4.1 - Systems of Measurement

Make Connections

In 1976, Canada adopted SI units to measure length. However, construction and manufacturing industries continue to use **imperial units**. Many Canadians use imperial units to measure their height.

What is your height?

Look around the classroom.
Which object has a length of about one foot?
Which object has a length of about one inch?
Which object has a length of about one yard?

Referent the thing that a word or phrase stands for.

Imperial units - English system (inch, feet, pounds, etc.)

SI units - system International. The metric system is a decimal system. (meter, kilograms, etc.)

Activate Prior Learning: SI Units

Common SI units of length are the metre, centimetre, and millimetre.

What are referents for these SI units?

Unit	Referent
millimetre	edge of a dime / thickness of a dime
centimetre	width of little finger
metre	width of classroom door

1.2 Math Lab: Measuring Length and Distance

Systeme international d'unites (SI)

This is a measurement system commonly used in Canada. It is a decimal system based on multiples of 10. This means you can convert to other SI units simply by multiplying or dividing by a multiple of 10!

What are multiples of 10?

TABLE 1.5 Selected Prefixes Used in the Metric System

Prefix	Abbreviation	Meaning	Example
Giga	G	10^9	1 gigameter (Gm) $= 1 \times 10^9$ m
Mega	M	10^6	1 megameter (Mm) $= 1 \times 10^6$ m
Kilo	k	10^3	1 kilometer (km) $= 1 \times 10^3$ m
Deci	d	10^{-1}	1 decimeter (dm) $= 0.1$ m
Centi	c	10^{-2}	1 centimeter (cm) $= 0.01$ m
Milli	m	10^{-3}	1 millimeter (mm) $= 0.001$ m
Micro	μ[a]	10^{-6}	1 micrometer (μm) $= 1 \times 10^{-6}$ m
Nano	n	10^{-9}	1 nanometer (nm) $= 1 \times 10^{-9}$ m
Pico	p	10^{-12}	1 picometer (pm) $= 1 \times 10^{-12}$ m
Femto	f	10^{-15}	1 femtometer (fm) $= 1 \times 10^{-15}$ m

[a]This is the Greek letter mu (pronounced "mew").

The imperial unit for measuring long distances is the mile. The length of one mile was first established as the distance a Roman soldier could walk in 1000 paces. One pace is 2 steps.

Imperial Unit	Abbreviation	Referent	Relationship between Units
Inch	in.	thickness of door ?	?
Foot	ft.	foot	
Yard	yd.	width of door	
Mile	mi.	marked distance 1.6km = 1 mile	

2.54cm = 1 inch

Base Unit: a unit of measurement on which other units are based.
ex: length - meter (m); volume - litre (L); mass - gram (g)

kilo hecto deca m deci centi milli

Volume: the amount of space a solid occupies.

1.1 Imperial Measures of Length

Measurements using Imperial Units

What units would you use if you were to tell me your height and weight?

Imperial units are still used in many industries in Canada even though we have adopted SI units, also known as the metric system. The **imperial system** is ***not*** a decimal system as the measurements were all developed at different times to meet certain needs. Therefore, you must use a **conversion factor** to convert one imperial unit to another.

FIGURE 4.1
Some Common Imperial Units

Length	
Unit	*Abbreviation*
inch	in or "
foot	ft or '
yard	yd
mile	mi

5"
5'

66" = 5'6"

$\frac{66}{12} = 5.\_$

Convert
12" = 1'

Terms

SI - System International
(Metric System)

Imperial - English System
(inch, feet, ounces, etc.)

Conversion Factor - constant used to convert from one unit to another
(12" = 1')

DISCUSSION...

Which imperial unit is the most appropriate unit to measure each item? Justify your choice.

a) the height of your desk
b) the thickness of a mattress
c) the width of a car
d) the length of a flat panel TV
e) the distance from the school to your home

To measure the length of an object, first determine the smallest indicated unit by counting the number of divisions between two adjacent inch marks. The ruler below has ? divisions between two adjacent inch marks

The pencil point is closest to ? $3\frac{7}{16}$" ?

A fraction of an imperial measure of length is usually written in fraction form, not decimal form.

Imperial Conversions

We will be working with units for length. The smallest unit we will use is the inch, followed by a foot, followed by a yard, and finally a mile. Read the top of page 143 and then copy and complete the table below.

IMPERIAL CONVERSION TABLE
1 foot = 12 inches
1 yard = 3 feet (×12) = 36 inches
1 mile = 1760 yards (×3) = 5280 feet

Example 1 Converting between Imperial Units

a) Convert 5 yd. to:

i) feet 5 yd. = 15 ft.

ii) inches ~~51 in. = 4 ft. 3 in.~~ 180 in

b) Convert 51 in. to:

i) feet and inches

51 in. = 4 ft. 3 in.

4' 3"

ii) yards, feet, and inches

51 in. = 1 yd. 1 ft. 3 in.

a) i) 5 x 3 = 15

ii) 15 x 12 = 180

b) 51" / 12 = 4 R 3

51 - 48 = 3

ii) 1 yd 1 ft 3 in

SOLUTION (Erase to reveal)

CHECK YOUR UNDERSTANDING

1.1 Imperial Measures of Length

TRY THIS ONE...

Pierre-Marc converted 21 ft. 9 in. into yards, feet, and inches. His answer was 7 yd. 1 ft. 6 in. X
Is his answer correct? If your answer is no, show the correct conversion.

21' 9" → ? yds

$\frac{21'}{3} = 7$

7yd 9in

1.1 Imperial Measures of Length

Example 2 Solving a Problem Involving Converting between Units

Anne is framing a picture.* Perimeter - distance around the figure
The perimeter of the framed picture will be 136 in.

a) What will be the perimeter of the framed picture in feet and inches?

b) The framing material is sold by the foot. It costs $1.89/ft. What will be the cost of material before taxes?

SOLUTION

(Erase to reveal)

136 in → ? ft in

$\frac{136}{12} = 11.\_$

12 x 11 = 132 11ft 4in

136 - 132 = 4

CHECK YOUR UNDERSTANDING

1.1 Imperial Measures of Length

Buy 12'

1.89 x 12 = $22.68

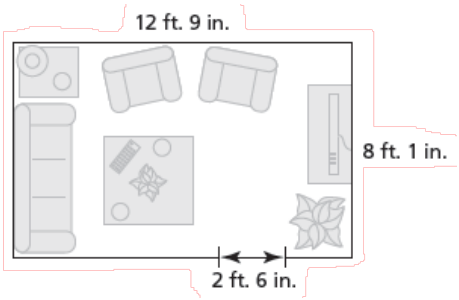
TRY THIS ONE...

14. A wallpaper border is to be pasted halfway up the wall around a child's bedroom.

a) What is the total length of border needed?

b) The border is purchased in 12-ft. rolls. How many rolls are required?

c) Each roll of border costs $12.49. How much will the border cost, before taxes?



a) 12' 9" + 12' 9" + 8' 1" + 8' 1" = 40' 20"

40' 20" − 2 6" = 38' 14" → 39' 2"

b) 39' 2" / 12 = 3.… → 4 rolls

c) $12.49/roll × 4 rolls = $49.96

1.1 Imperial Measures of Length

Example 3 Solving a Problem Involving Two Unit Conversions

The school council has 6 yd. of fabric that will be cut into strips 5 in. wide to make decorative banners for the school dance.

a) How many banners can be made?

SOLUTION

(Erase to reveal)

6 × 3 = 18'

18' × 12" / 1' = 216

216 / 5 = 43.2

43 Banners

CHECK YOUR UNDERSTANDING

1.1 Imperial Measures of Length

Example 4 Solving a Problem Involving Scale Diagrams

A map of Alaska has a scale of 1:4 750 000. The distance on the map between Paxson and the Canadian border is $3\frac{11}{16}$ in. What is this distance to the nearest mile?

SOLUTION

The distance between Paxson and the Canadian border is approximately 276 mi.

(Erase to reveal)

$3\frac{11}{16}'' \times 4\,750\,000 = \frac{59}{16} \times 4\,750\,000$

$= 17\,515\,625''$

$17\,515\,625 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ yd}}{3 \text{ ft}} \times \frac{\quad \text{mi}}{1760 \text{ yd}}$

$= 276.4 \text{ mi}$

$\frac{5}{5} = 1$

$\frac{6}{6} = 1$

CHECK YOUR UNDERSTANDING

1.1 Imperial Measures of Length

TRY THIS ONE...

A 3-D puzzle of the Eiffel Tower has a scale of 1:360. In the puzzle, the tower is $35\frac{2}{5}$ in. tall. What is the height of the Eiffel Tower in feet?

$35\frac{2}{5}'' \times 360 = \frac{177}{5} \times 360$

$= 12\,744 \text{ in}$

$12\,744 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} = 1062 \text{ ft}$

1.1 Imperial Measures of Length

1 What is the length of the paper clip?

A 1 in.

B $1\frac{1}{8}$ in. ✓

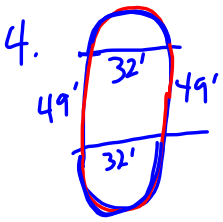
C $1\frac{1}{2}$ in.

HOMEWORK...

- Page 150 Worksheet - Intro. to Imperial Measurement.docx

Do questions: #1-5; 8

4.



$2\pi r$ $\pi d = \pi(32)$ 100.5
$= 32\pi$

total distance $= 32\pi + 49 + 49$
$= 98 + 32\pi$
≈ 198.5 ft

$\frac{198.5 \text{ ft}}{8} = 24.8$ bars
Buy 25 sheets of plywood

b) Cost $= \$14.15/\text{sheet} \times 25$ sheets
$= \$353.75$

Attachments

Worksheet - Intro. to Imperial Measurement.docx