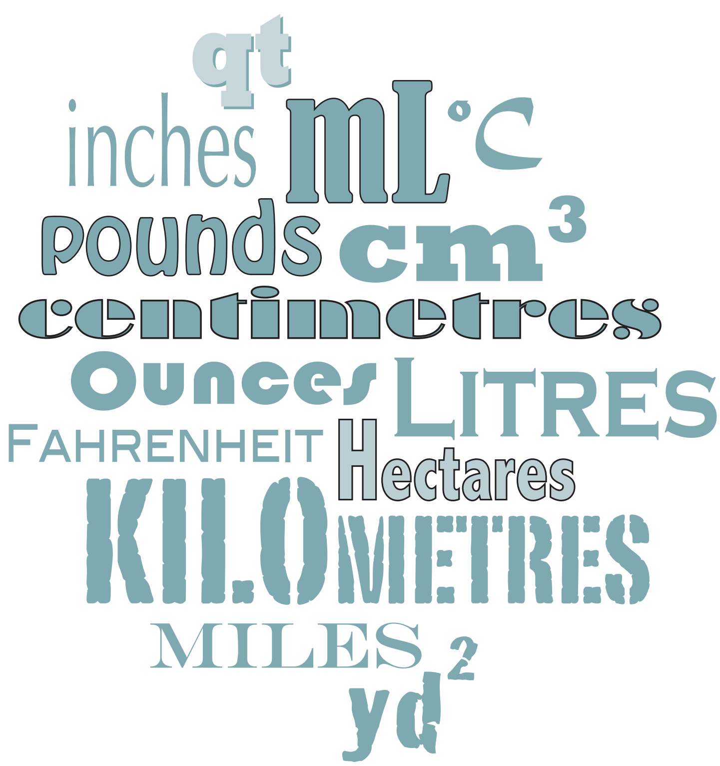
Version 01

The Metric System

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



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Course History

New, March 2012

Project Partners

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- Black Gold Regional Schools
- Calgary Board of Education
- Edmonton Public Schools
- Peace Wapiti School Division No. 76
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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 The Metric System 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.

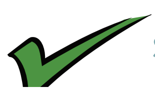
Appendix
Here you will find the Data Pages along with other extra resources that you need to complete the section. You will be directed to these as needed.

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)

The Metric System

The International Bureau of Weights and Measures is in Sèvres near Paris, France. This is the headquarters where representatives from around the world meet to set standards that affect the way people take and report measurements, both in science and in their daily lives. These standards are called the International System of Units. The internationally-used abbreviation, SI, comes from the French *le Système International d'Unités*. This system includes units of measure such as metres, litres, and kilograms, which you may already be familiar with. You may know this system by its other name—the metric system.

The SI has its origins in France. It arose as an effort to standardize and simplify measurements after the French Revolution. Today, the SI (or the metric system) is commonly used in the majority of countries around the world.

In Canada, the metric system was legalized in 1871, although the imperial system of measurement (feet and pounds) continued to be widely used until the second half of the 20th century. Even today, there are many people who think of their height and weight in feet and pounds rather than in centimetres and kilograms. Do you?

In this section you will:

- describe the relationships between the units for length, area, volume, capacity, mass and temperature in the Système International (SI).

Lesson A
Length

To complete this lesson, you will need:

- a metric (SI) ruler or metre stick
- a metric (SI) tape measure

In this lesson, you will complete:

- 7 activities

Essential Questions

- How is length measured in SI?
- What are the common units used when measuring length in SI?
- How are lengths in one unit converted to another unit?

My Notes

Focus

Anna is helping her father work on the family car.

“I think we’ll need the 10-mm metric wrench to loosen this bolt,” Anna observed.

“You’re right,” her father smiled. “How did you know?”

“Well, the hexagonal head of the bolt is about the width of my small finger. And that’s about 1 cm, or 10 mm!”

Metric wrenches, such as the one in the photograph, are sized in millimetres. Do you remember how to convert millimetres to centimetres? What would a 12-mm wrench be in centimetres? What would it be in metres?

Photo by Christopher Dodge © 2010

Get Started

You may have heard people describe horses’ heights using the term *hands*. They are referring to the number of hand-widths that make up the height of the horse.

Parts of your body can be used to measure objects. You could use the width of a finger or the width of your hand. Or, you might use the length of your arm. For example, what is a measure you could use to describe the distance from your home to your friend’s home? One suggestion might be to use the number of paces you would have to walk between the houses.

Activity 1
Try This

My Notes

In this activity you will measure the length of an object using parts of your body. You can use the table below to record your measurements. An example has been given in the first row.

Object	My Measurement
Length of a pen	8 thumb widths

Step 1: Identify parts of your body that could be used to measure the length of objects around you. These may include the width of your fingers or hands, arm lengths, or paces.

Step 2: Identify objects around you that can be measured using the body part measures identified in step 1. List these in the first column of your table. Your list may include objects like the width of a door, the length of a kitchen table, the length of a wall, and the height of a water glass.

Step 3: Measure the objects you listed in Step 2 using an appropriate body part measure. Record your measurement in the second column of your table.

Answer the following questions.

1. Review the measurements recorded in your table. Do you think they would be the same as those recorded by someone smaller than you, like a child? How about someone larger than you?

___

___

___

My Notes

2. What are some reasons why the measurements might be different between you and someone else, even though you're using the same body part to measure the same item?.

____

____

____

____

____

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

A Standard Unit of Length

You may have observed that using a measurement system that relies on body parts does not always allow for consistent measurement. SI provides a standard length called the **metre**, so two people measuring independently will obtain the same measures of length and distance.

For small lengths, the metre is divided into smaller parts using powers of 10. You will encounter decimetres, millimetres, and centimetres, which are tenths, hundredths, and thousandths of a metre. Similarly, for longer distances, 10 times, 100 times, and 1000 times a metre are common.

Any of the SI units of length relate to any other by a power of 10. That is why one of the skills you will need to work in SI is multiplying and dividing by powers of 10.

When the exponent of 10 is positive, see how the exponent relates to the number of instances 10 appears as a factor in the expanded form and the number of zeroes in the product.

My Notes

Powers of 10

$10^0 = 1$

$10^1 = 10$

$10^2 = 10 \times 10 = 100$

$10^3 = 10 \times 10 \times 10 = 1000$

$10^4 = 10 \times 10 \times 10 \times 10 = 10\,000$

$10^7 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10\,000\,000$

$10^{10} = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10\,000\,000\,000$

When the exponent is negative, see how the exponent relates to the number of zeroes in the product.

$$10^{-1} = \frac{1}{10} = 0.1$$

$$10^{-2} = \frac{1}{10 \times 10} = 0.01$$

$$10^{-3} = \frac{1}{10 \times 10 \times 10} = 0.001$$

$$10^{-4} = \frac{1}{10 \times 10 \times 10 \times 10} = 0.0001$$

$$10^{-5} = \frac{1}{10 \times 10 \times 10 \times 10 \times 10} = 0.0001$$

To practise working with powers of 10, go and look at *Powers of 10* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/powers10.htm)*. When you've launched this multimedia, drag the slider one way and then the other. When the exponent of 10 is positive, see how the exponent relates to the number of instances 10 appears as a factor in the expanded form and the number of zeroes in the product. When the exponent is negative, see how the exponent relates to the number of zeroes in the product.

My Notes

Activity 2
Self-Check

Complete the table below.

Powers of 10 in Standard Form	Powers of 10 in Exponent Form
1000	$10 \times 10 \times 10 = 10^3$
100	
10	10^1
1	
0.1	
0.01	10^{-2}
0.001	

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

Multiplying Powers of 10

Do you remember learning the shortcut or rule for multiplying by a power of 10? Suppose you had to multiply 17.54 by 10^2. Following the shortcut, you would simply move the decimal point to the right two places. You move the decimal point two places, because the exponent of 10 is 2, and you move to the right because the exponent is positive.

$17.54 \times 10^2 =$

$$17.54 = 1754$$

If you multiplied the number by a negative exponent, the decimal would move left:

$17.54 \times 10^{-2} =$

$$17.54 = .1754$$

My Notes

To practise this shortcut, look at *Multiplying by Powers of 10* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/multiply_powers.htm)*.

There are two sliders. The left slider allows you to enter a number from zero to 100. The other slider allows you to control the value of the exponent in the power of 10. Pay special attention to what happens to the decimal point when you multiply by a power of 10 that has a negative exponent. You can also enter values directly in the small box beside each slider.

Activity 3
Self-Check

Complete the following questions using the shortcut for multiplying by powers of 10.

1. What is 3.92 multiplied by 10^4?

2. What is 9.9 multiplied by 10^{-5}?

My Notes

3. $31.42 \times 1000 =$

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

Dividing by Powers of 10

You have seen that to multiply by a power of 10, you move the decimal to the right or left depending on the sign of the exponent.

Question: If you multiplied a number by 0.0001, how far would you move the decimal and in which direction?

Answer: ______________________

Since $0.0001 = 10^{-4}$, move the decimal 4 places to the left.

Now let's look at division. There is a shortcut for dividing by powers of 10. When you divide, the decimal moves in the opposite direction as it would if you were multiplying.

Question: What is $4.85 \div 1000$?

Answer: ______________________

Did you get the following answer?

$4.85 \div 1000 = 0.00485$ (Remember, $1000 = 10^3$, and the decimal moves to the left because you are dividing.)

You just reviewed your skills with powers of 10. These skills will help you convert a measurement in one SI unit of length to an equivalent one expressed in another unit of length. Now you should be ready to begin the Explore.

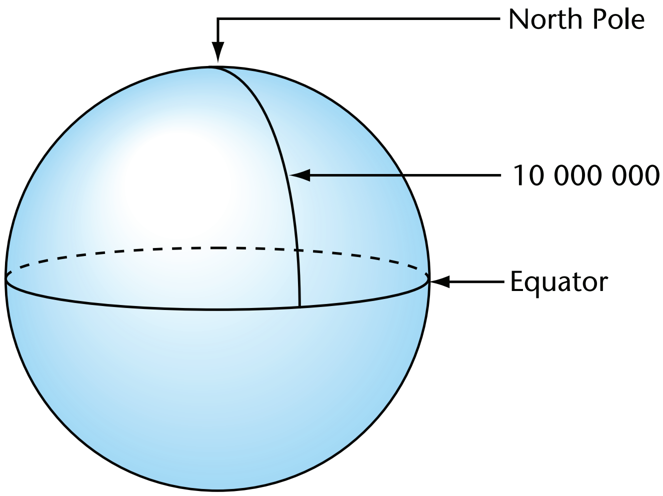
Explore

My Notes

You have probably measured your height in centimetres, but what if you needed to know your height in millimetres or in metres? How might you make such a conversion?

Bringing Ideas Together

When SI was first developed in France over 200 years ago, the metre was defined as one ten-millionth of the distance from the North Pole to the equator.



My Notes

Did You Know?

Today, because of the precision required in science and industry, the metre can be defined as the distance light travels in a vacuum in the time interval of $\frac{1}{299\,792\,458}$ of a second.

In SI, prefixes are used to represent multiples or fractions of the base unit.

- Add the prefix *kilo* to metre, and you have the kilometre.
- Add the prefix *centi* to metre, and you have the centimetre.
- Add the prefix *milli* to metre, and you have the millimetre.

The prefixes—kilo, centi, and milli—are the most common and are bolded, along with their symbols, in the following table of SI prefixes.

Prefix	Symbol	Factor
mega	M	1 000 000 or 10^6
kilo	**k**	1000 or 10^3
hecto	h	100 or 10^2
deca	da	10 or 10^1
—	—	1 or 10^0
deci	d	0.1 or 10^{-1}
centi	**c**	0.01 or 10^{-2}
milli	**m**	0.001 or 10^{-3}
micro	μ	0.000 001 or 10^{-6}

When you compare different SI units, the prefixes are important. *The Prefix Matching Game* (*http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/prefixgame.htm*) will help you to quickly recognize and order the prefixes based on the factor they represent.

My Notes

Prefixes in SI

For length, the most common prefixes you will generally encounter are *milli*, *centi*, and *kilo*. What are the symbols for millimetre, centimetre, metre, and kilometre? You may recall working with the symbols mm, cm, m, km in previous math courses.

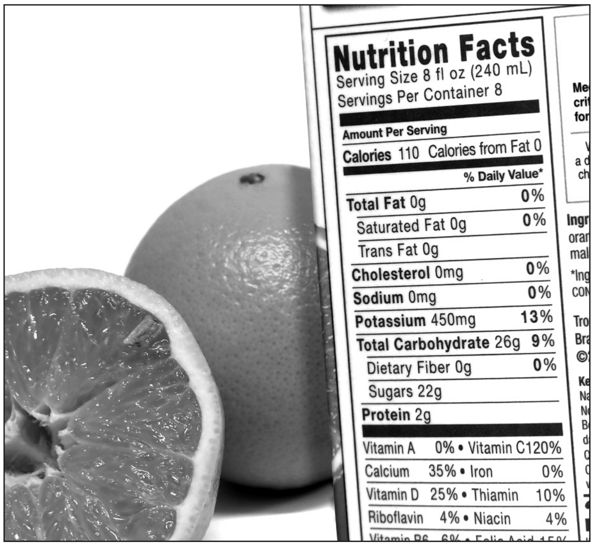


Photo by Stephen Coburn © 2010

Have you seen the prefixes milli, centi, and kilo used with volume? Record some examples that you have encountered.

In Lesson C you will explore volumes using these prefixes.

My Notes

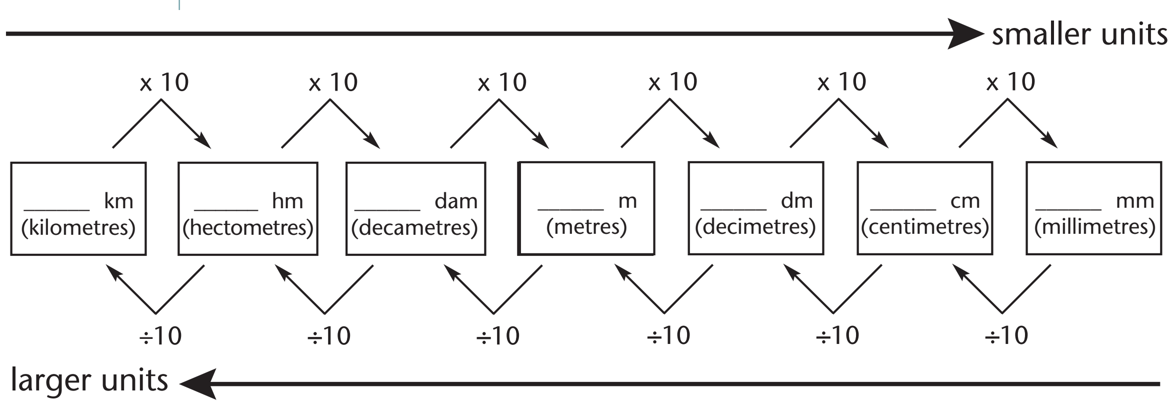
Length Conversion

Powers of 10 are involved in converting between SI units.

Fortunately, because only powers of 10 are involved, SI unit conversion only involves the movement of the decimal point. You can convert between SI units pretty quickly!

You may use *SI Area Conversion* (*http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/areaconvert/areaConver.htm*) to make the conversion from one area unit to another.

Conversion Method
— Multiply or Divide by 10, 100 or 1000



If you are converting from a larger unit such as centimetres to a smaller unit such as millimetres, you will multiply because large pieces can be broken into more smaller sized pieces. You multiply by 10 because centimetres and millimetres are next to each other on the chart and because 1 cm = 10 mm.

My Notes

Example 1

6.5 cm = _____ mm   cm are larger

mm are smaller

We multiply because we want smaller pieces

$6.5 \text{ cm} \times 10 = 65 \text{ mm}$

The answer is reasonable because we have more metres than millimetres.

If you are converting from a smaller unit such as centimetres to a larger unit such as metres, you will divide. When you fit smaller pieces inside a larger piece, you end up with fewer larger sized pieces.

Example 2

720 cm = _____ m   cm are smaller

m are larger

we divide because we want less larger pieces

$720 \text{ cm} \div 10 \div 10 = 7.2 \text{ m}$

or

$720 \text{ cm} \div 100 = 7.2 \text{ m}$

We divide by 10 twice because centimetres and metres are not next to each other.

When combined, dividing by 10 twice is the same as dividing by 100. We also divide by 100 because

1 m = 100 cm.

Our answer is reasonable because we have fewer metres than centimetres.

If you convert a measurement to a smaller unit, the decimal place moves to the right. If you convert to a larger unit, the decimal point moves to the left.

My Notes

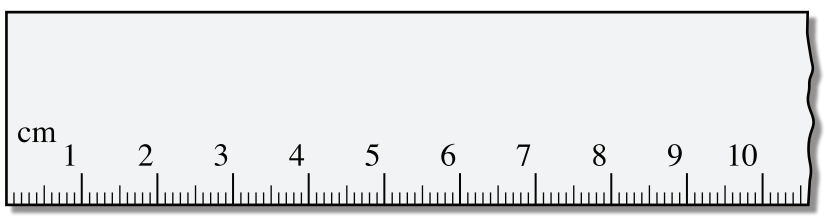
Activity 4
Self-Check

Complete the following table.

1 km = ________ m	1 m = ________ km
1 m = ________ cm	1 cm = ________ m
1 m = ________ mm	1 mm = ________ m
1 cm = ________ mm	1 mm = ________ cm

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

Estimating Lengths and Distances



Estimating lengths and distances in SI is a useful skill. To estimate, it helps to visualize the size of some SI units.

Unit	Approximate Size
mm	• thickness of a dime
cm	• width of your pinky finger • width of a dime
m	• length of a giant step
km	• distance you walk in about 10 minutes

My Notes

Because you are working with powers of 10, you simply move the decimal point to convert between units. Let's work through several examples together.

Example 1

A two-dollar coin is approximately 28 mm in diameter.

a. What is the width in centimetres?

b. What is the width in metres?

Solution

a. 28 mm by 0.1 or 10^{-1}

$$\begin{aligned} 28\,\text{mm} &= (28 \times 0.1)\,\text{cm} \\ &= 2.8\,\text{cm} \end{aligned}$$

To multiply by 0.1, move the decimal point 1 place to the left.

Can you suggest another way of doing the problem?

Since 1 cm = 10 mm, divide 28 cm by 10.

$$\begin{aligned} 28\,\text{mm} &= (28 \div 10)\,\text{cm} \\ &= 2.8\,\text{cm} \end{aligned}$$

To divide by 10, move the decimal point 1 place to the left.

b. Since 1 mm = 0.001 m, multiply 28 mm by 0.001 or 10^{-3}.

$$\begin{aligned} 28\,\text{mm} &= (28 \times 0.001)\,\text{m} \\ &= 0.028\,\text{m} \end{aligned}$$

To multiply by 0.001, move the decimal point 3 places to the left.

Example 2

Yin lives 2.5 km from school. Convert that distance to metres.

Solution

Since 1 km = 1000 m, multiply 2.5 km by 1000 or 10^3.

$$\begin{aligned} 2.5\,\text{km} &= (2.5 \times 1000)\,\text{m} \\ &= 2500\,\text{m} \end{aligned}$$

To multiply by 1000, move the decimal point 3 places to the right.

My Notes

Example 3

Jon's height printed on his driver's licence is 162 cm. What is his height in metres?

Solution

Since 1 cm = 0.01 m, multiply 162 cm by 0.01 or 10^{-2}.

$$\begin{aligned} 162\,\text{cm} &= (162 \times 0.01)\,\text{m} \\ &= 1.62\,\text{m} \end{aligned}$$

To multiply by 0.01, move the decimal point 2 places to the left.

Activity 5
Self-Check

1. The local golf course is 6750 m in length. What is the length of this course in kilometres?

2. A roadside sign indicates a school-bus stop in 0.3 km. How far is the sign from the bus stop in metres?

3. The length and width of a stamp are most often expressed in millimetres. Why?

My Notes

4. A package of 500 sheets of printer paper is 5 cm thick. How thick, in metres, is a single sheet?

5. The height of the walls in Shawna's room is 2.4 m. What is the height in centimetres?

My Notes

6. A letter-size sheet of copy paper is 216 mm by 279 mm. What are its dimensions in centimetres?

7. Andrey Alexandrovich Silnov, of Russia, won the 2008 men's high jump gold medal in the 2008 Olympics with a leap of 2.36 m. What was his achievement in centimetres?

My Notes

8. Anya, in Newfoundland, found an arrowhead from the Beothuks tribe. Being curious, she researched her find and discovered it was not an arrowhead but the head of a sealing harpoon. Anya discovered that the Beothuks tribe hunted seals by pursuing them in human-propelled boats (known as kayaks today). They made their catch by throwing harpoons (with rope attached) at their prey. The harpoon head is made from flint and is 44.5 mm long. What is the length of this harpoon head in centimetres?

9. The school running track is oval in shape and is 200 m in circumference. How many times must a runner go around the track to run 1.6 km?

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

My Notes

Activity 6
Mastering Concepts

Try these questions. Express your answers in standard (everyday) notation. For example, 3.2×10^2 is a number in scientific notation. If you use 10^2 to move the decimal point two places to the right, the result, 320, is in standard notation.

The orbit of Earth around the Sun is not perfectly circular. The distance from Earth to the Sun changes as it travels around the Sun.

1. The closest Earth is from the Sun is about 1.46×10^{11} metres. What is this distance in kilometres?

2. The farthest Earth is from the Sun is about 1.52×10^{11} metres. What is this distance in kilometres?

3. What is the difference, in kilometres, between the distances you found in questions 1 and 2?

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

Lesson Summary

My Notes

Auto mechanics are skilled technicians who know the importance of choosing the right tool for the job. To choose the right tool, mechanics must be familiar with SI units.

Photo by Tselichtchev © 2010

In this lesson, you discovered that the metre is the base unit of length from which other units can be derived. You examined the relationships among the metre, millimetre, centimetre, and kilometre. Since these relationships are based on powers of 10, to convert among these units, you simply move the decimal to the left or right. Look back to the prefix chart to review how each prefix relates to powers of 10 and the position of the decimal.

Lesson B
Area

To complete this lesson, you will need:

- cooking oil or food dye
- an old newspaper
- adhesive tape
- scissors
- a metric measuring tape or ruler

In this lesson, you will complete:

- 6 activities

Essential Questions

- How is area measured in SI?
- What are the common units we use to measure area?
- How are areas in one unit converted to another unit?

My Notes

Focus

The bison is part of the natural landscape on the Canadian prairies. Today, you will often see bison as they graze on ranches and reserves. The number of bison that can graze on pasture of a given **area** depends on plants, rainfall, soil conditions, and climate. For example, suppose a nearby reserve has 2 km^2 of pasture available, and Elders estimate that each animal requires 2.5 hectares. How many animals should they have in their herd?

Photo by LightShaper © 2010

Get Started

Suppose you wanted to describe the areas of a postage stamp, the front of your MP3 player, a living-room carpet, and a buffalo paddock.

Could you use your thumbprints to describe the area of any of these?

Photo by Germán Ariel Berra © 2010

My Notes

For the postage stamp and the MP3 player, you can count the number of thumbprints that fit on each of them. The number of thumbprints would give a rough estimate of the area of each surface. This technique, however, would not be practical for estimating the area of the carpet or the paddock. For the carpet and the paddock, you would need an area unit much larger than a thumbprint. If you chose an appropriate area unit, you could cover the carpet or paddock with a specific numbers of area units that would be easy to express and to understand.

Activity 1
Try This

In this activity you will use your thumbprints to see how area units can be used to measure the area of a surface.

You will need a sheet of unlined paper. In order to leave a record of your thumbprints, you will dip your thumb in cooking oil or a diluted mixture of food dye. You could also just use a pencil to outline the positions of your thumb on the sheet of paper.

Step 1: On a piece of unlined paper, apply a method to give the approximate number of thumbprints you can fit on a sheet of paper.

1. Approximately how many of your thumbprints would cover the sheet of paper?

   ____

2. Describe a method you used to find the approximate number of thumbprints you can fit on the sheet of paper.

   ____

   ____

   ____

   ____

   ____

My Notes

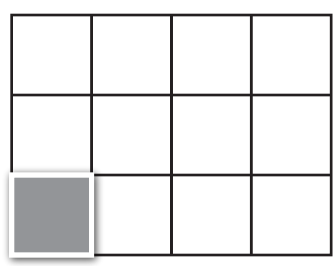
3. Based on your findings, what is the area of the sheet of paper in thumbprints?

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

Unit Squares

Since your thumbprint is rounded and not square, there is always some surface left uncovered between the thumbprints. You will remember from your earlier work, that **area** is the number of unit squares needed to cover a surface. Unit squares can cover a surface without leaving any space between them exposed. That's one reason why unit squares—rather than rounded unit shapes—are used to measure area.

Suppose a rectangular sheet is 4 units long and 3 units wide. A grid of lines is drawn over the sheet to make the dimensions and area visible. What is the area of this rectangular sheet?



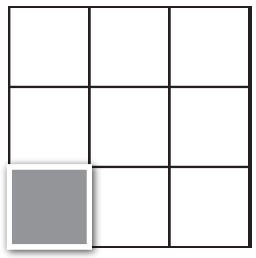
How many unit squares cover this rectangle? ______________

Did you count the total number of squares, or did you remember a shortcut method based on multiplication?

____

My Notes

Suppose a sheet is square, having a side length of 3 units.



What is the area of this square sheet? ______________

How can you use multiplication to determine the area of this square and any other square?

____

____

Since the length and width of the square are equal, the area is:

$3 \times 3 = 3^2 = 9$ square units

To find the area of a square, simply square the number of units in a side length!

Explore

You have seen that unit squares of various sizes can be used to measure area. SI provides units of area for many situations.

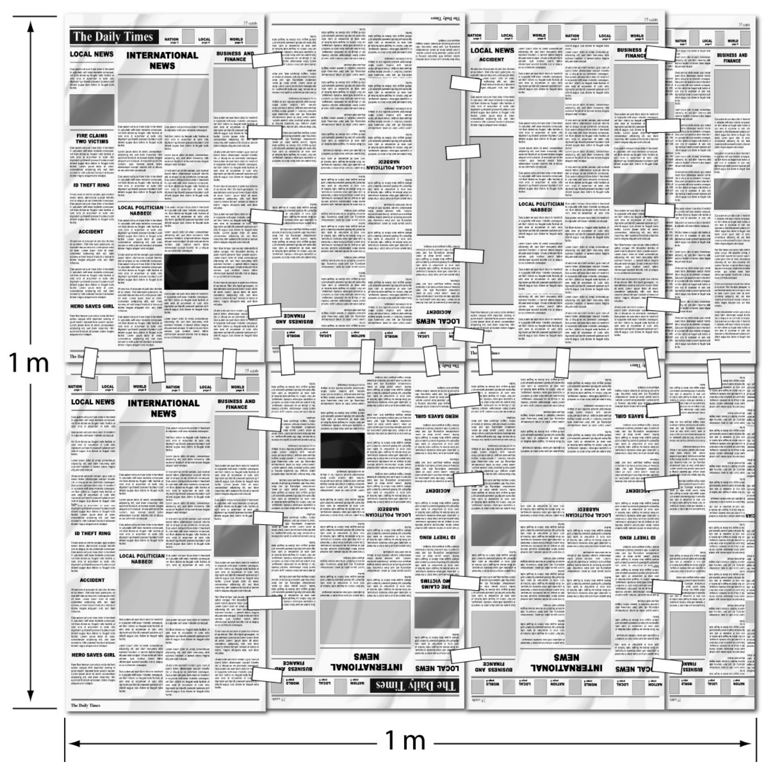
My Notes

Activity 2
Try This

In this activity, you will explore common SI units of area and the relationships among them.

You will need an old newspaper, tape, scissors, and a metric measuring tape or ruler.

Measure, cut, and tape some newspaper together to form a square. The square should measure 1 metre on each side. You have created a *square metre* ($1\,m^2$).



1. You could use the square you created to measure the area of a variety of surfaces. Name three such surfaces.

___

___

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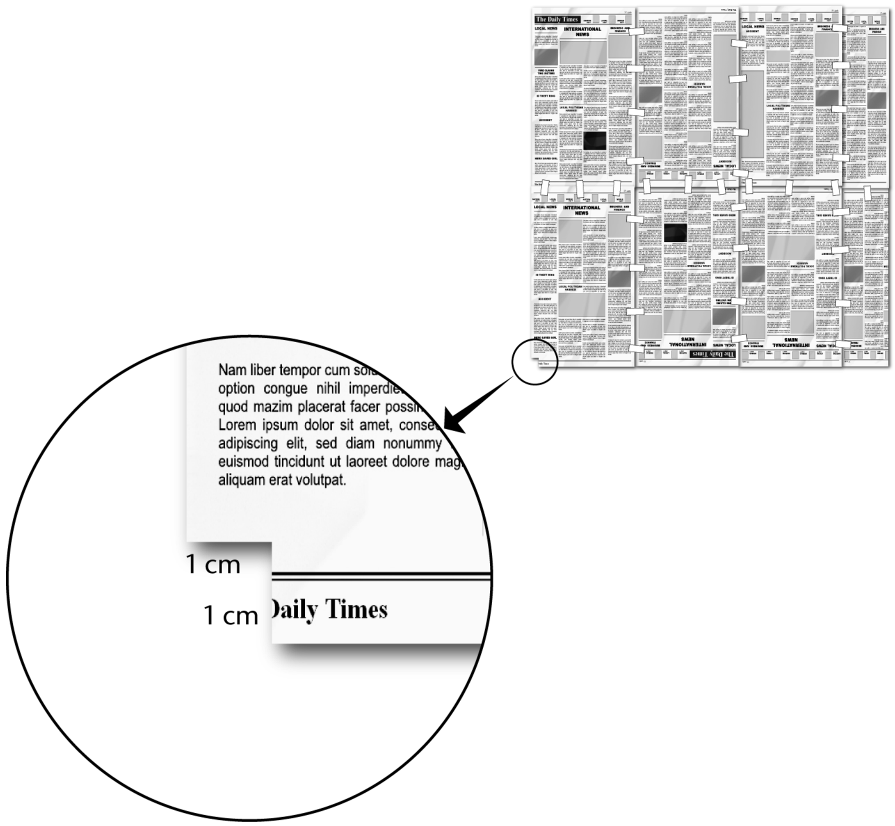
Next, cut a square, 1 centimetre on each side, from one corner of your square metre. The piece you have removed is a *square centimeter* ($1\,cm^2$).



2. You could use the second square you created to measure the area of a variety of surfaces. Name three such surfaces.

___

___

___

3. How many square centimetres could be cut from the square metre? How do you know?

___

___

___

___

My Notes

My Notes

Finally, cut a square, 1 millimetre on each side, from one corner of your square centimetre. The piece you have removed is a *square millimetre*.

4. You could use the third square you created to measure the area of a variety of surfaces. Name three such surfaces.

5. How many square millimetres could be cut from the square centimetre? How do you know?

6. How many square millimetres could be cut from the square metre? How do you know?

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

Bringing Ideas Together

My Notes

In Explore you worked with three common SI units of area. They are the square metre (m^2), the square centimeter (cm^2), and the square millimeter (mm^2).

Activity 3
Self-Check

In the following table, write your answers in two different ways—in standard form and as powers of ten. The first row is done for you as an example.

SI Area Unit	An equal area using a different unit (standard form)	An equal area using a different unit (powers of 10)
1 m^2	10 000 cm^2	10^4 cm^2
1 m^2	mm^2	mm^2
1 cm^2	mm^2	mm^2

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

Converting Units of Area

Since the metric system uses powers of 10, you can simply move the decimal point to convert between units.

Please read and work through the following examples.

You may use *SI Area Conversion* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/areaconvert/areaConver.htm)* to make the conversion from one area unit to another.

My Notes

Example 1

This stamp measures 40 mm long by 31 mm wide.

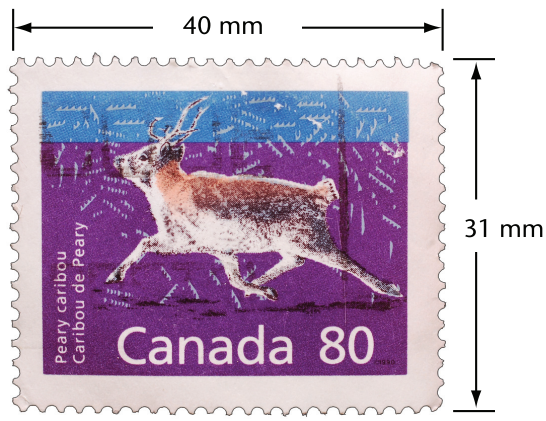


Photo by Brendan Howard © 2010

a. What is the area of the stamp in mm^2?

b. What is the area of the stamp in cm^2?

Solution

a. Since the stamp is a rectangle,

area = length × width

$$A = l \times w$$
$$= 40\,\text{mm} \times 31\,\text{mm}$$
$$= 1240\,\text{mm}^2$$

Both length and width must be in the same units.

b. Since $1\,\text{cm}^2 = 100\,\text{mm}^2$, there will be fewer cm^2. To convert from cm^2 to mm^2, divide by 100.

$$1240\,\text{mm} = \left(\frac{1240}{100}\right)\text{cm}^2$$
$$= 12.40\,\text{cm}^2$$

To divide by 100, move the decimal 2 places to the left.

Another way to solve this problem is to change the dimensions to centimetres first.

$$A = l \times w$$
$$= 40\,\text{mm} \times 31\,\text{mm}$$
$$= 4.0\,\text{cm} \times 3.1\,\text{cm}$$
$$= 12.40\,\text{cm}^2$$

Remember there are 10 mm in 1 cm.
40 mm = 4.0 cm
31 mm = 3.1 cm

Example 2

A bathroom mirror is 0.9 m long and 0.6 m wide.

a. What is the area of the mirror in m^2?

b. What is the area of the mirror in cm^2?

Solution

a. Since the mirror is a rectangle,

area = length × width

$$\begin{aligned} A &= l \times w \\ &= 0.9\,\text{m} \times 0.6\,\text{m} \\ &= 0.54\,\text{m}^2 \end{aligned}$$

Both length and width must be in the same units.

b. Since 1 m^2 = 10 000 cm^2, there will be more cm. To convert from m^2 to cm^2, multiply by 10 000.

$$\begin{aligned} 0.54\,\text{m}^2 &= (0.54 \times 10\,000)\,\text{cm}^2 \\ &= (0.54 \times 10^4)\,\text{cm}^2 \\ &= 5400\,\text{cm}^2 \end{aligned}$$

To multiply by 10^4, move the decimal 4 places to the right.

Another way to solve this problem is to change the dimensions to centimetres first.

$$\begin{aligned} A &= l \times w \\ &= 0.9\,\text{m} \times 0.6\,\text{m} \\ &= 90\,\text{cm} \times 60\,\text{cm} \\ &= 5400\,\text{cm}^2 \end{aligned}$$

Remember there are 100 cm in 1 m.
0.9 m = 90 cm
0.6 m = 60 cm

My Notes

My Notes

Activity 4
Self-Check

Complete the following questions.

1. A Canadian flag is 64 cm by 32 cm.

    a. What is the area of the flag in cm^2?

    b. What is the area of the flag in square metres? Please show two different ways of calculating your answer.

My Notes

2. Measure the dimensions of a light-switch cover in your home.
   a. What is its area in square centimetres?

   b. What is its area in square millimetres?

   c. Why wouldn't it be appropriate to express the area in m^2?

      ____
      ____
      ____
      ____

3. What unit of area would be the most appropriate for measuring the area of a computer disk? Why?

   ____
   ____
   ____
   ____

My Notes

4. A sheet of computer paper measures 216 mm by 279 mm. What is its area in square centimetres?

5. Measure the dimensions of the floor in your bedroom.

    a. What is its area?

    b. Why did you choose the units you did?

    ____

    ____

    ____

    ____

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

My Notes

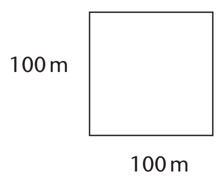
Large Areas

To measure larger areas, such as the area of a province or the area of a grazing lease, two other SI units are commonly use. They are the hectare and the square kilometre (km^2).

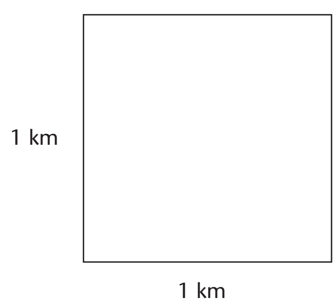
Did You Know?

The area of Wood Buffalo National Park, the largest national park in Canada, has an area of 44 807 km^2.

A **hectare** is the area of a square that measures 100 m on each side. It's approximately the area of a large football or soccer field.



A square kilometre is a square that measures one kilometre on each side.



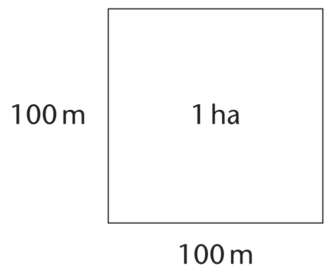
Work through the following examples to practise using hectares and square kilometres.

My Notes

Example 3

How many square metres are there in one hectare?

Solution



$$1\text{ ha} = 100\text{ m} \times 100\text{ m}$$
$$= 10\ 000\text{ m}^2$$

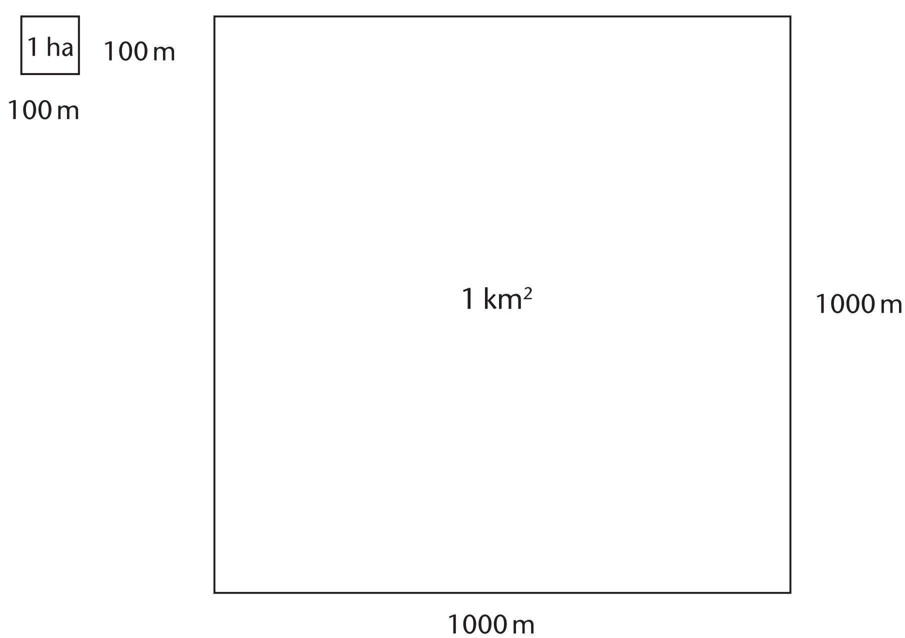
There are 10 000 square metres in one hectare.

Example 4

How many hectares are there in a square kilometre?

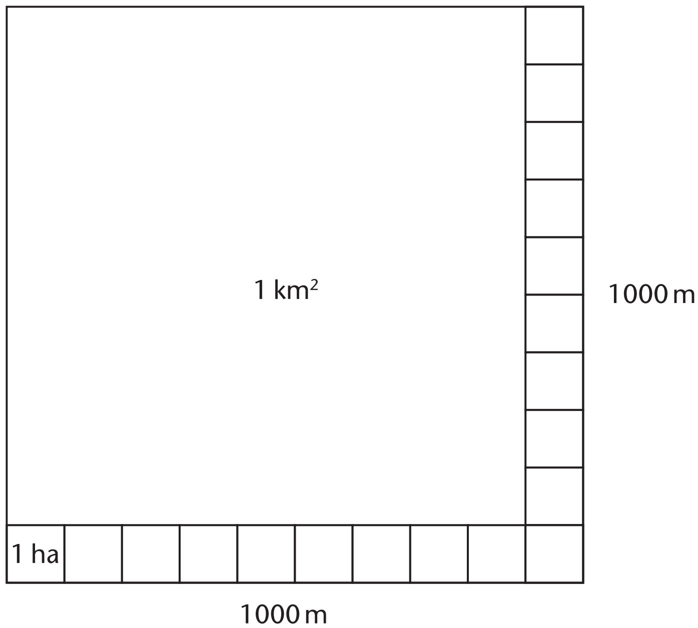
Solution

A hectare measures 100 m by 100.
A square kilometre measures 1 km by 1 km (1000 m by 1000 m).



My Notes

Therefore, a square kilometre is a square that is 10 times as long and 10 times as wide as a hectare. In other words, you can fit hectares into a square kilometer as shown below.



$$\begin{aligned} 10 \text{ rows of } 10 \text{ ha} &= 10 \times 10 \text{ ha} \\ &= 100 \text{ ha} \end{aligned}$$

Therefore, $1\,\text{km}^2 = 100\,\text{ha}$.

Example 5

A forest fire in northern Saskatchewan covered an area of 2000 ha. How many square kilometres did the fire cover?

Solution

There are 100 ha in 1 km^2, so there would be fewer km^2 than ha. To convert from hectares to square kilometers, divide the area in hectares by 100.

$$\begin{aligned} 2000\,\text{ha} &= \left(\frac{2000}{100}\right)\text{km}^2 \\ &= 20\text{km}^2 \end{aligned}$$

My Notes

Example 6

A CFL football field is, with end zones and sidelines, about 137 m long and 59.5 m wide. What is its approximate area in hectares? Round your answer to one decimal place.

Solution

area = length × width

$$\begin{aligned} A &= l \times w \\ &= 137\,\text{m} \times 59.5\,\text{m} \\ &= 8151.5\,\text{m}^2 \end{aligned}$$

There are 10 000 m^2 in 1 ha, so there would be fewer hectares than square metres. Divide the area in square metres by 10 000 ha.

$$\begin{aligned} A &= \left(\frac{8151.5}{10\,000}\right)\text{ha} \\ &= 0.81515\,\text{ha} \end{aligned}$$

A CFL football field is about 0.8 ha.

Activity 5
Self-Check

My Notes

Please answer the following questions. When you are finished, check your answers.

1. Stony Plain 135 is an Indian reserve west of Edmonton. Its area is 51.61 km^2. What is the area of the reserve in hectares?

2. Pacific Rim National Park, in British Columbia, covers 51 000 ha. What is its area in square kilometres?

3. A quarter-section of land in Western Canada is a square about 804.7 m on a side. How many hectares does this area represent? Express your answer to the nearest unit.

My Notes

4. West Edmonton Mall covers an area of about 570 000 m^2. How many hectares is this area?

5. At the turn of the century there was one bison, on average, for every 8.5 ha of grasslands on the Great Plains. How many square metres is 8.5 ha?

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

Activity 6
Mastering Concepts

My Notes

A certain rural road is 10 m wide. In paving a section of this road, a crew surfaced an area equal to 1 hectare. What is the length of the newly paved section of road? Express your answer in metres.

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

My Notes

Lesson Summary


Photo by 2009fotofriends © 2010

Bison ranches are becoming more common across the prairies. Ranchers need to determine the number of animals that the area they have for pasture can sustain. If you were a rancher, you would apply the skills you mastered in this lesson in the management of grazing land and your livestock.

In this lesson, you examined the relationships among the square metre, square centimetre, square millimetre, square kilometre, and hectare. You discovered that these relationships are based on powers of 10, and, to convert among these units you just have to move the decimal to the left or right.

Lesson C
Volume and Capacity

To complete this lesson, you will need:

- 24 little cubes. You can use sugar cubes, children's blocks, or cubes cut out of Styrofoam or other material.
- A metric tape-measure

In this lesson, you will complete:

- 5 activities

Essential Questions

- How are volume and capacity measured in SI?
- What are the common units used to measure volume and capacity?
- How can you convert between SI units for volumes and capacities?

My Notes

Focus

Have you ever helped plan or pour a concrete walk or driveway? For this type of project you must be able to accurately estimate the **volume** of concrete you will need. After all, you need to order enough materials without being wasteful. The base unit for volume in SI is the cubic metre. For example, how much concrete would you need for a sidewalk that is 1 m wide, 6 m long, and 10 cm thick?

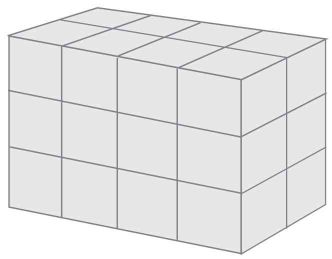
Photo by Jim Lopes © 2010

Get Started

Suppose you wanted to determine the dimensions of a (rectangular) **prism**-shaped container that would hold exactly 24 sugar cubes with no wasted space. The cubes would have to be packed one against the other and tightly against the walls of the container. What would the dimensions of the box depend upon?

My Notes

The dimensions of the box would depend on the size of a sugar cube and how they are arranged in the box. The diagram below illustrates one possible prism-shaped arrangement.



How many sugar cubes are there in the bottom layer?

____

____

How do you know how many cubes there are altogether?

____

____

Think of a box made of thin cardboard, just large enough to hold this arrangement of cubes. You can then describe the dimensions of this box—4 cubes long, 2 cubes wide, and 3 cubes high. The total number of cubes is found by multiplying length × width × height.

$$4 \times 2 \times 3 = 24$$

There are 24 cubes in the box.

So, the **volume** of the box = length × width × height.

Explore

By making various rectangular prisms from a set number of cubes, you will discover that a certain volume can come in many shapes.

My Notes

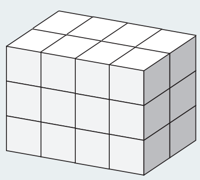
Activity 1
Try This

For this activity, you will need 24 sugar cubes. Alternatively, you may use children's blocks, or you could cut cubes out of Styrofoam, a block of cheese, or a potato.

You will arrange the 24 cubes to make as many different (rectangular) prisms as you can.

1. For each arrangement of cubes, complete a row in the table below. Remember, you must use all 24 cubes for each arrangement. The first row is completed as an example.

Prism Data Table

Visual Representation of Prism	Prism Dimensions	Product of Dimensions	Volume
	2 wide 3 high 4 long	2 x 3 x 4 = 24	24 cubes

2. Are all the arrangements different?

3. What can you say about the volume of sugar that each box holds?

4. How can you determine how much each box can hold from its dimensions?

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

My Notes

My Notes

Bringing Ideas Together

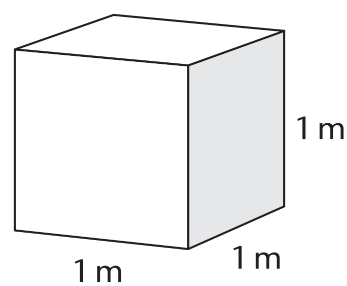
In Explore, the volume of sugar each container held was given by the number of cubes of sugar. This is how all volumes are expressed—as the number of cubic units of space something occupies.

Remember, the volume of a rectangular box is found using the following formula:

volume = length × width × height

$V = l \times w \times h$

A Cubic Metre



One commonly used unit of volume in SI is the *cubic metre* (m^3).

Let's try finding the volume of a rectangular prism, and practise converting between units.

Example 1

What is the volume in cubic metres of a rectangular box 60 cm long, 50 cm wide, and 40 cm high?

Solution

Because the volume is asked for in cubic metres, first convert the dimensions of the box to metres.

$$60\,\text{cm} = \left(\frac{60}{100}\right)\text{m} = 0.60\,\text{m}$$

$$50\,\text{cm} = \left(\frac{50}{100}\right)\text{m} = 0.50\,\text{m}$$

$$40\,\text{cm} = \left(\frac{40}{100}\right)\text{m} = 0.40\,\text{m}$$

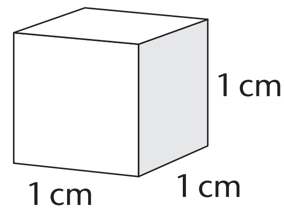
Then, find the volume of the box.

$$\begin{aligned} V &= l \times w \times h \\ &= 0.60\,\text{m} \times 0.50\,\text{m} \times 0.4\,\text{m} \\ &= 0.12\,\text{m}^3 \end{aligned}$$

My Notes

Small Units of Volume

Another common unit of volume is the *cubic centimetre* (cm^3). The cubic centimetre is used for the volumes of smaller objects, such as the volume of a milk container or the volume of a jewel.



Did You Know?

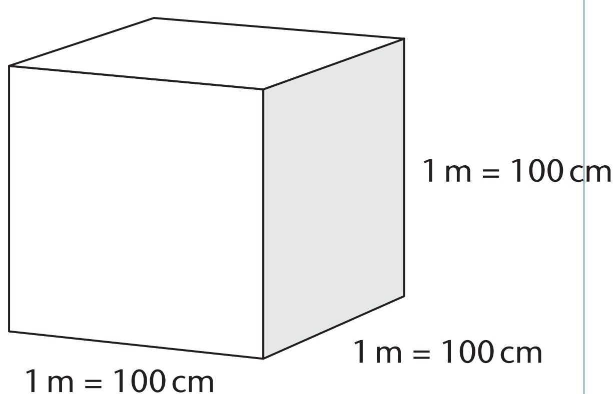
Did you know the cubic centimetre is often referred to as the millilitre?

The cubic centimetre is much smaller than a cubic metre. How many cubic centimetres are there in a cubic metre?

____

____

Since there are 100 cm in a metre, a cubic metre is 100 cm by 100 cm by 100 cm



$$1\ m^3 = 1\ m \times 1\ m \times 1\ m$$
$$1\ m^3 = 100\ cm \times 100\ cm \times 100\ cm$$
$$1\ m^3 = 1000\ 000 cm^3$$
or
$$1\ m^3 = 10^6\ cm^3$$

My Notes

The interactive *SI Volume Conversion* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/volumeconvert/volumeConvert.htm)* can be used to show the conversion between units. For example, by positioning the left slider next to m^3 and the right slider to cm^3 you can see that 1 m^3 = 1 000 000 cm^3 without doing any calculation. You can use *SI Volume Conversion* to confirm the solutions in the examples, in the Self-Check questions that follow, and anywhere else you need to make volume conversions."

Example 2

Convert 0.12 m^3 to cubic centimetres.

Solution

$$0.12\,\text{m}^3 = \left(0.12\times10^6\right)\text{cm}^3$$
$$= 120\ 000\ \text{cm}^3$$

Remember, there are 1 000 000 cm^3 (or 10^6 cm^3) in 1 m^3

Activity 2
Self-Check

You will need a metric tape-measure to complete this activity. Please answer the following questions.

1. Using a metric tape-measure, measure the dimensions of your bedroom closet.

   Dimensions: ______________________________

   a. What is its volume in cubic centimetres?

My Notes

b. What is its volume in cubic metres?

c. Which unit of volume is the more appropriate one? Why?

____

____

____

____

2. Using a metric tape-measure or ruler, measure the dimensions of a cereal box.

Dimensions: ____

a. What is its volume in cubic centimetres?

b. What is its volume in cubic metres?

c. Which unit of volume is the more appropriate? Why?

____

____

____

____

My Notes

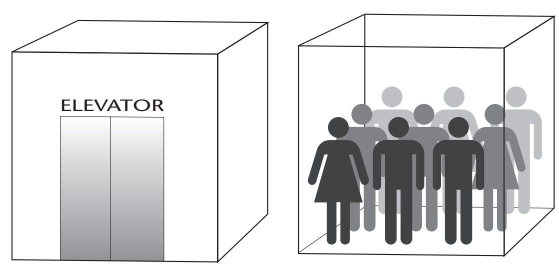
3. Convert $0.05\,m^3$ to cubic centimetres.

4. How much concrete measured in cubic metres is required for a driveway 3 m wide, 20 m long, and 15 cm thick?

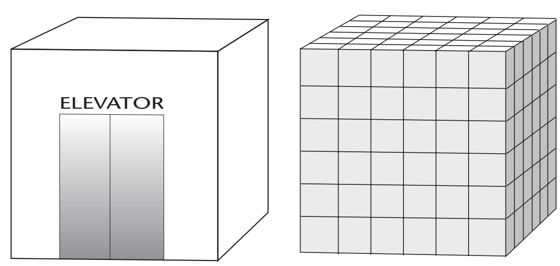
Turn to the solutions at the end of the section and mark your work.

Capacity

People use the word **capacity** in various ways. For example, the capacity of an elevator can refer to the number of passengers it can safely hold.



But in SI, capacity refers to the amount of liquid a container can hold, or the amount of space inside it.



My Notes

In Explore, you placed sugar cubes in various rectangular prism-shaped arrangements. You considered the dimensions of the boxes—imagined to be made of thin cardboard—that would hold the sugar cubes. You found that the dimensions of the boxes allowed you to calculate the volume of sugar they could hold. That is, the product of the dimensions gave you the **capacity** of the boxes.

Activity 3
Try This

1. Look at various containers, such as soft-drink bottles, juice containers, and tinned goods that you have in your house.

   a. Record the measure of at least three containers and include the SI unit used.

   ____

   ____

   ____

   b. What does each of those SI symbols stand for?

   ____

   ____

   c. What is the relationship between these units?

   ____

   ____

My Notes

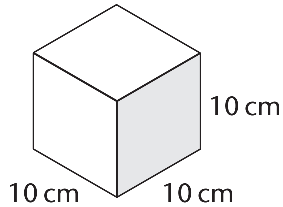
2. a. If you have a rectangular 1 L milk or juice container in the fridge, carefully measure its dimensions and calculate its volume. Round your answer to the nearest cubic centimetre.

   b. What is the relationship between the volume of the container and its 1 L capacity?

My Notes

3. A container that has the shape of a cube measuring 10 cm (or 1 dm) on a side has a capacity of 1000 mL or 1 L.

This container holds 1 L



Here's why.

$$\begin{aligned} \text{volume} &= 10\,\text{cm} \times 10\,\text{cm} \times 10\,\text{cm} \\ &= 1000\,\text{cm}^3 \\ \text{capacity} &= 1000\,\text{mL} \\ &= 1\,\text{L} \end{aligned}$$

Why do you think a 1 L milk carton is not the shape of a cube having side lengths of 10 cm?

____

____

____

____

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

Capacity Examples

Work through the following examples to apply your knowledge of the units of capacity.

Example 3

On a Prince Rupert utility bill, the water a homeowner uses each month is reported in cubic metres.

WATER

Provided by EPCOR Water Services Inc.

Basic monthly service charge		\$5.51
Meter reading on Jun 25 (actual)	4585.0	
Meter reading on May 27 (actual)	–4566.0	
Amount of water you used in cubic metres	19.0	
Cost of water you used		
19.00 m^3 at 156.25¢ per m^3		29.69
Your total water charges		**\$35.20**

My Notes

This homeowner used 19 m^3 of water last month. If this water was for a family of four, how many litres were consumed per person?

Solution

$$
\begin{aligned}
1\,m^3 &= 1\,m \times 1\,m \times 1\,m \\
&= 100\,cm \times 100\,cm \times 100\,cm \\
&= 1\,000\,000\,cm^3 \\
&= 1\,000\,000\,mL \\
&= 1000\,L
\end{aligned}
$$

Remember, 1 m = 100 cm

1 cm^3 = 1 mL

1 L = 1000 mL

Since 1 m^3 = 1000 L, it follows that 19 m^3 = 19 000 L.

To find the consumption per person, divide by the number of people.

$$\frac{19\,000\text{ L}}{4\text{ people}} = 4750\text{ L/person}$$

Therefore, the consumption per person was 4750 L.

Example 4

Alexa has a small rectangular cooler she takes with her on picnics. The interior of the cooler is 32 cm long, 25 cm wide, and 25 cm deep. What is the capacity of the cooler in litres?

Solution

$$
\begin{aligned}
V &= 32\,cm \times 25\,cm \times 25\,cm \\
&= 20\,000\,cm^3 \\
\text{capacity} &= 20\,000\,mL \\
&= 20\,L
\end{aligned}
$$

This is because 1 mL = 1 cm^3

Remember, 1 L = 1000 mL.

The cooler holds 20 L.

My Notes

SI Units of Capacity

The prefixes of SI are used to form various units of capacity. You already saw these prefixes when you investigated units of length, area, mass, and volume.

Prefix	Symbol	Factor
mega	M	1 000 000 or 10^6
kilo	**k**	1000 or 10^3
hecto	h	100 or 10^2
deca	da	10 or 10^1
—	—	1 or 10^0
deci	d	0.1 or 10^{-1}
centi	**c**	0.01 or 10^{-2}
milli	**m**	0.001 or 10^{-3}
micro	μ	0.000 001 or 10^{-6}

The following tables show how the units of capacity and volume compare. See how the relationship 1 cm^3 = 1 mL in one row connects the two tables so that the amounts in corresponding rows are equivalent.

Capacity			Volume	
Unit	**Symbol**		**Symbol**	**Unit**
1 millilitre	1 mL	⟷	1 cm^3	1 cubic centimetre
1000 litres or 1 kilolitre	1000 L or 1 kL	⟷	1 m^3	cubic metre
1 litre	1 L	⟷	1000 cm^3 or 1 dm^3	1000 cubic centimetres or 1 cubic decimetre

Open *Capacity Conversions (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/capacityconvert/capacityConver.htm)* to have a look at the relationship between kilolitres (kL) and litres (L). To confirm the relationship between kL and L indicated in the capacity-volume table, move the sliders in the *Capacity Conversions* to convert 1 kilolitre into litres.

My Notes

Activity 4
Self-Check

Now try these practice questions. To do these questions you will need to remember the relationships between volume and capacity!

1. A container of liquid laundry detergent holds 3.75 L. How many millilitres does this container hold?

2. A soft-drink bottle holds 355 mL. How many litres does it hold?

3. Last month, the Ahenekiw family used 25 400 L of water in their home. How many cubic metres did they use?

My Notes

4. A rectangular aquarium is 50 cm long, 40 cm wide, and 30 cm deep. If it were filled with water, how many litres of water would it contain?

5. When full, a rain barrel holds 220 L. What is the volume (in cm^3) of the inside of the barrel?

6. When full, a watering can holds 8 L. What is the volume of water it holds in cubic centimetres?

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

My Notes

Activity 5
Mastering Concepts

The area of Vancouver is almost 115 km². On average, the city receives 1200 mm of precipitation each year.


Photo by Hannamariah © 2010

How many litres of water does this precipitation represent?

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

Lesson Summary

My Notes

Ordering concrete for a project involves careful planning, measuring, and calculating. The amount ordered may involve adding a small percentage extra. In order to keep costs down and to ensure the job can be completed with the amount of concrete delivered, mathematics, similar to what you explored in this lesson, are a critical component.


Photo by Christina Richards © 2010

In this lesson, you examined the relationships among the cubic metre, cubic centimetre, millilitre, and litre. As in the previous two lessons, you discovered that these relationships are based on powers of 10. To convert among these units you can simply move the decimal to the left or right.

Lesson D
Mass

To complete this lesson, you will need:

- your calculator

In this lesson, you will complete:

- 3 activities

Essential Questions

- How is mass measured in SI?
- What are the common units used to measure mass?
- How is one unit used to describe a mass converted to another unit?

My Notes

Focus

Most produce in grocery stores is sold by weight. Recently, in a flyer from a local supermarket, apples and peaches were advertized at \$2.16/kg, cantaloupe at \$1.50/kg, and mushrooms at \$5.47/kg. These prices are quoted in terms of kilograms—an SI (metric) measure of mass. Scales to weigh produce are available in most stores for customers to use. Have you used a scale similar to the one in the photograph?

Photo by Stephen Coburn © 2010

Get Started

Do you have an driver's license or a passport? If you do, take a closer look at either of these pieces of identification now.

Notice that the physical characteristics listed on your identification card include SI (metric) measures for your height and weight.

My Notes

In everyday conversation, people use the terms **weight** and **mass** interchangeably. The terms are related, but strictly speaking, *weight* and *mass* have different meanings. Weight depends on gravity, while mass remains constant. For example, on the Moon, where the force of gravity is less than on Earth, your weight would be less but you would still be you—mass-wise. Since an object's mass and weight are numerically the same here on Earth, we will use the two terms interchangeably in this lesson.

The kilogram is a unit of mass, but it is commonly used to indicate weight. If you have access to a bathroom scale, weigh yourself now.

What is your weight (mass) in kilograms? __________

If you've been to a doctor's office or health clinic, you may have noticed that the scales there use a balance beam. This type of scale is more accurate than most bathroom scales.

Photo by Stavchansky Yakov © 2010

Explore

Many sports teams show the mass of each player on the team roster. What is your favourite professional sports team? Perhaps you have a favourite hockey, football, or basketball team. Choose this team for the next activity.

My Notes

Activity 1
Try This

In this activity you will investigate the mass of players and the effect of a player's mass on performance.

You will need your calculator to complete this activity.

Step 1: Examine the following player statistics for the Vancouver Canucks in 2011.

Name	Height	Weight
Alexander Burrows	6'1"	188
Andrew Ebbet	5'9"	174
Ryan Kesler "A"	6'2"	202
Mark Mancari	6'3"	225
Steven Pinizzotto	6'1"	200
Mason Raymond	6'0"	185
Mikael Samuelsson	6'2"	218
Daniel Sedin "A"	6'1"	188
Henrik Sedin "C"	6'2"	188
Sergei Shrokov	5'10"	195
Marco Sturm	6'0"	194

Step 2: Prepare a chart that lists the following players' statistics. You should have columns for the players' names, height, and weight.

The players' weight is given in pounds. Divide the weight in pounds by 2.2 to find the SI (metric) equivalent. For example, Marco Sturm's weight is listed at 194 pounds.

To find his weight in kilograms, divide 194 by 2.2.

$$194 \div 2.2 = 88.18$$

So, Marco's weight is about 88 kg.

My Notes

1. What is the weight, in kilograms, of the heaviest player on the team you chose?

2. What is the weight, in kilograms, of the lightest player on your favourite team?

3. What is the difference between the weights of the heaviest and lightest player on the team?

4. From the data you have collected, and from your own personal experience, do you feel the mass of the individual affects his or her ability to excel in a certain position (or sport)? Or do you think the position (or sport) influences the mass of the athlete instead? Explain.

My Notes

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

Bringing Ideas Together

The base unit of mass in the SI (metric) system is the **kilogram (kg)**. Originally, in 1796 in France, during the Revolution, the kilogram was defined as the mass of 1 L of ice water. A few years later, it was redefined as the mass of 1 L of water at 4º C, the temperature when water is its densest. However, for consistency, metal cylinders were manufactured that came as close as possible to this mass.

The metal cylinder used today was manufactured in the 1890s. It is made from a metal alloy of platinum and iridium because of its stability. This cylinder is called the International Kilogram Prototype and is kept in a vault at the Internal Bureau of Weights and Measures (BIPM) in Sèvres, France, near Paris. This is the standard used by science, industry, and commerce around the world.

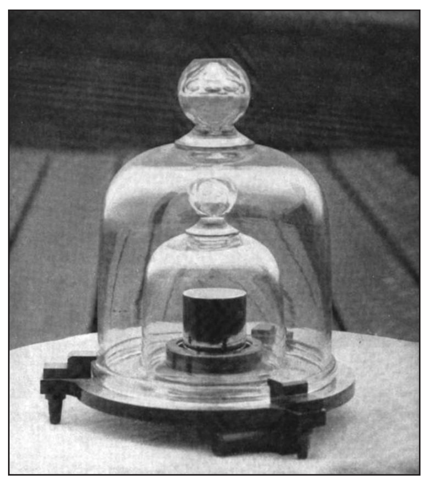


Photo by National Institute of Standards and Technology © 2010 Public Domain

Scientists are in the process of trying to agree on a different way of defining the kilogram to make it easier to duplicate. Agreement may be reached in 2011.

My Notes

For the examples in this lesson, the mass of 1 L of water provides a very good approximation of the kilogram. If you have access to a litre of milk, or perhaps a litre of bottled water or pop, go and take it out of the fridge or container now. When you lift it, you are lifting a 1-kg mass. What other everyday objects can you name that have about a 1-kg mass?

____

____

A math textbook, a cushion, three apples, and a dress shoe are some items that weigh about 1 kg.

Example 1

Marty weighed himself on the bathroom scale. He weighed 61 kg. Later that day, at the store where he works, he lifted five dozen bottles of water into the trunk of a customer's car. He told the customer he just lifted his own weight in water. Was Marty correct in what he said?

Solution

Five dozen bottles is (5×12), or 60 bottles. Each bottle holds 1 L, and 60 L of water has a mass of 60 kg, which is close to Marty's weight. Including the containers, the total would be at least 61 kg. Marty was telling the truth!

Comparing Units

So how do different units of mass relate to each other?

There are two common units derived from the kilogram. What does the prefix kilo mean? ____________________

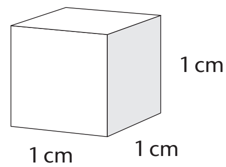
How many grams are there in a kilogram? ____________________

$$1\,\text{kg} = 1000\,\text{g} \quad \text{or} \quad 1\,\text{g} = 0.001\,\text{kg}$$

Remember that 1 L of water has a mass of 1 kg. But 1 L = 1000 mL and 1 kg = 1000 g. So, 1 mL of water has a mass of 1 g.

My Notes

Do you remember what the volume of 1 mL of water is? ____________



$1\ cm^3 = 1\ mL$

Mass of 1 mL of water = 1 g

A grape has a mass of about 5 grams. Can you think of some objects that are approximately 1 g in mass?

____

____

Some objects that have a mass of 1 g are: a button, a small gold earring, or a five-dollar bill. You may have suggested different items.

Let's work through an example using units of mass.

Example 2

A Canadian dime has a mass of 1.75 grams.

a. Express the mass of the dime in kg.

b. If you had a kilogram of dimes, approximately how many dimes would you have?

Solution

Move the decimal point 3 places to the left.

a. $1.75\,g = \left(\frac{1.75}{1000}\right) kg$

$= 0.00175\,kg$

b. $1\,kg = 1000\,g$

$1 \text{ dime} = 1.75\,g$

So, the number of dimes in 1000 g is $\frac{1000\ g}{1.75\ g} = 571.42$

There are about 571 dimes in a kilogram or about $57.10 worth of dimes.

The previous examples showed that converting among SI units of mass involves only powers of 10. So mass unit conversion only involves the movement of the decimal.

Open *Mass Conversions* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/massconvert/massConver1.htm)*. Then, go back to Example 2 and use this multimedia to confirm the conversion from grams to kilogram

My Notes

Large Masses

Another unit derived from the kilogram is the **tonne (t)**. It is used for measuring large masses, such as the mass of concrete in a bridge, the mass of goods in a truck and trailer unit, or the mass of an airplane.

In the lesson on volume, you explored the number of litres in $1\,m^3$. Remember that $1\,m^3 = 1000\,L$. So, what would be the mass of $1\,m^3$ of water?

Since $1\ m^3 = 1000\ L$, each litre of water has a mass of 1 kg. So, $1\,m^3$ of water has a mass of 1000 kg or 1 t.

Example 3

A Canadair 415 water bomber used in fighting forest fires can hold 6137 L of water. What is the mass, in tonnes, of water that it can release?

Solution

Since 1 L of water weighs 1 kg, the mass of 6137 L of water is 6137 kg.

$$\begin{aligned} 6137\,\text{kg} &= \left(\frac{6137}{1000}\right)\text{t} \\ &= 6.137\,\text{t} \end{aligned}$$

The water bomber holds 6.137 t of water in its tanks.

My Notes

Example 4

Photo by Joyfull © 2010

An Antonov 225, the world's largest cargo plane, can carry 250 t of cargo. What is this mass in kilograms?

Solution

$$\begin{aligned} 250\,\text{t} &= (250 \times 1000)\,\text{kg} \\ &= 250\,000\,\text{kg} \end{aligned}$$

The Antonov can haul 250 000 kg.

Activity 2
Self-Check

My Notes

Please do the following questions.

1. Every day, Maria drinks at least 1.75 L of water. What mass of water would she drink in the year 2013, measured in
   a. kilograms?

   b. grams?

2. The blue whale can grow to over 170 000 kg. What is that mass in tonnes?

3. The Smiths' baby was 3125 g at birth. How much did the baby weigh in kg?

My Notes

4. The Canadian $1 coin is 7 g in mass. In 2007, the Royal Canadian Mint struck 36 424 000 of these coins. What is the total mass of all of these coins in tonnes?

5. A package of 50 cheese slices weighs 0.5 kg. What is the mass, in grams, of each slice?

6. The total weight of a truck and cargo could weigh over 45 t. What is 45 t in kilograms?

7. A package of meat is labelled 1.37 kg. What is its weight in grams?

8. Convert 67 000 g to tonnes.

My Notes

9. A 2-kg sausage is divided into several 100-g portions. How many portions are there?

10. Cream puffs are advertized by a local store for $3.49 for a 250-g package. What is the price per kilogram?

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

My Notes

Activity 3
Mastering Concepts

If you have mastered the concepts of this lesson and would like a challenge, try these questions.

The multimedia piece *Mass Conversions* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/massconvert/massConver1.htm)* can help you make the conversion between mass units.

The quantity of active ingredients in a pill or vitamin tablet is often quoted in milligrams (mg).

1. What does the prefix "m" in mg mean?

   ____

   ____

2. How many milligrams are there in a gram?

   ____

   ____

3. A baby aspirin contains 75 mg of medication. Convert 75 mg to grams.

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

Lesson Summary

My Notes

Do you check your bill when you purchase groceries from a supermarket? Prices of items that are sold by weight, such as meats and vegetables, are listed per kilogram. As a careful shopper, you should be familiar with the SI (metric) system's units for mass.

Photo by ownway © 2010

In this lesson, you discovered that the base unit for mass in SI is the kilogram, from which gram and tonne are derived. You examined the relationships among the gram, kilogram, and tonne. To convert among these units, you can simply move the decimal to the left or right.

Lesson E
Temperature

To complete this lesson, you will need:

- a thermometer (optional)

In this lesson, you will complete:

- 4 activities

Essential Questions

- How is temperature measured in SI?
- What is the history of this temperature scale?
- How is the SI temperature scale used today?

My Notes

Focus

For those who enjoy outdoor activities, winter time, whether it's sunny or cloudy, simply means dressing for the weather and enjoying the ice, snow, and scenery. Skiing, skating, curling, snowmobiling, and ice-fishing are a few winter sports enjoyed by Canadians across the country. Of course, occasionally the temperature is too cold to go outdoors safely for extended periods of time. What do you think the temperature was on the day the photograph below was taken?

Photo by Galyna Andrushko© 2010

Get Started

How well can you estimate temperature from how warm or how cold something feels?

___

___

Gauging Temperature

The human body is not a very good gauge of temperature. If you've been outside on a cold day and then come indoors, the indoor temperature will feel hot. But, someone coming out of a hot bath into the same room will feel cold.

To measure temperatures accurately, you need a thermometer.

Explore

My Notes

Although the human body is not a good gauge of temperature, the human body is sensitive to temperatures outside. Outside temperatures affect what type of clothing people need to wear to avoid discomfort or even to injury from exposure to temperature extremes. By investigating temperatures in various places in Canada, and thinking about how you would need to dress in these places, you will become more familiar with the Celsius scale of temperatures.

Activity 1
Try This

In this activity you will explore some temperatures from around the country. Think about how you would need to dress in each locale.

The following table records the highest and lowest temperatures for one day in July.

Temperatures in Degrees Celsius		
Community	**Highest (Maximum)**	**Lowest (Minimum)**
Edmonton, AB	25.8	11.2
Iqaluit, NU	15.3	7.6
Regina, SK	26.7	14.5
Vancouver, BC	23.3	11.9
Whitehorse, YK	18.5	8.2
Winnipeg, MB	26.5	13.5
Yellowknife, NT	22.1	12.3

1. Which community had the highest temperature? Describe how you would feel at that temperature.

____

____

____

____

My Notes

2. Which community had the lowest temperature? Describe how you would feel at that temperature.

____

____

____

____

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

Bringing Ideas Together

Did You Know?

The Inuit have six different words for 'snow'!

To travel in the Arctic, you need to know how various conditions can affect your travel by sled or by snowmobile.

The thermometer in the diagram gives temperature in **Celsius** and Fahrenheit. The Celsius scale gives temperature readings in SI. In Section 2, Lesson E, you will explore the Fahrenheit scale. For now, we'll focus on the Celcius scale.

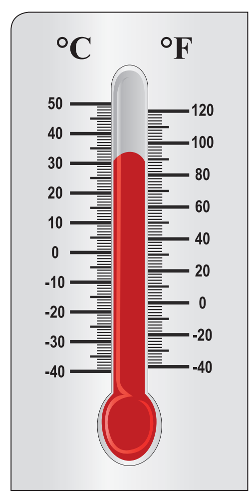
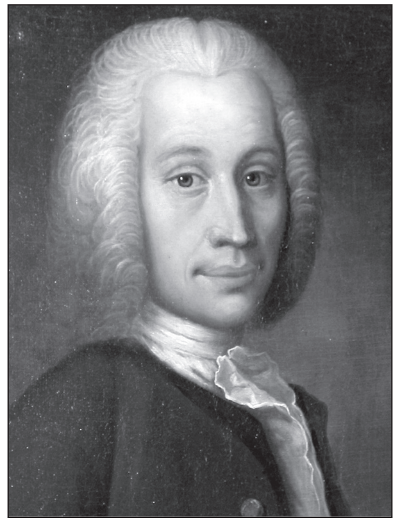


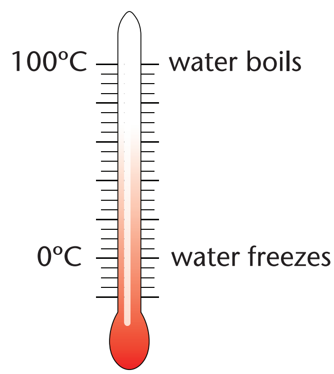
Image by michael lawlor © 2010

My Notes

The Celsius temperature scale is named after the Swedish scientist Anders Celsius, who invented a similar temperature scale in the 1740s. Anders Celsius took the temperature difference between the boiling point of water and the temperature at which ice melts, and divided it into 100 degrees.



The modern Celsius scale is very similar in design. The freezing point of water is very nearly 0ºC, and the boiling point of water is very nearly 100ºC, so the two temperatures, for all practical purposes, are 100 degrees apart.



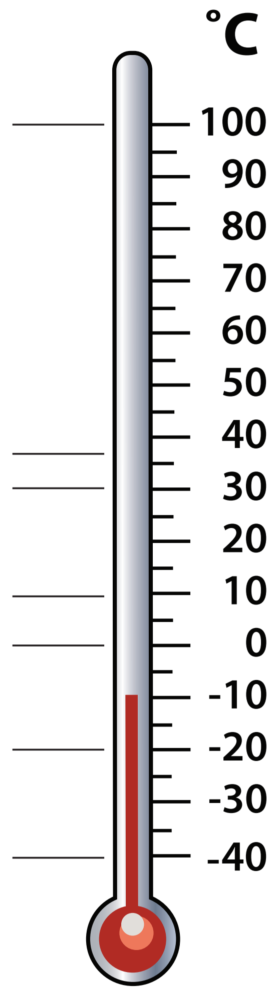
Open *The Celsius Scale* (http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/celsius_scale/index.html). To reacquaint yourself with important benchmarks on the Celsius scale, watch the thermometer level and the descriptors for different temperatures.

My Notes

Activity 2
Try This

Label the thermometer diagram using the descriptors below.

a. freezing point of water
b. plug in car's block heater
c. hot summer day
d. body temperature
e. exposed flesh freezes quickly
f. water boils
g. pleasant spring day



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

My Notes

Temperature Measurements

In Iqaluit, Nunavut, the average daily temperature during the month of February is –26°C. In order to determine this average, someone had to perform calculations based on temperature measurements.

The following examples show other contexts for calculations involving temperature measurements.

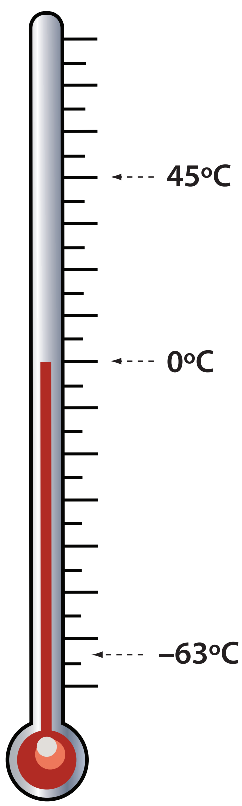
Example 1

The coldest recorded temperature in Canada is –63°C. This temperature was recorded on February 3, 1947, at Snag, Yukon. The hottest recorded temperature was 45°C on July 5, 1947, at Midale and Yellowgrass, Saskatchewan. What is the difference between these two temperatures?

Solution

45°C is 45 degrees above freezing

–63°C is 63 degrees below freezing



The difference between these two temperatures can be found by subtracting –63°C from 45°C.

$$\begin{aligned} 45°\text{C} - (-63°\text{C}) &= 45°\text{C} + 63°\text{C} \\ &= 108°\text{C} \end{aligned}$$

A temperature of 45°C is 108 degrees warmer than –63°C.

My Notes

Example 2

One day last spring, Ester recorded the maximum (highest) temperature on her farm. The maximum temperature was +13°C. The minimum (lowest) temperature was –7°C. What was the average temperature that day?

Solution

+13°C is 20 degrees warmer than –7°C

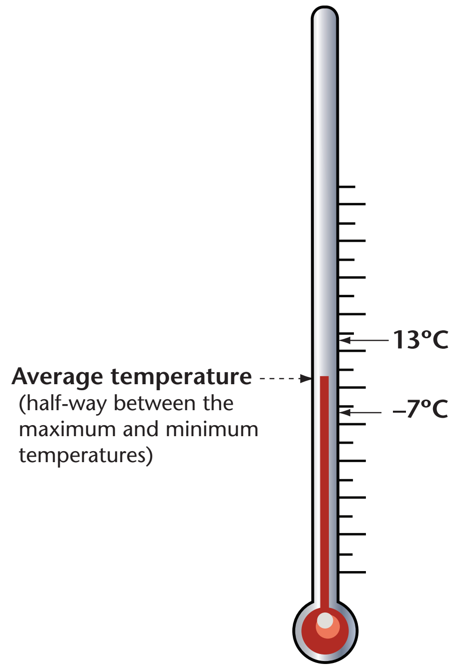
So, the average temperature is 10 degrees colder than +13°C and 10 degrees warmer than –7°C.

So, the average temperature was

$$13°\text{C} - 10°\text{C} = +3°\text{C}$$

or

$$-7°\text{C} + 10°\text{C} = +3°\text{C}$$



Can you suggest another way of finding the average?

____

____

An average of two numbers can be found by adding them together and dividing by 2.

$$\begin{aligned}\text{average temperature} &= \left(\frac{\text{maximum} + \text{minimum}}{2}\right)\\ &= \left(\frac{+13°\text{C} + (-7°\text{C})}{2}\right)\\ &= \frac{+6°\text{C}}{2}\\ &= +3°\text{C}\end{aligned}$$

The average temperature on Ester's farm was +3°C.

Temperature Differences

Using the interactive piece *Average Temperature and Temperature Difference* *(http://media.openschool.bc.ca/osbcmedia/math/mathawm10/html/tempdif/tempAverageDifference.htm)* confirm the temperature difference and average temperature calculated in the examples 1 and 2. Just drag the sliders for the temperatures. You can also use the arrow keys to move the sliders.

My Notes

Activity 3
Self-Check

Please complete the following questions.

1. What are the most common oven temperatures, in degrees Celsius, for baking? (You may check some recipes you have at home, or you may use the internet to look up some recipes.)

2. The temperature forecast for May 8, 2010 in Prince George, BC gives a maximum temperature of 14°C and minimum temperature of –2°C.

   a. Briefly describe how you would dress for comfort at each temperature.

   b. What was the average temperature?

My Notes

3. When you are outdoors in winter, you will feel much colder in a strong wind than when the wind is calm. Environment Canada provides the following chart for calculating wind chill.

Windspeed (km/h) \ Temperature (°C)	5	0	–5	–10	–15	–20
5	4	–2	–7	–13	–19	–24
10	3	–3	–9	–15	–21	–27
15	2	–4	–11	–17	–23	–29
20	1	–5	–12	–18	–24	–30
25	1	–6	–12	–19	–25	–32
30	0	–6	–13	–20	–26	–33
35	0	–7	–14	–20	–27	–33
40	–1	–7	–14	–21	–27	–34
45	–1	–8	–15	–21	–28	–35
50	–1	–8	–15	–22	–29	–35
55	–2	–8	–15	–22	–29	–36
60	–2	–9	–16	–23	–30	–36
65	–2	–9	–16	–23	–30	–37
70	–2	–9	–16	–23	–30	–37
75	–3	–10	–17	–24	–31	–38
80	–3	–10	–17	–24	–31	–38

Adapted from http://www.msc.ec.gc.ca/education/windchill/windchill_chart_e.cfm

a. What does the temperature feel like in a 30 km/h wind when the outdoor temperature is +0°C?

____

b. What does the temperature feel like in a 40 km/h wind when the outdoor temperature is –15°C?

____

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

Activity 4
Mastering Concepts

My Notes

One other temperature scale that scientists often use is the Kelvin (K) scale. In fact, the kelvin is the base unit for temperature in the SI. This scale is closely related to the Celsius scale.

Zero kelvin (0 K) is absolute zero—the coldest possible temperature. It is also the temperature at which all molecular motion is a minimum. The temperature 0 K is approximately –273°C.

Because the divisions are the same size on both the Celsius and Kelvin scales, the freezing point of water, or 0°C, must be 273 K.

The formula for converting degrees Celsius to kelvins is

$$K = °C + 273.$$

For example, room temperature, or 20°C, would be

$$\begin{aligned} K &= 20 + 273 \\ &= 293 \end{aligned}$$

What is each of the following temperatures in kelvins?

1. body temperature, 37°C

 ____

2. boiling point of water, 100°C

 ____

3. a moderate oven temperature, 175°C

 ____

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

My Notes

Lesson Summary

Knowledge of temperature is not simply a way to help you dress appropriately for the weather.

Meats must be cooked to high enough temperatures to avoid illness. For instance, the Canadian Food Inspection Agency recommends that whole poultry, such as turkey, duck, or goose, should be cooked to an internal temperature of 85°C. You can check the internal temperature using a meat thermometer.

James "BO" Insogna © 2010

In this lesson, you discovered that the Celsius temperature scale is part of the SI. You explored how the benchmarks on the Celsius scales are related to the melting point of ice and the boiling point of water.

The Metric System—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

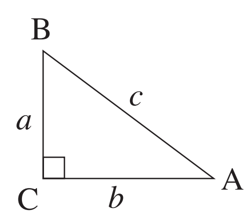
  Pythagorean Theorem

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

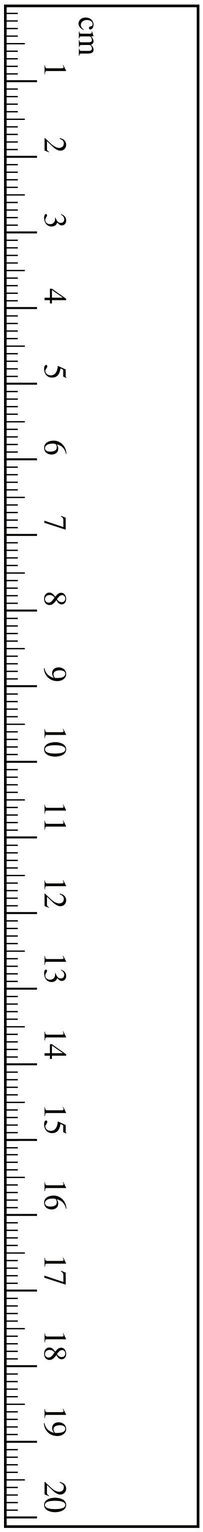
  $$\sin A = \frac{\text{opposite}}{\text{hypotenuse}}$$

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

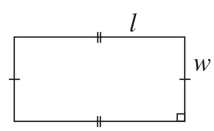
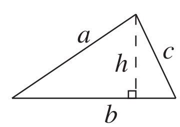
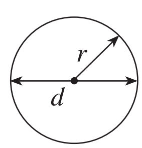
  $$\tan A = \frac{\text{opposite}}{\text{adjacent}}$$



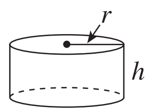
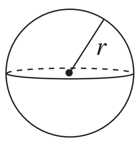
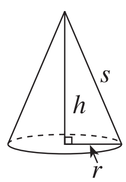
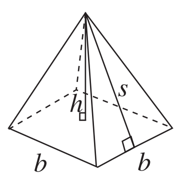
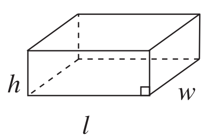
GEOMETRIC FORMULAE



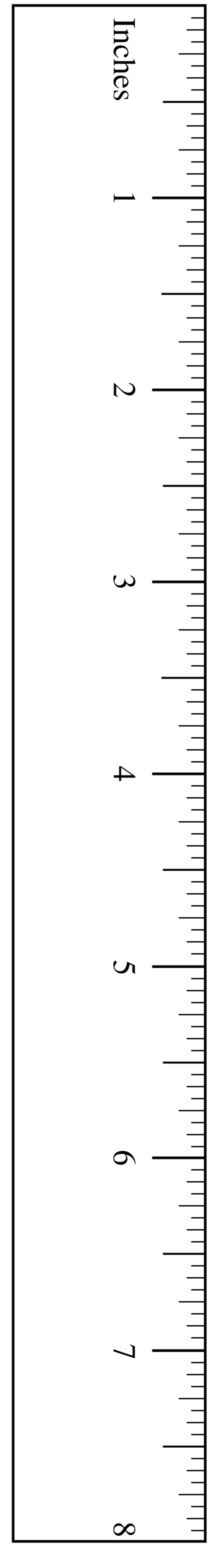
Key Legend	
l = length w = width b = base h = height s = slant height r = radius d = diameter	P = perimeter C = circumference A = area SA = surface area V = volume

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.



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

Pay Rémunération		CPP RPC	Pay Rémunération		CPP RPC	Pay Rémunération		CPP RPC	Pay Rémunération		CPP RPC
From - De	To - À		From - De	To - À		From - De	To - À		From - De	To - À	
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 $

Insurable Earnings Rémunération assurable		EI premium Cotisation d'AE	Insurable Earnings Rémunération assurable		EI premium Cotisation d'AE	Insurable Earnings Rémunération assurable		EI premium Cotisation d'AE	Insurable Earnings Rémunération assurable		EI premium Cotisation d'AE
From - De	To - À		From - De	To - À		From - De	To - À		From - De	To - À	
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 %

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	

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

Lesson A: Length

Lesson A: Activity 2: Self-Check

Powers of 10 in Standard Form	Powers of 10 in Exponent Form
1000	$10 \times 10 \times 10 = 10^3$
100	$10 \times 10 = 10^2$
10	10^1
1	10^0
0.1	10^{-1}
0.01	10^{-2}
0.001	10^{-3}

Lesson A: Activity 3: Self-Check

1. $3.92 \times 10^4 = 3.9200 \times 10^4$
   $= 39\,200$

   Append enough zeroes to allow for the decimal point to be moved 4 places to the right.

2. $9.9 \times 10^{-5} = 000\ 009.9 \times 10^{-5}$
   $= 0.000\ 099$

   Append enough zeroes to allow for decimal point to be moved 5 places to the left.

   Move the decimal point 5 places to the left.

3. $31.42 \times 1000 = 31.42 \times 10^3$
   $= 31.420 \times 10^3$
   $= 314\ 20$

   Use an exponent to express the power of 10.

   Append enough zeroes to allow for the decimal point to be moved 3 places to the right.

Lesson A: Activity 4: Self-Check

1 km = 1000 m or 10^3 m	1 m = 0.001 km or 10^{-3} km
1 m = 100 cm or 10^2 cm	1 cm = 0.01 m or 10^{-2} m
1 m = 1000 mm or 10^3 mm	1 mm = 0.001 m or 10^{-3} m
1 cm = 10 mm or 10^1 mm	1 mm = 0.1 cm 10^{-1} cm

Lesson A: Activity 5: Self-Check

1. Since $1\,\text{m} = 0.001\,\text{km}$, multiply 6750 by 0.001 or 10^{-3}.

$$\begin{aligned} 6750\,\text{m} &= (6750 \times 0.001)\,\text{m} \\ &= 6.750\ \text{km} \end{aligned}$$

2. Since 1 km = 1000 m, multiply 0.3 by 1000 or 10^3.

$$\begin{aligned} 0.3\ \text{km} &= (0.3 \times 1000)\ \text{m} \\ &= 300\ \text{m} \end{aligned}$$

3. Because stamps are small in size, expressing their dimensions in millimetres avoids decimals. For example, a regular stamp on a letter is about 24 mm long and 20 mm wide.

4. First, find the thickness of 500 sheets of paper in metres.

   Since 1 cm = 0.01 m, multiply 5 by 0.01 or 10^2

$$\begin{aligned} 5\ \text{cm} &= (5 \times 0.01)\ \text{m} \\ &= 0.05\ \text{m} \end{aligned}$$

   Divide by 500 to find the thickness of 1 sheet.
   $0.05\,\text{m} \div 500 = 0.0001\,\text{m}$.

   One sheet is about 0.0001 m or 10^{-4} m thick.

5. Since 1 m = 100 cm, multiply 2.4 by 100 or 10^2

$$\begin{aligned} 2.4\ \text{m} &= (2.4 \times 100)\ \text{cm} \\ &= 240\ \text{cm} \end{aligned}$$

6. Since 1 mm = 0.1 cm, multiply 216 by 0.1 or 10^{-1}

$$\begin{aligned} 216 \text{ mm} &= (216 \times 0.1) \text{ cm} \\ &= 21.6 \text{ cm} \end{aligned}$$

Since 1 mm = 0.1 cm, multiply 279 by 0.1 or 10^{-1}

$$\begin{aligned} 279 \text{ mm} &= (279 \times 0.1) \text{ cm} \\ &= 27.9 \text{ cm} \end{aligned}$$

A letter-size sheet of copy paper is 21.6 cm × 27.9 cm

7. Since 1 m = 100 cm, multiply 2.4 by 100 or 10^2.

$$\begin{aligned} 2.36 \text{ m} &= (2.36 \times 100) \text{ cm} \\ &= 236 \text{ cm} \end{aligned}$$

8. Since 1 cm = 10 mm, multiply 44.5 by 0.1 or 10^{-1}.

$$\begin{aligned} 44.5 \text{ mm} &= (44.5 \times 0.1) \text{ cm} \\ &= 4.45 \text{ cm} \end{aligned}$$

The harpoon head is 4.45 cm long.

9. First, convert 1.6 km to metres.

Since 1 km = 1000 m, multiply 1.6 by 1000 or 10^3.

$$\begin{aligned} 1.6 \text{ km} &= (1.6 \times 1000) \text{ m} \\ &= 1600 \text{ m} \end{aligned}$$

Since one lap is 200 m, a runner must complete 1600 m ÷ 200 m = 8 laps.

Activity 6: Mastering Concepts

1. The greatest distance to the sun is 1.52×10^{11} m

   To change this number to standard notation, move the decimal point 11 places to the right.

$$1.52 \times 10^{11} \text{ m} = 152\,000\,000\,000 \text{ m}$$

$$\text{Since } 1 \text{ km} = 1000 \text{ m,}$$

$$\begin{aligned} 152\,000\,000\,000 \text{ m} &= \left(\frac{152\,000\,000\,000}{1000}\right)\text{km} \\ &= 152\,000\,000 \text{ km} \end{aligned}$$

2. The shortest distance to the sun is 1.46×10^{11} m

   To change this number to standard notation, move the decimal point 11 places to the right.

$$1.46 \times 10^{11} \text{m} = 146\,000\,000\,000 \text{ m}$$

$$\text{Since } 1 \text{ km} = 1000 \text{ m,}$$

$$\begin{aligned} 146\,000\,000\,000 \text{ m} &= \left(\frac{146\,000\,000\,000}{1000}\right)\text{km} \\ &= 146\,000\,000 \text{ km} \end{aligned}$$

3. The difference in distance is 152 000 000 km – 146 000 000 km = 6 000 000 km

Lesson B: Area

Lesson B: Activity 1: Try This

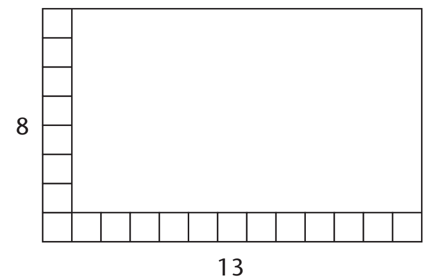
1. The following is a sample answer:
   Approximately 100 thumbprints would cover the sheet of paper.

2. There are various methods you could use to find the approximate number of thumbprints you can fit on the sheet of paper. Sample methods are described below.

   One method is to actually make the thumbprints you need to cover the sheet of paper. Then count the thumbprints. It would take about 100 thumbprints to cover the sheet of paper.

   Another method relies on a shortcut involving multiplication. You don't have to cover the entire surface of the paper, just two edges, as shown in the diagram. Each square represents a thumbprint. Multiply the number of thumbprints that fit along one edge by the number of prints along the adjacent edge.

Using this method, you can describe the shortcut method as follows. There are 13 of my thumbprints across the page, and I could cover the entire page with 8 of these rows.



13 × 8 = 104 thumbprints.

3. Your answer will depend on the number of thumbprints you could place on the sheet. For example, if you could have placed 100 thumbprints on the sheet, then your answer would be this: The area of the sheet of paper is 100 thumbprints.

Lesson B: Activity 2: Try This

1. The square metre can be used to measure areas for carpet, home construction, and painting. You may have different answers than the ones given.

2. The square centimetre can be used to measure the area of a desktop, the top surface of a pizza, a computer mouse pad, a book cover, or a photograph.

3. Since a metre is 100 cm long, the length and width of a square metre are both 100 cm.

   100 cm × 100 cm = 10 000 cm^2

   A square metre contains 10 000 square centimeters.

4. The square millimetre is appropriate to measure the areas of small objects such as computer coins, stamps, and calculator screens.

5. Since a centimetre is 10 mm long, the length and width of a square metre are both 10 mm.

   10 mm × 10 mm = 100 mm^2

   A square centimetre contains 100 square millimetres.

6. Since a metre is 1000 mm long, the length and width of a square metre are both 1000 mm.

   1000 mm × 1000 mm = 1000 000 mm^2

   A square metre contains 1000 000 square millimetres.

Lesson B: Activity 3: Self-Check

SI Area Unit	An equal area using a different unit (standard form)	An equal area using a different unit (powers of 10)
1 m^2	10 000 cm^2	10^4 cm^2
1 m^2	1000 000 mm^2	10^6 mm^2
1 cm^2	100 mm^2	10^2 mm^2

Lesson B: Activity 4: Self-Check

1. a. $\text{area} = \text{length} \times \text{width}$

$$\begin{aligned} A &= l \times w \\ &= 64 \text{ cm} \times 32 \text{ cm} \\ &= 2048 \text{ cm}^2 \end{aligned}$$

The area of the flag is 2048 cm^2.

b. Since 1 m^2 = 10 000 cm^2, there will be fewer m^2. So, divide by 10 000.

$$\begin{aligned} 2048 \text{ cm}^2 &= \left(\frac{2048}{10\ 000}\right) \text{m}^2 \\ &= 0.2048 \text{ m}^2 \end{aligned}$$

The area of the flag is 0.2048 m^2.

Another way to solve this problem is to change the dimensions to metres first.

$$\begin{aligned} A &= l \times w \\ &= 64 \text{ cm} \times 32 \text{ cm} \\ &= 0.64 \text{ m} \times 0.32 \text{ m} \\ &= 0.2048 \text{ m}^2 \end{aligned}$$

2. Answers will vary. A sample answer is given.

The switch cover was measured in cm.
length = 12.5 cm and width = 8 cm

a. $\text{area} = \text{length} \times \text{width}$

$$\begin{aligned} A &= l \times w \\ &= 12.5 \text{ cm} \times 8 \text{ cm} \\ &= 100 \text{ cm}^2 \end{aligned}$$

The area of the switch cover is 100 cm^2.

b. Since 1 cm^2 = 100 mm^2, there will be more mm^2. To convert from cm^2 to mm^2, multiply by 100.

$$\begin{aligned}100\text{ cm}^2 &= (100 \times 100)\text{ mm}^2\\ &= 10\ 000\text{ mm}^2\end{aligned}$$

The area of the switch cover is 10 000 mm^2.

Another way to solve this problem is to change the dimensions to mm first.

$$\begin{aligned}A &= l \times w\\ &= 12.5\text{ cm} \times 8\text{ cm}\\ &= 125\text{ mm} \times 80\text{ mm}\\ &= 10\ 000\text{ mm}^2\end{aligned}$$

c. Expressing the area of a light-switch cover in m^2 would not be appropriate because the unit is too large. Expressing the area in square meters wouldn't be incorrect, but it isn't the best choice of units to use.

3. Answers will vary. A sample answer is given.

   The area of a computer disk is most easily understood in cm^2 since mm^2 is too small a unit, and m^2 is too large.

4. $$\begin{aligned}\text{area} &= \text{length} \times \text{width}\\ A &= l \times w\\ &= 279\text{ mm} \times 216\text{ mm}\\ &= 27.9\text{ cm} \times 21.6\text{ cm}\\ &= 602.64\text{ cm}^2\end{aligned}$$

   The area of the sheet of paper is 602.64 cm^2.

5. Answers will vary. A sample answer is given.

   a. My room is 4 m long and 3 m wide. The area of my room is 12 m^2.

   b. I can imagine 12 m^2 much more easily than 120 000 cm^2 or 12 000 000 mm^2.

Lesson B: Activity 5: Self-Check

1. Stony Plain 135

$$1\text{ km}^2 = 100\text{ ha}$$

$$\begin{aligned}51.61\text{ km}^2 &= (51.61 \times 100)\text{ ha}\\ &= 5161\text{ ha}\end{aligned}$$

2. Pacific Rim National Park

$$1\text{ km}^2 = 100\text{ ha}$$

$$\begin{aligned}51\,000\text{ ha} &= \left(\frac{51\,000}{100}\right)\text{km}^2\\ &= 510\text{ km}^2\end{aligned}$$

3. Quarter section

$$\begin{aligned}A &= 804.7\text{ m} \times 804.7\text{ m}\\ &= 647542.09\text{ m}^2\end{aligned}$$

$$1\text{ ha} = 10\,000\text{ m}^2$$

So,

$$\begin{aligned}647542.09\text{ m}^2 &= \left(\frac{647542.09}{10\,000}\right)\text{ha}\\ &= 64.754\,209\text{ ha}\end{aligned}$$

4. West Edmonton Mall

$$1\text{ ha} = 10\,000\text{ m}^2$$

$$\begin{aligned}570\,000\text{ m}^2 &= \left(\frac{570\,000}{10\,000}\right)\text{ha}\\ &= 57\text{ ha}\end{aligned}$$

The mall covers about 57 ha.

5. Bison

$$1 \text{ ha} = 10\,000 \text{ m}^2$$

$$\begin{aligned} \text{So, } 8.5 \text{ ha} &= (8.5 \times 10\,000) \text{ m}^2 \\ &= 85\,000 \text{ m}^2 \end{aligned}$$

There were about 85 000 m^2 of grazing land per bison.

Lesson B: Activity 6: Mastering Concepts

$$1 \text{ ha} = 10\,000 \text{ m}^2$$

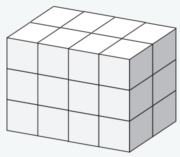
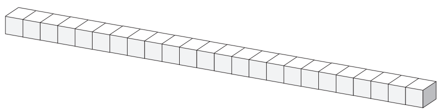
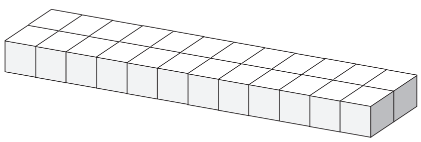
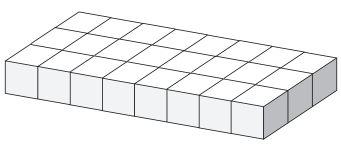
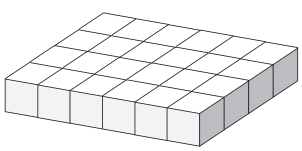
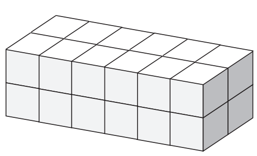
$$\begin{aligned} A &= l \times w \\ 10\,000 \text{ m}^2 &= l \times 10 \text{ m} \\ l &= \left(\frac{10\,000 \text{ m}^2}{10 \text{ m}}\right) \\ &= 1000 \text{ m} \\ &= 1 \text{ km} \end{aligned}$$

A distance of 1 km was paved.

Lesson C: Volume and Capacity

Lesson C: Activity 1: Try This

1.

Visual Representation of Prism	Prism Dimensions	Product of Dimensions	Volume
	2 wide 3 high 4 long	2 × 3 × 4 = 24	24 cubes
	1 wide 1 high 24 long	1 × 1 × 24 = 24	24 cubes
	2 wide 1 high 12 long	2 × 1 × 12 = 24	24 cubes
	3 wide 1 high 8 long	3 × 1 × 8 = 24	24 cubes
	4 wide 1 high 6 long	4 × 1 × 6 = 24	24 cubes
	2 wide 2 high 6 long	2 × 2 × 6 = 24	24 cubes

2. Answers will vary. Note that not all sets of dimensions would give you a different box.

   For example, 3 cubes wide, 1 cube high, and 8 cubes long is really the same as 8 cubes wide, 3 cubes long, and 1 cube high.

3. In every case, the volume of sugar is the same—24 cubes. So each box holds the same volume of sugar!

4. For a (rectangular) prism-shaped box, the volume (V) the box can hold is equal to the product of its dimensions. volume = length × width × height.

Lesson C: Activity 2: Self-Check

1. Answers will vary. Sample answers are given.

   My closet is 90 cm wide, 65 cm deep, and 244 cm high.

   a. $$\begin{aligned} V &= l \times w \times h \\ &= 90 \text{ cm} \times 65 \text{ cm} \times 244 \text{ cm} \\ &= 1\,427\,400 \text{ cm}^3 \end{aligned}$$

   b. $$\begin{aligned} V &= l \times w \times h \\ &= 0.90 \text{ m} \times 0.65 \text{ m} \times 2.44 \text{ m} \\ &= 1.4274 \text{ m}^3 \end{aligned}$$

   c. The answer makes more sense in cubic metres since the volume of the closet is close to 1.5 m^3. I can picture 1.5 more easily than 1 427 400.

2. Answers will vary. Sample answers are given.

   The cereal box I measured is 16 cm wide, 2.5 cm deep, and 20 cm high.

   a. $$\begin{aligned} V &= l \times w \times h \\ &= 16 \text{ cm} \times 2.5 \text{ cm} \times 20 \text{ cm} \\ &= 800 \text{ cm}^3 \end{aligned}$$

   b. $$\begin{aligned} V &= l \times w \times h \\ &= 0.16 \text{ m} \times 0.025 \text{ m} \times 0.20 \text{ m} \\ &= 0.0008 \text{ m}^3 \end{aligned}$$

   c. The answer makes more sense in cm^3, as I can picture 800 more easily than 0.0008.

3. 1 m³ = 1 000 000 cm³ or 106 cm³

$$\begin{aligned}\text{So, } 0.05\text{ m}^3 &= 0.05 \times 1\ 000\ 000\text{ cm}^3 \\ &= 0.05 \times 10^6\text{ cm}^3 \\ &= 50\ 000\text{ cm}^3\end{aligned}$$

4. All the dimensions must be in metres before you can calculate the volume.

$$\begin{aligned}15\text{ cm} &= \left(\frac{15}{100}\right)\text{m} \\ &= 0.15\text{ m}\end{aligned}$$

$$\begin{aligned}V &= l \times w \times h \\ &= 20\text{ m} \times 3\text{ m} \times 0.15\text{ m} \\ &= 9\text{ m}^3\end{aligned}$$

Nine cubic metres of concrete are needed for the project.

Lesson C: Activity 3: Try This

1. a. One SI (metric) symbol is mL. A soft-drink bottle might contain 300 mL, and a can of soup 540 mL. Another symbol is L. A milk container might hold 2 L, or a large soft-drink bottle might hold 1.5 L.
   b. L stands for litre, and mL stands for millilitre.
   c. 1 L = 1000 mL

2. a. Answers will vary depending on the container chosen.
   b. Answers will vary depending on the container's shape. One such container sits on a square base 7 cm a side and is 20.4 cm tall. Its volume is

$$\begin{aligned}V &= l \times w \times h \\ &= 7\text{cm} \times 7\text{cm} \times 20.4\text{ cm} \\ &= 999.6\text{ cm}^3\end{aligned}$$

$$\left(1\text{L} = 1000\text{ cm}^3\right)$$

3. Answers will vary. A sample answer is given. Perhaps a 1 L milk carton is not this shape because other shapes are easier to hold in your hand, to pour, or to store on a shelf or in your refrigerator.

Lesson C: Activity 4: Self-Check

1. $$\begin{aligned} 3.75 \text{ L} &= (3.75 \times 1000) \text{ mL} \\ &= 3750 \text{ mL} \end{aligned}$$

   The laundry detergent container holds 3750 mL.

2. $$\begin{aligned} 355 \text{ mL} &= \left(\frac{355}{1000}\right) \text{L} \\ &= 0.355 \text{ L} \end{aligned}$$

   The soft-drink bottle holds 0.355 L.

3. 1 m^3 = 1000 L

   $$\begin{aligned} \text{So, } 25\ 400 \text{ L} &= \left(\frac{25\ 400}{1000}\right) \text{m}^3 \\ &= 25.4 \text{ m}^3 \end{aligned}$$

4. $$\begin{aligned} V &= l \times w \times h \\ &= 50 \text{ cm} \times 40 \text{ cm} \times 30 \text{ cm} \\ &= 60\ 000 \text{ cm}^3 \\ \text{capacity} &= 60\ 000 \text{ mL} \\ &= \left(\frac{60\ 000}{1000}\right) \text{L} \\ &= 60 \text{ L} \end{aligned}$$

5. Since 1 m^3 = 1000 L,

   $$\begin{aligned} 220 \text{ L} &= \left(\frac{220}{1000}\right) \text{m}^3 \\ &= 0.220 \text{ m}^3 \end{aligned}$$

   The volume of the rain barrel is 0.220 m^3.

6. Since $1 \text{ L} = 1000 \text{ mL}$ and $1 \text{ mL} = 1 \text{ cm}^3$,

   $$\begin{aligned} 8 \text{ L} &= 8000 \text{ mL} \\ &= 8000 \text{ cm}^3 \end{aligned}$$

Lesson C: Activity 5: Mastering Concepts

1. Volume of precipitation = area of Vancouver × annual precipitation.
   The units you use must be the same.

$$\text{Recall, } 1 \text{ km} = 1000 \text{ m.}$$

$$\begin{aligned}\text{area of Vancouver} &= 115 \text{ km}^2 \\ &= 115 \times (1000 \text{ m} \times 1000 \text{ m}) \\ &= 115\,000\,000 \text{ m}^2\end{aligned}$$

$$\text{Recall, } 1 \text{ m} = 1000 \text{ mm.}$$

$$\begin{aligned}\text{annual precipitation} &= 1200 \text{ mm} \\ &= \left(\frac{1200}{1000}\right) \text{m} \\ &= 1.2 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{So, volume of precipitation} &= 115\,000\,000 \text{ m}^2 \times 1.2 \text{ m} \\ &= 138\,000\,000 \text{ m}^3\end{aligned}$$

There are 1000 L in 1 m^3. So,

$$\begin{aligned}\text{volume of precipitation} &= (138\,000\,000 \times 1000) \text{ L} \\ &= 138\,000\,000\,000 \text{ L}\end{aligned}$$

Lesson D: Mass

Lesson D: Activity 1: Try This

Answers will vary. Sample answers are provided.

1. The heaviest player is Marc Mancari. He weighs 225 pounds or 102 kg.
2. The lightest player on the Canucks is Andrew Ebbett. He weighs 174 pounds or 79 kg.
3. The difference in the weight between between Marc Mancari and Andrew Ebbett is 23 kg.
4. Skilled players can be large or small in mass; however, because of the intense physical nature of the game, size will dictate the players' effectiveness on the ice in a game situation. The sport's cliché is true: "Too small, too bad!" However, mass is no substitute for skill or attitude. Despite being the heaviest athlete on his team, a player may not lead his team in goals and assists.

Lesson D: Activity 2: Self-Check

1. There are 365 days in 2013.
   a. At 1.75 L of water or 1.75 kg/day, she would drink 365 × 1.75 kg = 638.75 kg in 2013.
   b. $$\begin{aligned} 638.75 \text{ kg} &= (638.75 \times 1000)\text{ g} \\ &= 638\,750 \text{ g} \end{aligned}$$

2. $$\begin{aligned} 170\,000 \text{ kg} &= \left(\frac{170\,000}{1000}\right)\text{t} \\ &= 170 \text{ t} \end{aligned}$$

   The blue whale can grow to over 170 t.

3. $$\begin{aligned} 3125 \text{ g} &= \left(\frac{3125}{1000}\right)\text{kg} \\ &= 3.125 \text{ kg} \end{aligned}$$

   The baby weighed 3.125 kg at birth.

4. $$\begin{aligned} \text{Mass of 36 424 000 coins} &= 36\,424\,000 \times 7\text{g} \\ &= 254\,968\,000 \text{ g} \\ &= \left(\frac{254\,968\,000}{1000}\right)\text{kg} \\ &= 254\,968 \text{ kg} \\ &= \left(\frac{254\,968}{1000}\right)\text{t} \\ &= 254.968 \text{ t} \end{aligned}$$

   In 2007, the mint struck 254.968 t of loonies.

5. $$\begin{aligned} 0.5 \text{ kg} &= (0.5 \times 1000)\text{ g} \\ &= 500 \text{ g} \end{aligned}$$

   $$\begin{aligned} \text{Mass of one slice} &= \left(\frac{500 \text{ g}}{50 \text{ slices}}\right) \\ &= 10 \text{ g} \end{aligned}$$

6. $$\begin{aligned} 45 \text{ t} &= (45 \times 1000)\text{ kg} \\ &= 45\,000 \text{ kg} \end{aligned}$$

7. $1.37 \text{ kg} = (1.37 \times 1000)\text{ g}$
$= 1370 \text{ g}$

8. $67\,000\text{ g} = \left(\frac{67\,000}{1000}\right)\text{kg}$
$= 67 \text{ kg}$
$= \left(\frac{67}{1000}\right)\text{t}$
$= 0.067\text{ t}$

9. $2 \text{ kg} = (2 \times 1000)\text{ g}$
$= 2000 \text{ g}$

There are 100 g in each portion.

$\text{Number of portions} = \left(\frac{2000\text{ g}}{100}\right)\text{g}$
$= 20$

10. Since 250 g × 4 = 1000 g or 1 kg, multiply the cost of 250 g by 4.

$3.49 × 4 = $13.96

The cost of the cream puffs per kilogram is $13.96.

Lesson D: Activity 3: Mastering Concepts

1. The prefix "m" stands for "one thousandth" or 0.001.
1 mg = 0.001 g

2. These are 1000 mg in a gram.
1000 mg = 1 g

3. $75 \text{ mg} = \left(\frac{75}{1000}\right)\text{g}$
$= 0.075\text{ g}$

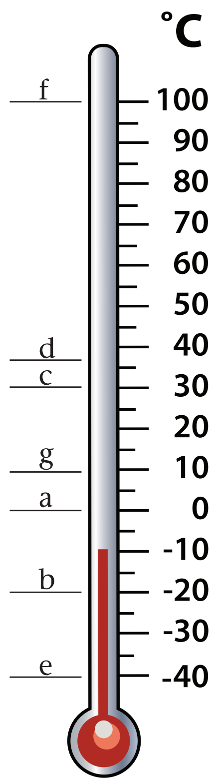
Lesson E: Temperature

Lesson E: Activity 1: Try This

1. Regina recorded the highest temperature at 26.7°C. At 26.7°C, I would feel hot.

2. On this day, Iqaluit recorded the lowest temperature at 7.6°C. At 7.6°C, I would feel cool/cold.

Lesson E: Activity 2: Try This



Lesson E: Activity 3: Try This

1. Answers will vary. Sample answers are given below.
   - A moderate oven temperature, such as 175°C, is good for baking cakes and breads.
   - A hot oven temperature, such as 220°C, is good for baking cookies or cooking a pizza.

2. a. The maximum temperature, 14°C, is less than room temperature. Long sleeves would likely be comfortable. You may want to have a light jacket handy. But, –2°C is below freezing; you would probably need a warm jacket and maybe a scarf. If you're going out all day, you should probably dress in layers so you can adapt as the temperature changes.

   b. $$\text{average temperature} = \frac{14°\text{C} + (-2°\text{C})}{2}$$
   $$= 6°\text{C}$$

   The average temperature, forecast for May 8, 2010 in Prince George, BC, is 6°C.

3. a. –6°C

   b. –27°C

Lesson E: Activity 4: Mastering Concepts

1. K = 37 + 273 or 310 K

2. K = 100 + 273 or 373 K

3. K = 175 + 273 or 448 K

Glossary

acre (ac)
a unit of area in the imperial system

An acre is 22 yd wide by 220 yd long or 4840 yd^2.

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.

capacity
a measurement of how much a container can hold

Commonly, capacity refers to the amount of liquid that can be poured into a container, but it can also be used to refer to an amount of solid that can be placed into a container.

Celsius
a temperature scale commonly used in every major country throughout the world, except the United States

compatible numbers
numbers that are easy to use in a mental computation, especially division

cubic foot (ft^3)
a unit of volume in the imperial system

A cubic foot is the volume of a cube having an edge length of 1 ft.

cubic inch (in^3)
a unit of volume in the imperial system

A cubic inch is the volume of a cube having an edge length of 1 in.

cubic yard (yd^3)
a unit of volume in the imperial system

A cubic yard is the volume of a cube having an edge length of 1 yd.

foot
a unit of length in the imperial system equal to 12 in

A measure of one foot can be expressed as 1 ft or 1′.

gallon (gal)
a measure of capacity in the imperial system

A gallon is 4 qt in size.

hectare
the area of a square 100 m on a side. The symbol for one hectare is 1 ha.

inch
a unit of length in the imperial system

A measure of 1 inch can be written as 1 in or 1″.

kilogram (kg)
the base unit of mass in the metric system

A kilogram is equal to the mass of a certain cylinder of platinum-iridium alloy kept at the International Bureau of Weights and Measures in France.

litre (L)
the capacity of a container having a volume of 1000 cm^3

Since 1 L = 1000 mL, 1 mL = 1 cm^3.

long ton
a unit of weight (mass) in the imperial system

1 long ton = 2240 lb

mass
a measure of the quantity of matter in an object

metre
the base unit of length (or linear measure) in SI

mile(mi)
a unit of length in the imperial system

The mile is defined today as exactly 5280 ft.

ounce (oz)
a unit of weight (mass) in the imperial system

There are 16 oz in 1lb.

1 lb = 16 oz

pint (pt)

a measure of capacity in the imperial system

A pint is roughly equal to 0.5 L.

pound (lb)

a unit of weight (mass) in the imperial system

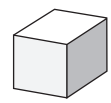
One pound is defined as exactly 0.453 592 37 kg.

prism

in geometry, a 3-D object that has two congruent and parallel faces (the top and bottom bases) and lateral faces that are parallelograms

Such a 3-D object is also known as a rectangular box.

The following is a 3-D object known in geometry as a prism.



proportion

a statement showing one ratio equal to another

For example, $\frac{1}{12} = \frac{3}{36}$ is a proportion statement.

quart(qt)

a measure of capacity in the imperial system

There are 2 pt in a quart.

A quart is approximately equal to 1 L.

short ton

a unit of weight (mass) in the imperial system (also called a ton)

1 short ton = 2000 lb

square foot (ft^2)

a unit of area in the imperial system

A square foot is the area of a square 1ft on a side.

square inch (in^2)

a unit of area in the imperial system

A square inch is the area of a square 1 in on a side.

square mile(mi^2)

a unit of area in the imperial system

A square mile is the area of a square 1 mi on a side.

square yard (yd^2)
a unit of area in the imperial system

A square yard is the area of a square 1yd on a side.

ton
a unit of weight (mass) in the imperial system (also called a short ton)

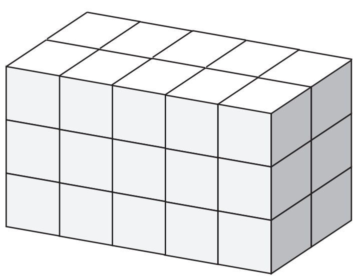
1 ton = 2000 lb

tonne (t)
in the metric system, a unit of mass equal to a 1000 kg

1 t = 1000 kg.

volume
a measurement of how many cubic units into which a object or space may be divided

For example, if your living room is 5 m long by 3 m wide by 3 m high, its volume is $5 \text{ m} \times 3 \text{ m} \times 3 \text{ m} = 45 \text{ m}^3$.



weight
a measure of the force of gravity on an object

yard (yd)
a unit of length in the imperial system

One yard equals 3 ft or 0.9411 m.

