

**EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING**
Revised for
ACCESS TO APPRENTICESHIP

**MATHEMATICS SKILLS
IMPERIAL MEASUREMENT**

**AN ACADEMIC SKILLS MANUAL
for
The Hairstylist Trade**

*Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities*

Revised 2011

In preparing these Academic Skills Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

MATHEMATICS SKILLS

IMPERIAL MEASUREMENT

*An academic skill required for the study of the
Hairstylist Trades*

INTRODUCTION

The earliest systems of measurement of length were based on parts of the human body. An inch was about the size of a thumb while a foot about was the size of a man's foot. With the advance of trade, measurements became more or less standardized among nations that traded with each other. These common sizes gradually developed into *the imperial or customary system of measurement*. In the imperial system, there is no simple relationship between different units of the same type of measurements such as inches and feet.

Canada now officially uses the metric system, but for several reasons, you need to be familiar with both systems. Many clients will ask you to cut off 2 inches from their hair instead of saying 5 centimeters. Most industries have not fully changed over to metric measurements. Products move freely between Canada and the United States which has not yet switched to metric. As a result, supplies come in a mixture of imperial and metric measurements. Also, textbooks and manuals from the U.S. are written using imperial units.

This skills manual covers the following aspects of the imperial system of measurement:

- ◆ The basic units of length, weight, volume and temperature
- ◆ Imperial conversion, including
 - a chart of imperial equivalents
 - rules for converting
 - examples of converting from one imperial unit to another

BASIC UNITS OF MEASUREMENT

The basic units of measurement include those for *length, area, weight, volume or capacity, and temperature*.

Length: Units of length are called linear units. The imperial system has a variety of linear units. The most common are the *inch, foot, yard* and *mile*. A common symbol used to represent inches is " , while feet are represented by the symbol '. You work with linear measurements whenever you use a ruler or when you choose between a 3 inch or a 4 inch curler.

Imperial rulers or measuring tapes are divided into inches.

- The inches are subdivided into $\frac{1}{2}$, or half inches, $\frac{1}{4}$, or quarter inches, $\frac{1}{8}$, or one-eighth inches, $\frac{1}{16}$, or one-sixteenth inches and sometimes as small as $\frac{1}{32}$ or one thirty-second inches.
- Most of these subdivisions are shown in Figure 1.

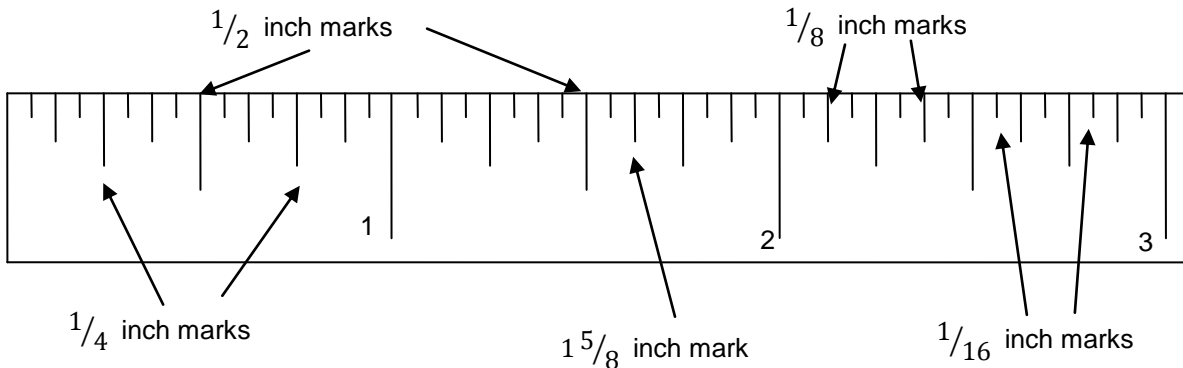


Figure 1: Imperial Ruler

To measure a length such as $1 \frac{5}{8}$ inch, find the 1 inch division.

- Starting at the first $\frac{1}{8}$ division mark past the 1 inch mark, count 5 of the $\frac{1}{8}$ division marks.
- This brings you to $1 \frac{5}{8}$ inches.

Notice that the second $\frac{1}{8}$ division mark is the same as the first $\frac{1}{4}$ mark and the fourth $\frac{1}{8}$ division mark is the same as the $\frac{1}{2}$ mark.

A longer tape measure will also show divisions for feet. To measure 7 feet $5 \frac{3}{4}$ inches, find the 7 foot division mark.

- Next, find the 5 inch division mark past the 7 feet.
- Then count 3 of the $\frac{1}{4}$ marks (including the larger $\frac{1}{2}$ mark but not the smaller $\frac{1}{8}$ and $\frac{1}{16}$ division marks).
- This will bring you to the 7 ft $5 \frac{3}{4}$ in division mark.

Area: Area is the amount of surface space enclosed by a linear boundary.

- The area of a salon floor can be found by multiplying the length by the width.
- If the length and width are measured in feet, the unit, feet, is **squared**; the unit of area is **squared feet** (sq ft or ft²).

Weight: The imperial units of weight include the **ounce**, **pound** and **ton**. They are measured using a weigh scale.

Capacity and Volume:

Units of capacity are used to measure the amount an object can hold. The units vary depending on whether you are measuring a liquid or a dry material.

Liquid capacity units include the *fluid ounce*, *teaspoon*, *cup*, *pint*, *quart* and **gallon**.

- They are measured using various containers such as a graduated liquid measuring cup.

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- Many of the products you use, such as conditioner and hair colouring, come in bottles that are measured in fluid ounces in the imperial system.

Units of volume are used to measure the size of a three dimensional space occupied by or enclosed by an object.

- The volume of a regularly shaped object is measured by the cubic space it occupies.
 - The amount of space or the volume occupied by a room is found by multiplying *the length times the width times the height*.
 - If the unit used to measure the distances is feet, then the unit of volume is cubic feet (cu ft or ft³).

Temperature: The unit used to measure temperature in the imperial system is the Fahrenheit degree (°F).

- Water freezes at 32°F and boils at 212°F.
- You need to be aware of temperature differences when using a hair dryer or a curling iron. Too hot a temperature can burn hair while too low a temperature can be ineffective.

IMPERIAL CONVERSION

To do calculations such as finding area, it is easier to multiply measurements if they are all in the same units. You can convert one of the units, say feet, so it is the same as the other unit, inches.

To change a measurement from feet to inches, convert the amount in feet to an equivalent amount in inches. A length of 1 foot is the same distance as a length of 12 inches. One foot and 12 inches are exactly the same length. They are **equivalent** amounts that have different units.

A **conversion factor** is used to convert one unit to the other. Each conversion factor relates equivalent amounts in different units.

Some imperial conversion factors are listed in the Chart of Imperial Equivalents. In this chart, the larger unit usually has the number 1 in front of it. The number in front of the other unit is the conversion factor used to convert the units.

Chart of Imperial Equivalents		
12 inches (in)	=	1 foot (ft)
3 ft	=	1 yard (yd)
1760 yd	=	1 mile (mi)
16 ounces (oz)	=	1 pound (lb)
2000 lb	=	1 ton
3 teaspoons (tsp)	=	1 tablespoon (tbsp)
16 tbsp = 1 cup (c)	=	8 fluid oz (fl oz)
2 c	=	1 pint (pt)
2 pt	=	1 quart (qt)
4 qt	=	1 gallon (gal)

Before you can convert from one unit to another, you need to memorize the conversion factor or have a chart you can refer to. In the chart above, the conversion factor is the number in front of the unit that doesn't have 1 in front of it.

Example: The chart shows that 3 feet is equal to 1 yard. The conversion factor for feet and yards is 3.

Equivalents of length

The imperial units of length are inches (in), feet (ft), yards (yd) and miles (mi). Here are common equivalents for length from the chart. The conversion factors are the numbers in front of the units that don't have a one in front of them:

- 12 inches = 1 foot
- 3 feet = 1 yard
- 1760 yards = 1 mile

Equivalents of weight

Here are the common equivalents for weight from the chart:

- 16 oz = 1 lb
- 2000 lb = 1 ton

Equivalents of capacity

Some equivalents of capacity are:

- 3 teaspoons (tsp) = 1 tablespoon (tbsp)
- 16 tbsp = 1 cup
- 1 cup = 8 fluid ounces (fl oz)
- 2 cups = 1 pint
- 2 pints = 1 quart
- 4 quarts = 1 U.S. gallon

Note: The difference between fluid ounces, a unit of volume, and ounces, a unit of weight, can cause confusion. Ounces marked on a measuring cup are fluid ounces, which measure capacity. Ounces on a scale are a unit of weight. In most cases, fluid ounces are not interchangeable with ounces of weight.

Rules for Converting

To convert from one unit to another in the imperial system:

1. Divide or multiply the amount in the original unit by the **conversion factor**.
 - This changes the original amount to an equivalent amount in the other unit.
 - Whether you multiply or divide depends on whether the conversion is from a larger unit such as pounds to a smaller unit such as ounces, or from a smaller unit such as inches to a larger one such as feet.

There are two general rules to follow when using an imperial conversion chart:

- ◆ To convert from a **smaller** unit to a **larger** one, **divide** by the conversion factor.
- ◆ To convert from a **larger** unit to a **smaller** one, **multiply** by the conversion factor.

Examples of Converting

Now we will look at some examples of converting from one imperial measurement to another using these basic rules.

Example: Convert 48 inches to feet.

$$\begin{aligned} 48 \text{ in} \div 12 \\ = 4 \text{ ft} \end{aligned}$$

From the chart, the conversion factor is 12.
a smaller unit to a larger one, **divide** the quantity by the conversion factor

Example: Convert 3 feet to inches.

$$\begin{aligned} 3 \text{ ft} \times 12 \\ = 36 \text{ inches} \end{aligned}$$

a larger unit to a smaller one, **multiply** by the conversion factor.

Example: Change 3.5 gallons to quarts.

$$\begin{aligned} 3.5 \text{ gallons} \times 4 \\ = 14 \text{ quarts} \end{aligned}$$

a larger unit to a smaller one, **multiply** by the conversion factor

Example: Convert 75 inches to feet.

To convert inches to feet, a smaller unit to a larger one, **divide** the amount in inches by the conversion factor 12.

$$75 \div 12 = 6 \text{ remainder } 3$$

To express the remainder as a fraction, put it as the numerator of a fraction with 12 as the denominator.

$$6 \text{ remainder } 3 = 6 \frac{3}{12} \text{ feet}$$

Reduce to lowest terms.

$$6 \frac{3}{12} = 6 \frac{1}{4} \text{ feet}$$

If you are dividing with a calculator, it will give the answer 6.25 feet.

An amount expressed in mixed units has part of the answer in a larger unit and part in a smaller unit. To express your answer using mixed units, follow these steps:

1. The whole number part of the division answer is the amount of the larger unit.
2. The remainder is the amount of the smaller unit.

Example: 75 inches becomes 6 feet 3 inches.

Example: Convert 65 inches to feet.

To convert inches to feet, a smaller unit to a larger one, **divide** the amount in inches by the conversion factor 12.

$$\begin{aligned} 65 \div 12 &= 5 \text{ ft remainder } 5 \\ &= 5 \text{ ft } 5 \text{ in} \end{aligned}$$

If you divide using a calculator, the answer is:

$$65 \text{ in} \div 12 = 5.41666... \text{ ft} \quad \text{This repeating decimal can be } \textit{rounded off}.$$

Rounding off: Often a decimal answer is rounded off to two places, although you might choose to round off to the nearest whole number or to one decimal place. To round off to two decimal places:

1. Look at the digit in the third decimal place.
2. You have two choices:
 - a. If the third digit is 5 or more, drop it and round up the digit in the second decimal place to make it one digit higher.
 - b. If the third digit is less than 5, drop it and leave the second digit as it is.
3. Write the answer; *drop all other digits to the right.*

Example: Round .333... off to two decimal places.

1. The digit in the third decimal place (three places to the right of the decimal point) is 3.
 - a. It is less than five, drop it and leave the second digit as it is.

.333... rounded to two places is .33

To round off to any other number of places, look at the digit **one past where you are rounding off to**. Then proceed in the same way.

Example: Round off .666... to one place.

1. The digit past the first decimal place is 6.
 - a. 6 is greater than 5, so the digit in the first decimal place becomes one digit higher, 7.
2. Drop the other digits.

.666... rounded to one place is .7

Example: Round off .6995 to three places.

1. The fourth digit past the decimal point is 5,
2. The third digit, 9, becomes one larger, which makes it 10.
3. The zero is written in the place where the 9 was.
 - The 1 is added to the 9 in the next place to the left which also makes it 10.
 - The zero is written in place of the 9 and the 1 is added to the 6, which changes it to 7.

.6995 rounded off to three places becomes .700

Example: Convert 65 inches to feet.

For this question, if you divide using a calculator, the answer is:

$$65 \text{ in} \div 12 = 5.41666... \text{ ft} \quad \text{round off.}$$

$$5.4166... \text{ rounded off to two places is } 5.42 \text{ ft}$$

To convert ounces to pounds, a smaller unit to a larger one, **divide** by the conversion factor 16.

- If your answer includes a remainder, the remainder can be expressed as a decimal number, a fraction or an amount with mixed units.
- If you use a calculator, any remainder will be shown as a decimal number.

Example: Convert 40 ounces to pounds.

$$40 \text{ oz} \div 16 = 2.5 \text{ lb}$$

If you divide 40 by 16 by hand, you will get an answer of 2 with a remainder of 8.

- You can continue dividing to get the answer 2.5 lb.
- You can also express the remainder as a fraction by placing it over the divisor 16, getting the answer $2 \frac{8}{16}$, reduced to $2 \frac{1}{2}$ lb.

An amount expressed in mixed units has part of the answer in a larger unit and part in a smaller unit.

To express your answer using mixed units, follow these steps:

1. The whole number part of the division answer is the amount of the larger unit.
2. The remainder is the amount of the smaller unit.

Example: Convert 40 ounces to pounds.

$$40 \text{ oz} \div 16 = 2 \text{ remainder } 8 \quad \text{the whole number is the amount of the larger unit.}$$
$$= 2 \text{ lb } 8 \text{ oz.} \quad \text{the remainder is the amount of the smaller unit}$$

Example: Convert 88 inches to a mixed unit with feet and inches.

$$88 \div 12 = 7 \text{ R}4 \quad \text{the whole number is the amount of the larger unit.}$$
$$= 7 \text{ ft } 4 \text{ in.} \quad \text{the remainder is the amount of the smaller unit}$$

88 inches is 7 feet 4 inches.

You can convert between units that aren't next to each other on the chart.

- ◆ If you don't know all the conversion factors, work up or down from one unit to the next until you reach the unit you need.
 - To convert inches to yards, first convert inches to feet, then feet to yards.

Example: Convert 108 inches to yards.

$$108 \text{ inches} \div 12 = 9 \text{ feet} \quad \text{convert 108 inches to feet, then feet to yards.}$$

$$9 \text{ feet} \div 3 = 3 \text{ yards}$$

If you know the conversion factor 36 inches = 1 yard, you can convert directly.

Divide 108 inches by 36 to get 3 yards.

In Brief: the steps in converting from one imperial unit to another:

- Equivalent amounts are shown on a conversion chart.
 - Usually the larger unit has the number 1 in front of it.
 - The number in front of the other unit is the conversion factor.
- To convert from a smaller unit to a larger one, divide by the conversion factor.
- To convert from a larger unit to a smaller one, multiply by the conversion factor.
- If the conversion answer isn't a whole number, the remainder can be expressed as a decimal, a fraction or a mixed unit.

Answer the following questions on converting from one imperial unit to another. The answers are at the end of this manual. Check your answers as you proceed.

1. Fill in the blanks in the table below:

IMPERIAL EQUIVALENTS
_____ inches (in) = 1 foot (ft)
3 _____ = 1 yard (yd)
1760 yd = _____ mile (mi)
_____ ounces (oz) = 1 pound (lb)
_____ fluid ounces (fl oz) = 1 cup (c)
2 pt = 1 _____
_____ qt = 1 gallon (gal)

2. Convert as indicated.

- | | | |
|-----------------|------------------|-----------------|
| a) 132 in to ft | b) 4 lb to oz | c) 32 oz to lb |
| d) 12 ft to yd | e) 12 c to qt | f) 44 qt to gal |
| g) 7 ft to in | h) 3520 yd to mi | i) 10 yd to in |
| j) 144 in to yd | k) 15 yd to ft | l) 78 in to ft |

3. Convert the following into feet and inches.

- | | | | |
|----------|----------|-----------|----------|
| a) 82 in | b) 25 in | c) 112 in | d) 66 in |
|----------|----------|-----------|----------|

ANSWER PAGE

1.

IMPERIAL EQUIVALENTS
12 inches (in) = 1 foot (ft)
3 ft = 1 yard (yd)
1760 yd = 1 mile (mi)
16 ounces (oz) = 1 pound (lb)
8 fluid oz (fl oz) = 1 cup (c)
2 pt = 1 quart (qt)
4 qt = 1 gallon (gal)

2. a) 11 ft
b) 64 oz
c) 2 lb
d) 4 yd
e) 3 qt
f) 11 gal
g) 84 in
h) 2 mi
i) 360 in
j) 4 yd
k) 45 ft
l) 6.5 ft

3. a) 6 ft 10 in
b) 2 ft 1 in
c) 9 ft 4 in
d) 5 ft 6 in