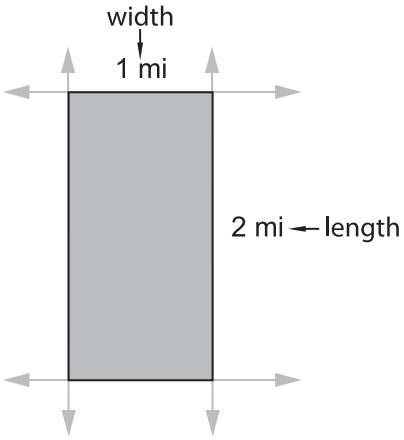
Lesson A: Activity 3: Self-Check

1. What you use as a referent is your choice. Sample answers are provided below.

Unit	Referent
1 in	width of a thumb
1 ft	width of a square floor tile or length of a large shoe
1 yd	distance from your nose to the tips of your fingers of your outstretched arm; long step or stride; height of a kitchen stove; height of a doorknob; width of a door
1 mm	thickness of a dime
1 cm	width of your little finger
1 m	long stride

2. Use a tape measure or ruler to check your estimates.

Lesson A: Activity 4: Self-Check

1. 

$w = 1$ mi, $l = 2$ mi

$P = 2l + 2w$
$= 2\ (2\text{ mi}) + 2\ (1\text{ mi})$
$= 4\text{ mi} + 2\text{ mi}$
$= 6\text{ mi}$

You would have to drive 6 miles to travel once around the area bound by the four roads.

2. A stop sign is a regular octagon. This means that the sign's eight sides are of equal length. Each side measures 10 in.

$P = 8 \times 10$ in
$= 80$ in

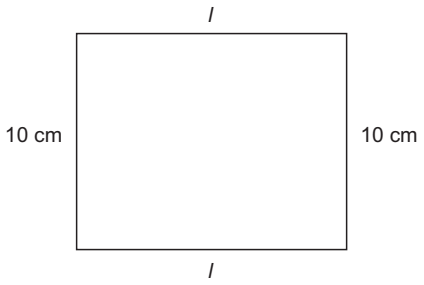
The perimeter of the stop sign is 80 in long. Now, convert the length in inches to a measurement in feet and inches. There are 12 inches in a foot, so divide 80 by 12.

$$12\overline{)80}$$

6 ← quotient – # of feet
72
8 ← remainder – # of inches

The road-maintenance worker needs 6 ft 8 in of tape for each stop sign.

3.



$$P = 2l + 2w$$
$$50 \text{ cm} = 2l + 2\,(10 \text{ cm})$$
$$50 \text{ cm} = 2l + 20 \text{ cm}$$

Subtract 20 cm from both sides.

$$50 \text{ cm} - 20 \text{ cm} = 2l + 20 \text{ cm} - 20 \text{ cm}$$
$$30 \text{ cm} = 2l$$

Divide both sides by 2 to isolate *l*.

$$\frac{30 \text{ cm}}{2} = \frac{2l}{2}$$
$$15 \text{ cm} = l$$
$$l = 15 \text{ cm}$$

The length of the rectangular picture is 15 cm.

Lesson A: Activity 5: Mastering Concepts

1. The doorway reduces the length of baseboard needed by 30 in.

2. For every inch the wall sticks out, the amount of baseboard needed increases by double, because the baseboard has to run out that distance and come back the same distance. So, for this room, you have to double 2 ft 6 in to calculate the extra baseboard needed.

3.

2 ft 6 in is the same as 2 ft + 6 in

$$P = 9 \text{ ft} + 12 \text{ ft} + 9 \text{ ft} + 2(2 \text{ ft } 6 \text{ in}) + 12 \text{ ft} - 30 \text{ in}$$

$$P = 42 \text{ ft} + 2(2 \text{ ft} + 6 \text{ in}) - 2(2 \text{ ft} + 6 \text{ in})$$

$$P = 42 \text{ ft} + 4 \text{ ft} + 12 \text{ in} - 2 \text{ ft} - 6 \text{ in}$$

$$P = 44 \text{ ft} + 6 \text{ in}$$

$$P = 44 \text{ ft } 6 \text{ in}$$

$$12\overline{)30}\ \begin{array}{l} 2 \leftarrow \text{\# of feet} \\ 24 \\ \hline 6 \leftarrow \text{\# of inches} \end{array}$$

So 30 in = 2 ft 6 in

44 ft 6 in is the same as $44\frac{1}{2}$ ft.

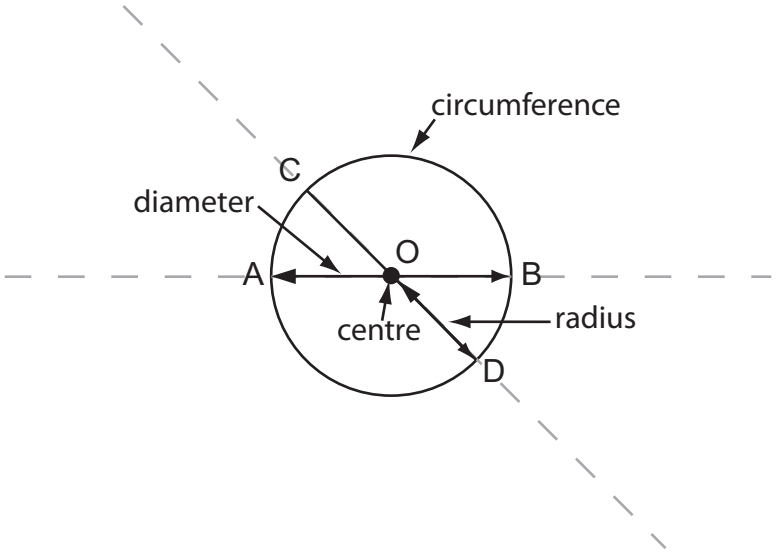
1 ft costs \$0.86.

$$\text{Cost of } 44\frac{1}{2} \text{ ft} = 44\frac{1}{2} \text{ ft} \times \$0.86/\text{ft}$$
$$= \$38.27$$

The baseboard for the guest room would cost \$38.27.

Section —Lesson B: Measuring Diameters

Lesson B: Activity 1: Try This



Lesson B: Activity 2: Self-Check

1. a. Since $d = 25$ cm,

$$r = \frac{25 \text{ cm}}{2}$$
$$= 12.5 \text{ cm}$$

b. The circumference is about 3 × 25 cm, or 75 cm.

c. Since the diameter was given, use

$$C = \pi d$$
$$= \pi \times 25 \text{ cm}$$

Enter the following key stokes on your calculator.

$\boxed{\pi}\boxed{\times}\boxed{2}\boxed{5}\boxed{=}$

Your display should be 78.539816 . . .

Round your answer to the nearest cm.

$C \approx 79$ cm

The circumference is about 79 cm. An answer of 79 cm is reasonable, since the estimate was 75 cm.

2. You know $r = 14$ mm. You want to find C.

Since the diameter was given, use

$$C = 2\pi r$$
$$= 2\pi \times 14 \text{ mm}$$

Enter the following keystrokes on your calculator.

$\boxed{2}\boxed{\pi}\boxed{\times}\boxed{1}\boxed{4}\boxed{=}$

Your display should be 87.9645943 . . .

Round your answer to the nearest mm.

$C \approx 88$ mm

The circumference is about 88 mm.

Lesson B: Activity 3: Try This

1. The centre of the circle is located at the point where two diameters meet. The diameters were created by folding the circle's tracing in half.

2. Answers will vary. You should have used a ruler or a tape measure. Depending on your tools, you may have had to use multiple tools to obtain measurements in SI and imperial units.

3. Answers will vary. You can obtain fairly precise measurements (to the nearest millimetre or sixteenth of an inch) using a ruler. However, when you traced the object, you may not have traced the exact size of the object (usually tracings are slightly larger). Error in your tracing will decrease the accuracy of your measurements.

Lesson B: Activity 4: Try This

1. $C = \pi d$

   $\frac{C}{\pi} = \frac{\pi d}{\pi}$

   $\frac{C}{\pi} = d$ OR $d = \frac{C}{\pi}$

2. Answers will vary.

3. $C = 2\pi r$

   $\frac{C}{2\pi} = \frac{2\pi r}{2\pi}$

   $\frac{C}{2\pi} = r$ OR $r = \frac{C}{2\pi}$

4. Answers will vary.

5. Answers will vary. Since you calculated the diameter and radius lengths based on the length of the circumference, the accuracy of these measurements depend on the accuracy of the circumference measurement. You can obtain fairly accurate measurements (to the nearest millimetre or sixteenth of an inch) using a ruler. However, when you wrapped the string around the object, you may not have measured the exact size of the object. Using string can be awkward, especially on very small or very large objects, and you may have ended up with a slightly larger or smaller measurement.

Lesson B: Activity 5: Self-Check

1. 3.64 cm
2. 2.37 cm
3. 4.76 cm
4. 1.93 cm
5. 3.32 cm

Lesson B: Activity 6: Self-Check

1. 7 + 0.18 = 7.18 mm
2. 12 + 0.43 = 12.43 mm
3. 21.5 + 0.37 = 21.87 mm
4. 13.5 + 0.12 = 13.62 mm
5. 4 + 0.15 = 4.15 mm

Lesson B: Activity 7: Mastering Concepts

The best tool for this job is the Vernier calliper. Terry should use the inside jaws to measure the diameter of the opening of the pot. He will need to make the lid just slightly smaller than the opening—but not too much smaller, or the lid will fall in. Once he's made the lid, he can use the outside jaws to measure the diameter of the part of the lid that fits inside the opening of the pot. (Measuring the lid is easier than putting the lid into the pot to see if it fits. The clay will be wet and doing the latter might cause damage to either of the pieces.)

Note:

- Terry could use a ruler, but it wouldn't be as precise as a calliper. Also, a calliper is much easier to use. With a ruler, he'd have to guess where the centre point of the opening is (in order to ensure he is measuring the diameter). With a Calliper, the jaws will close (or open, in the case of the inside jaws) on the widest part of the circle, resulting in an accurate diameter measurement.
- The micrometer is used for much smaller measurements.

Section —Lesson C: Locating Midpoints

Lesson C: Activity 1: Try This

Part A:

1. From the top of the sheet, the centre should be 5 ½ in (14 cm).
   From the sides of the sheet, the centre should be 4 ¼ in (10.8 cm).

2. The distance from the top of the sheet to the centre is half of the distance from the top to the bottom. 5 ½ = 11 ÷ 2 (or 14 cm = 27.9 cm ÷ 2)
   The distance from the side of the sheet to the centre is half of the distance from one side to the other. 4 ¼ = 8 ½ in ÷ 2 (or 10.8 cm = 21.6 cm ÷ 2)

3. You could trace the object onto a piece of paper, fold to find the midpoint and then lay the tracing back over the object and mark the centre.

4. For large objects, the folding technique won't work. For example, if you were trying to hang a picture on a wall, and needed to know the midpoint, you couldn't use the folding technique because the wall is too big to trace onto a piece of paper. Also, the folding technique's accuracy depends on the accuracy of your tracing and folding. It is not the most precise way to find the midpoint.

Part B:

1. The diagonals of the rectangle cross where the creases meet. This is the middle point of the sheet of paper. Therefore, the diagonals pass through the midpoint of the page.

2. Use a straightedge to draw the boards diagonals (lines that connect opposite corners). The point where the diagonals meet is the midpoint of the surface of the board.

Lesson C: Activity 2: Self-Check

1. $\frac{1}{2} \div 2 = \frac{1}{2} \times \frac{1}{2}$
$= \frac{1}{4}$

2. $7\frac{1}{4} \div 2 = \frac{29}{4} \div 2$
$= \frac{29}{4} \times \frac{1}{2}$
$= \frac{29}{8}$
$= 3\frac{5}{8}$

3. $9\frac{1}{4} \div 2 = \frac{37}{4} \div 2$
$= \frac{37}{4} \times \frac{1}{2}$
$= \frac{37}{8}$
$= 4\frac{5}{8}$

Lesson C: Activity 3: Self-Check

1. $1\frac{1}{2} \div 2 = \frac{3}{2} \div 2$
$= \frac{3}{2} \times \frac{1}{2}$
$= \frac{3}{4}$

Masie should drill ¾" into the wood.

2. $85\frac{1}{2} \div 2 = \frac{171}{2} \div 2$
$= \frac{171}{2} \times \frac{1}{2}$
$= \frac{171}{4}$
$= 42\frac{3}{4}$

The board should be cut at 42 ¾ inches from either end.

3. 30 cm ÷ 2 = 15 cm
   15 cm ÷ 2 = 7.5 cm
   The centre of the drawer front is 15 cm from either side, and is 7.5 cm from the top and bottom edges.

4. First, convert the length of the ribbon into inches.
   5 feet = (5 × 12) inches
   = 60 inches
   Now divide the length of the ribbon by the length of the pieces that need to be cut.

$$60 \text{ inches} \div 8\frac{1}{2} \text{ inches} = \frac{60}{1} \text{ in} \div \frac{17}{2} \text{ in}$$
$$= \frac{60}{1} \text{ in} \times \frac{2}{17 \text{ in}}$$
$$= \frac{120}{17}$$
$$= 7\frac{1}{17}$$

   Alex can cut 7 full pieces and will have a little bit of ribbon leftover.

Lesson C: Activity 4: Mastering Concepts

1. Segment AB is a diameter of the circle. If you fold the diagram along AB and hold the folded paper up to the light, you will see that two halves of the circle coincide. One semi-circle falls on the other semi-circle.

2. By creating a second diameter, you can locate the centre of the circle. Since all diameters go through the centre of the circle, the intersection point of the two diameters that you sketched is the circle's centre.

3. Proceed as with the circle drawn on paper. Place the right-angle corner of the carpenter's square right at the circular edge of the disk. Mark the points where the top edges of the square cross the disk. Join those points. That line is one diameter of the disk. Make a second diameter in the same way. The intersection of the diameters is the centre.

4. You might need to find centres in the following situations:

   - drilling a hole at the centre of a disk
   - art work
   - design work

Section —Lesson D: Linear Problems

Lesson D: Activity 1: Self-Check

Descriptions		Formulas
1. **D**	This formula is used to calculate the circumference of a circle when the diameter is known.	A. $C = 2\pi r$
2. **C**	This formula is used to calculate the perimeter of a rectangle.	B. $P = a + b + c$
3. **E**	This formula is used to calculate the perimeter of a square.	C. $P = 2l + 2w$
4. **A**	This formula is used to calculate the circumference of a circle when the radius is known.	D. $C = \pi d$
5. **B**	This formula is used to calculate the perimeter of a triangle.	E. $P = 4s$

Lesson D: Activity 2: Self-Check

1. 1 in = 2.54 cm

$$158 \text{ cm} = \left(\frac{158}{2.54}\right) \text{ in}$$
$$= 62.20472441 \ldots \text{ in}$$
$$\approx 62 \text{ in}$$

The 158 cm limit is 62 inches.

2. Answers will vary. A sample response is given below.

The dimensions of the luggage are 79 cm by 41 cm by 30 cm.

Sum of dimensions = length + width + height
= 79 cm+ 41 cm + 30 cm
= 150 cm

The sum of the dimensions of this suitcase does not exceed the 158-cm airline limit.

3.

Length	Width	Height
80 cm	40 cm	**38 cm**
30 in	**22 in**	10 in
36 in	1 ft 6 in = **18 in**	8 in

Lesson D: Activity 3: Self-Check

1. a. Start with your estimate.

$d = 4.3 \text{ cm} \approx 4 \text{ cm}$

The circumference is about three times the length of the diameter.

$C \approx 3 \times d$

$\approx 3 \times 4 \text{ cm}$

$\approx 12 \text{ cm}$

When the ball rotates once, it travels about 12 cm.

Divide to find the number of rotations in 1 m. Remember, 1 m = 100 cm.

100 cm ÷ 12 cm ≈ 8 rotations

In 10 m, the ball will rotate about 10 × 8 m, or 80 times.

b. Now find the exact number of rotations.

$C = \pi d$

$= \pi \times 4.3 \text{ cm}$

$= 13.5088 \ldots \text{ cm}$

The ball travels 13.5088 . . . cm in one rotation.

1 m = 100 cm

10 m = 10 × 100 cm

= 1000 cm

Find the number of rotations in 10 m, or 1000 cm.

1000 cm ÷ 13.5088 . . . cm = 74.0255 . . . rotations

The ball will rotate about 74 times, which is reasonable as the estimated answer was about 80 rotations.

2. P = 30 m + 30 m + ¼ C — circumference of a circle with a radius of 30 m

   = 60 m + ¼ (2 × π × 30 m)

   = 107.1238898 . . . m

   ≈107.12 m

   So, the perimeter is about 107.12 m.

   Fencing costs $8.00 per metre.

   So, 107.12 m costs

   107.12 × $8.00 = $856.96

   To the nearest dollar, the fence will cost $857.00.

3. Estimate the perimeter, P.

   The diameter of the circular part is:

   2 × 5 ft = 10 ft

   P ≈ 5 ft + 5 ft + ¾ C — circumference of a circle with a diameter of 10 ft

   P ≈ 10 ft + 0.75 × 30 ft

   P ≈ 10 ft + 22.5 ft

   P ≈ 32.5 ft

   The perimeter is about 32.5 ft.

   Refine your answer.

   P = 5 ft + 5 ft + ¾(π × 10) ft

   = 33.5619449 . . . ft

   The perimeter is about 33.6 ft. This answer is reasonable, since the estimate was 32.5 ft.

4. a. Start from the top, right corner of the house and move clockwise.

      The top of the diagram is:

      20 ft + 12 ft + 18 ft = 50 ft

      The right side of the diagram is:

      15 ft + 5 ft + 10 ft = 30 ft

      The total distance across the bottom must be the same as across the top, or 50 ft.

      The total distance along the left side must be the same as along the right, or 30 ft.

Therefore,

P = 50 ft + 30 ft + 50 ft + 30 ft

= 160 ft

b. The perimeter of the house is unchanged. Why? Putting in the bedrooms in the plans was done by simply replacing two line segments with two others of the same length.

You can think of the two line segments as having been simply moved to include the new bedroom in the revised plans. Therefore, the perimeter of the house remains unchanged. The perimeter of the house is still 160 ft.

You can also determine the value of the perimeter of the enlarged house by calculating as you did part a. You will arrive at the same answer.

5. Convert the height of the stack to inches.

1 ft 6 ¾ in = 12 in + 6 ¾ in

= 18 ¾ in

Divide the height of the stack by the thickness of one board to determine the number of boards.

$$18\frac{3}{4}\text{ in} \div \frac{3}{4}\text{ in} = \frac{75}{4}\text{ in} \div \frac{3}{4}\text{ in}$$
$$= \frac{75}{4}\text{ in} \times \frac{4}{3\text{ in}}$$
$$= \frac{300}{12}$$
$$= 25$$

There are 25 boards in the stack.

Lesson D: Activity 4: Mastering Concepts

1. **Estimation**

Recall the relationship between the circumference (C) of a circle and its diameter (d). Since C is approximately $3d$, d is about $\frac{1}{3}C$.

C = 1 m — The length of wire used to make the circle is 1 m.

So,

$d = \frac{1}{3}(1\text{ m})$

$= \frac{1}{3}\text{ m}$

For a square, its perimeter (P) equals 4 times the side length (s).

So,

$$s = \frac{1}{4} P$$

$P = 1$ m

The length of wire used to make the square is 1m.

So,

$$s = \frac{1}{4} (1 \text{ m})$$

$$= \frac{1}{4} \text{ m}$$

Since $\frac{1}{3}$ m is larger than ¼ m, d is greater than s.

Therefore, the diameter of the circle is larger than the side of the square.

Calculation

Now calculate to find a more precise answer.

1 m = 100 cm

Find the side length, s of the square.

$$P = 4s$$
$$100 \text{ cm} = 4s$$
$$\frac{100 \text{ cm}}{4} = \frac{4s}{4}$$
$$25 \text{ cm} = s$$

OR

$$s = 25 \text{ cm}$$

The side length of the square is 25 cm.

Find the diameter (d) of the circle.

$$C = \pi d$$
$$100 = \pi d$$
$$\frac{100}{\pi} = \frac{\pi d}{\pi}$$
$$d = \frac{100 \text{ cm}}{\pi}$$
$$= 31.830998862 \ldots \text{ cm}$$
$$= 31.8 \text{ cm}$$

The diameter of the circle is over 31.8 cm.

The diameter of the circle is larger than the side-length of the square.

Glossary

apex
the point furthest from a base in a cone

area
a measurement of how many square units into which a surface may be divided

For example, if your living room carpet can be divided into 10 square metres, its area is 10 m^2.

centre
a point of a circle that is at the circle's middle

circumference
the perimeter of, or the distance around, a circle

composite figure
any shape formed by combining simpler shapes

Combining simpler shapes such as the triangle, rectangle, parallelogram, and circle results in a composite figure.

cone
a three-dimensional object made up of a flat circular base and an attached curved surface that comes to a point called the *apex*

cube
a rectangular prism for which all faces are identical squares

cylinder
a three-dimensional object that has two congruent circular bases attached by a curved surface

diagonal
a straight line joining any two non-adjacent vertices of a polygon

Non-adjacent vertices are vertices that are not end points of the same side. For example, a diagonal of a rectangle is a line joining opposite corners.

diameter
a line segment that divides a circle in half

A diameter of a circle passes through the circle's centre point.

face
a 2-D side of a prism

horizontal
parallel to the level of the ground

On a sheet of paper, the horizontal direction is parallel to the top and bottom sides of the paper.

linear measurement
the measurement of length

Units of linear measure include centimetre, metre, kilometre, inch, foot, and yard.

midpoint
the point at the middle or centre of an object

net
a two-dimensional (2-D) pattern used to create, by folding and joining, a three–dimensional (3-D) object

parallelogram
a quadrilateral in which opposite sides are parallel and are the same length

perimeter
the linear distance around the outside of a shape

pyramid
a 3-D object having a polygonal base and triangular sides with a common vertex

quadrilateral
a four-sided polygon

Quad represents four. *Lateral* represents side.

radius
a line segment that joins the centre of a circle to a point on the diameter of the circle

rectangular prism
a 3-D object for which all the sides are rectangles

A cardboard box is an example of a rectangular prism.

referent
an object or part of the human body you can refer to when estimating length or distance

scale factor
a number used to multiply the dimensions of a 2-D object such as a rectangle

semicircle
half of a circle

slant height
the shortest distance from the apex of a cone to its base along its curved surface

surface area
the measure of how much exposed area a solid object has, expressed in square units; the combined area of all of the surfaces of a three-dimensional object

trapezoid
a quadrilateral with one pair of parallel sides

two-dimensional (2-D) object
an object having just two dimensions

A 2-D object has length and width but no depth or thickness.

vertical
perpendicular to the level of the ground

On a sheet of paper, the vertical direction is parallel to the left and right sides of the paper.