# Unit 1: Measurement

In this unit we will solve problems involving:

- linear measurement

- conversion within or between SI and imperial systems of measurement

- surface area and volume of 3-D objects

- right triangles and trigonometry

Jul 1-8:05 PM

# Unit 1: Measurement

## Chapter 1: Measurement Systems

What is "*measurement*"?
Why do we need standardized units of measurement?

Chapter Goals:

- estimate a measurement and justify choice of units

- solve problems by using measuring instruments

- provide referents for linear measurements

- convert between or within SI and imperial systems.

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# 1.1 SI Measurement

Canada's official measurement system is SI (Système International d'Unités).

Some common SI units are listed below

| Unit | Abbreviation | Multiplying Factor |
|---|---|---|
| kilometre | km | 1000 |
| hectometre | hm | 100 |
| decametre | dam | 10 |
| metre | m | 1 |
| decimetre | dm | 0.1 |
| centimetre | cm | 0.01 |
| millimetre | mm | 0.001 |

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## Measuring instruments:

SI rulers, metre sticks, and measuring tapes give measurements to the nearest millimetre (0.1cm).

A **caliper** can accurately measure to the nearest tenth of a millimetre (0.01 cm), depending on scales. (see page 10)

Follow these steps to read a caliper.

1. Read the value on the fixed scale that is located exactly at or just to the left of the zero on the moving scale.
   For the caliper shown, the reading is 2.2.

2. Identify the next line on the moving scale that aligns with a line on the fixed scale. Read the value on the fixed scale.
   For this caliper, it is the line on the moving scale that represents 0.03.

3. The final reading is 2.23 cm. (2.2 + 0.03 = 2.23)
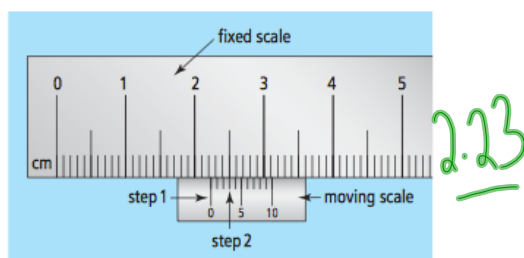


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# Referents are a non-standard measuring unit.

Referents help you to **estimate** a distance or length in standard units.

What are some examples of *referents* for SI units?

hand estimate          Km=12 city blocks

heet: football field

quarter          width figer :cm    feet          Stride =meter

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# Examples:

Estimate using a referent then measure the following measures. Record both the standard measurement and the estimated referent measure:

1. The height of the chair you are sitting on.

2. The length of the table you are at.

3. The distance from the floor to the bottom of the white board.

Jul 1-8:38 PM

# 1.1

# Converting Between SI Units for Length

| Unit | Abbreviation | Multiplying Factor |
|------|--------------|--------------------|
| kilometre | km | 1000 |
| hectometre | hm | 100 |
| decametre | dam | 10 |
| metre | m | 1 |
| decimetre | dm | 0.1 |
| centimetre | cm | 0.01 |
| millimetre | mm | 0.001 |

Convert 4 km into m:

We know: 1 km = 1000 m

We WANT to know: 4km = ? m

$4(1) = 4 = Km$

$4(1000) = \_ m$

*4000m*

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## Converting using **unit analysis**

First recall fractions: common factors in the numerator and denominator divide to 1. This is used to simplify fractions to lowest terms.

$\frac{9}{3} = \frac{3 \cdot 3}{3} = 3 \quad \frac{4}{4} = 1$

Example:
$$\frac{18}{45} = \frac{(9^1 \times 2)}{(9_1 \times 5)}$$
$$= \frac{2}{5}$$

In *unit analysis,* the same concept is applied to units of measurement.

Example:
To convert from metres to millimetres,

$$(25\ m)\left(\frac{1000\ mm}{1\ m}\right)$$
$$= \left(\frac{25\ m}{1}\right)\left(\frac{1000\ mm}{1\ m}\right)$$
$$= 25\,000\ mm$$

Because 1000mm = 1m

1000mm divided by 1 m equals 1. So in essence, we are multiplying 25m by 1 (using a fancy fraction trick)

Jul 15-3:39 PM

Convert 38 440 300 000 cm into kilometres.

1) how many cm in a Km?

$1 Km = 1000 m$　　　　$1m = 100 cm$

$1 Km = 1000 (100) cm$

$1 Km = 100 000 cm$

$\dfrac{1 Km}{100 000 cm} = 1$　　$38 440 300 000 cm$

Jul 2-9:57 AM

## Converting using **proportional reasoning**

This is easiest to explain by working through an example using it.

Let's convert 0.0019 m into millimetres.

First we need to know that 1000 mm = 1 m

Therefore $\dfrac{1000mm}{1m} = 1$ (since they are equivalent)

We also know that when we convert 0.0019 m into millimetres the distance recorded in metres and in millimetres will be equivalent. This means that if x = the number of millimetres required to convert 0.0019 m to millimetres then,

$$\dfrac{xmm}{0.0019m} = 1$$

Now we have 2 equations both equal to the same value, 1, so we can make them equal to each other.

$$\dfrac{xmm}{0.0019m} = 1 = \dfrac{1000mm}{1m}$$

$$\dfrac{xmm}{0.0019m} = \dfrac{1000mm}{1m}$$

Finally, we solve for x.

Jul 15-3:44 PM

Practice

Convert the following measurements into a more appropriate SI unit. You must use **proportional reasoning** and **unit analysis** at least once.

a) The circumference of a highlighter measures 0.06m

b) The top of a door is 2110 mm high
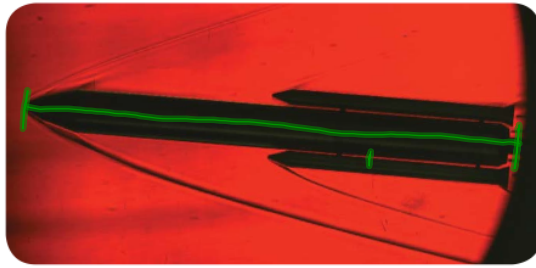
c) A tube of toothpaste is 205 mm long.

Jul 2-9:57 AM

Homework: Pg 15 #1, 2, 3, 5

Sep 10-2:38 PM

## 1.1 SI Scale

**4.** The photograph shows a wind-tunnel test of the airflow over a model of NASA's heavy launch vehicle, called Ares V.

Pg 16 in textbook

$$Scale = \frac{picture}{actual}$$

picture : actual

10,5cm

**a)** Assume the photo and model show a reduction of approximately 1:1000. What is the actual length of Ares V?
**b)** What is the diameter of one of the actual solid-rocket boosters?

a) Actual length is 10500 cm. or 105m.

$Scale = \frac{1}{1000} = \frac{10.5}{x}$   $\frac{10.5cm}{10500cm} = \frac{10.5cm}{?}$

×10.5

· Equivalent fraction    actual

Jul 2-10:00 AM

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**12.** Use the map of part of the Northwest Territories to help answer the following questions.

Page 18 in textbook

**a)** Express the scale of the map as a ratio in lowest terms.
**b)** Estimate the distance from Fort Simpson to Moose Ponds. Measure and compare the distance with your estimate.

50km = ? cm

picture $\frac{0.8cm}{0.8cm} = \frac{50km}{5000000}$ cm    actual

$0.8 = \frac{4}{5}$

$\left(\frac{4}{5}\right)\left(\frac{5}{4}\right) = 1$

$0.8 : 5000000$

$× \frac{5}{4}$      $× \frac{5}{4}$

$\frac{0.8 × \frac{5}{4}}{5000000 × \frac{5}{4}}$

$1 : 625\,000$

Sep 16-2:59 PM

Jul 2-9:59 AM

Homework: Pg 16# 4b, 6, 9, 13, 17

More Practice: Pg 16 #10, 14c

If you are stuck on #17 refer to Example 3 in textbook

Jul 7-11:07 AM

## 1.2 Imperial Measurement

The United States and most of the rest of the world uses the imperial system for linear measurement.

Canada began to switch from imperial to SI in 1970 but imperial is still widely used here too -- particularly in hardware stores. *Because no one calls a 2x4 a 5.08x10.16*

Imperial Measurements use inches, feet, and yards.

inch (in. or ″)
foot (ft or ′)        1 ft = 12 in.
yard (yd)             1 yd = 3 ft or 36 in.
mile (mi)             1 mi = 1760 yd or 5280 ft

Jul 7-11:06 AM

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Let's practice

inch (in. or ″)
foot (ft or ′)        1 ft = 12 in.
yard (yd)             1 yd = 3 ft or 36 in.
mile (mi)             1 mi = 1760 yd or 5280 ft

$$82 \text{ inches} \rightarrow \underline{\quad} \text{ yards}$$

$$82 \text{ in} \left( \frac{1 \text{ yd}}{36 \text{ in}} \right) = 2.28 \text{ yd.}$$

$$0.28 \text{ yd} \rightarrow \underline{\quad} \text{ inches}$$

$$2 \text{ yd}$$

$$0.28 \text{ yd} \left( \frac{36 \text{ in}}{1 \text{ yd}} \right) = 10.08 \text{ in}$$

$$2 \text{ yd}, 10.1 \text{ in}$$

Jul 15-8:48 PM

Take out your textbook, page 25

**Your Turn**

The photograph of a muskox uses a scale of 1:30. Calculate the height of the muskox and the distance between the tips of its horns. State each answer in feet and inches.

Jul 15-8:53 PM

Applying Linear Measurement

You are going to buy a 32" television. The size of a television is measured across the screen diagonally. You are deciding between a standard television set with a ratio of width to height of 4:3 and a widescreen HDTV with a ratio of width to height of 16:9. You want the television with the greatest viewing area. Which TV should you choose?

First - **Draw a diagram!** and record/measure the dimensions of the width and height (and diagonal).

We will be using this information to calculate the width and height of the actual television.

Jul 15-8:55 PM

## 1.2 Imperial Measurement
### Solving Problems

Alashun wants to make a drum, or qilaut, that resembles the one used by a drum dancer in Iqaluit, NU. He has a circular frame, over which to stretch caribou skin. Then, he will lash it into place along the frame with sinew. Alashun uses $3\frac{1}{2}$ in. of sinew for each inch of the frame.

**a)** Estimate the diameter of the drum frame in imperial units. The scale of the photo is 1:15.

**b)** Approximately what length of sinew does Alashun need to make the drum? State your answer in yards and inches.

a) measured: 1.25in

b) Circumference. $\left(= \pi d = \pi(18.75)\right)$

$\left(= 58.905 in\right)$

Jul 16-7:30 PM

<span style="color:blue">Quiz Tuesday Sept 29 on sections 1.1-1.2</span>

Homework:
Problem Solving pg 32  #9, 11, 14, 18

Jul 16-7:26 PM

1.3 Converting Between SI and Imperial Systems

To convert from one measurement system to another, you need to understand the **relationships** between the units of length in each system. Similar to how we would convert within a system, we do this using unit analysis and/or proportional reasoning.

Unlike conversions within systems of measurements, relationships between these units of length can be **exact** or **approximate**.

Warm Up:

The imperial yard **is defined as** 0.9144 m. (this is exact)

Use this information to find out how many metres are in a foot.

Jul 17-10:57 AM

When converting from metres to yards, 1 m **is often given as** 1.094 yards. Is this conversion exact or approximate? Explain.

Sep 29-9:04 PM

The following are some common conversions.

**Exact Conversions**

1 in. = 2.54 cm      1 ft = 30.48 cm      1 yd = 0.9144 m

**Approximate Conversions**

1 mm ≈ 0.0394 in.      1 cm ≈ 0.3937 in.      1 m ≈ 1.094 yd

1 m ≈ 3.281 ft      1 km ≈ 0.6214 mi      1 mi ≈ 1.609 km

Jul 17-1:03 PM

## Convert between SI and Imperial Units for Length

Swimmer Brian Johns of Richmond, BC, represented Canada at the 2008 Olympics in Beijing. He finished 7th in a race that one news report referred to as 400 m long and another news report referred to as $\frac{1}{4}$ mi. Are the two measurements equivalent? If not, which distance do you think is more accurate? Justify your reasoning.
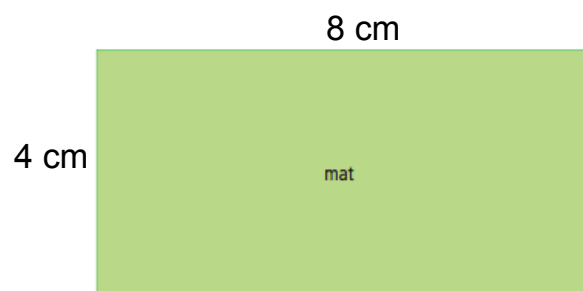
Jul 20-2:19 PM

Homework: Pg 42 #1 - 5

Sep 29-8:59 PM

Your class needs to lay mats on the gymnasium floor for a gymnastics meet. The gym measures 84' by 50'. A scale drawing of one mat is shown. The scale is 1:30.5.

How many mats are needed?

8 cm

4 cm

mat

Jul 20-2:34 PM

Your turn!

How many paving stones measuring $7\frac{1}{2}$ in. by $7\frac{1}{2}$ in. are needed to cover an area that is 1 yd by 1 yd?

Homework Pg 42 #6, 7, 8, 10, 11, 12

(home)work Pg 45 #13, 14, 15, 17, 18

Jul 20-2:53 PM

# Review!

**9. a)** Discuss with a classmate your preferred method of converting the following units.
  • metres to kilometres
  • metres to centimetres
  • yards to miles

**b)** Develop a strategy for converting from a smaller unit of length to a larger unit. Does your strategy apply in both SI and imperial systems of measurement? Explain.

**c)** How might your strategy change when you are converting from a larger unit of length to a smaller one?
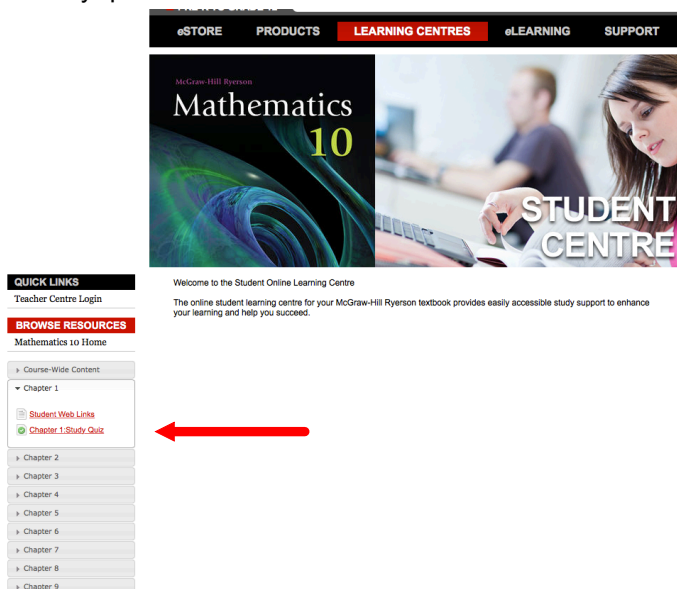
Jul 20-2:53 PM

Online review Quiz

1. Go to my classroom website:

misshuntsclassroom.wix.com/webpage

2. Click on MATHEMATICS 10 Student Resources under "Helpful Websites" on the math 10 page.

3. Click on "Chapter 1" on the side menu and select "Chapter one study quiz"
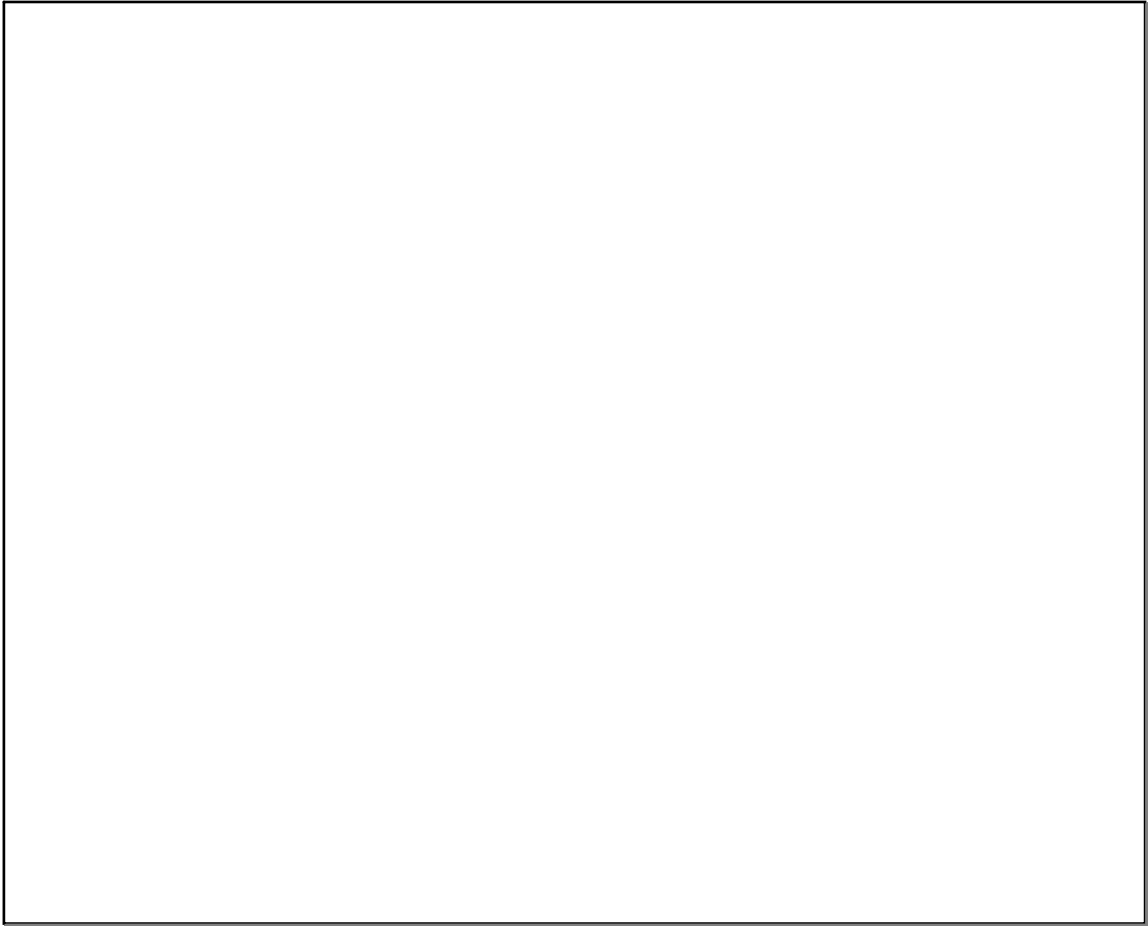


Jul 21-10:17 AM

Additional Review available in your textbook:

Pg 48-50 Chapter 1 Review

Pg 51-53 Chapter 1 Practice Test

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Sep 13-9:54 PM