

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

**MATHEMATICS SKILLS
IMPERIAL SYSTEM OF MEASUREMENT**

**AN ACADEMIC SKILLS MANUAL
for**

The Food Preparation Trades

This trade group includes the following trades:

Baker & Cook and Retail Meat Cutter

*Workplace Support Services Branch
Ontario Ministry of Education and Training*

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
Food Preparation 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 was about the size of a man's foot. With the advance of trade, measurements became more or less standardized throughout nations that traded with each other. These common sizes gradually developed into *the imperial or customary system of measurement*.

Although the metric system is the official system of measurement in Canada, many cookbooks, especially American ones, still list ingredients and cooking temperatures in imperial measurements. In your trades, you need to be most familiar with the units of weight, volume and temperature in both systems. You will also need to recognize and use units of length and area.

Ingredients are usually measured in units of volume or weight. You will need to understand the relationships between the different units used to measure weight or volume in the imperial system.

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

- ◆ The basic units of length, area, weight, volume and temperature
- ◆ Imperial Measurement Conversion
- ◆ Operations With Mixed Units

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 a micrometer to find the distance between two parts or the length of an object such as a bolt.

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.

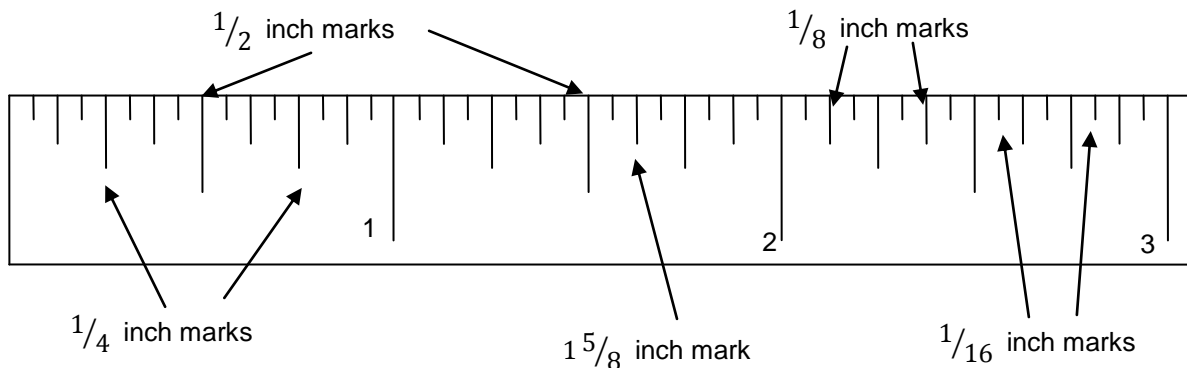


Figure 1: Imperial Ruler

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 kitchen 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.

Dry measurements of capacity include all of these units except the fluid ounce.

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 volume of a box is found by multiplying *the length times the width times the height*.
- If the unit of measure 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.

IMPERIAL MEASUREMENT CONVERSION

At times you will have to work with measurements that are in different units, such as a weight of 2 pounds 6 ounces. To make calculations with a measurement like this the measurements must be in the same units – either all pounds or all ounces.

To change a measurement from pounds to ounces to inches, you convert the amount in pounds to an equivalent amount in ounces. A weight of 1 pound is the same as a weight of 16 ounces. One pound and 16 ounces are exactly the same weight. 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 = 8 fluid ounces (fl oz)
- 2 cups = 1 pint = 16 fl oz
- 2 pints = 1 quart = 32 fl oz
- 4 quarts = 1 U.S. gallon = 128 fl oz

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.

The basic unit of capacity for liquids is the fluid ounce. This unit is based on the fact that 16 fluid ounces of water weigh 16 ounces. The basic unit in the kitchen for dry quantities is the cup. The units of volume in the imperial system vary slightly from the U.S. scale of volume. We use the U.S. scale for all smaller measurements like cups and pints. Since hardly anyone uses the imperial scale for volume anymore, we will only look at the American scale of volume.

Many recipes use volume measurements when listing the amounts of the different ingredients that are required. Volume measurement is actually not as accurate as measuring by weight for dry ingredients. The amount of weight of an ingredient does not vary but its volume can.

- A pound of flour takes up more space (has a greater volume) after it has been sifted but it still weighs one pound.
- The same volume of similar ingredients can have different weights. A cup of bread flour is heavier than a cup of pastry flour.
- 8 oz of corn starch is not the same as one cup (8 fluid ounces) of starch. 8 oz of a dry ingredient like corn starch is not equal to 8 fl oz. The 8 oz of corn starch is a measure of weight, not capacity. A cup of corn starch weighs only 5 1/2 oz.
- If a recipe calls for 8 oz of a fluid ingredient like oil or molasses, you should assume that the recipe refers to fluid ounces. Although 8 fl oz of water weighs 8 oz, this relationship is not true for other liquids.
 - Oil is lighter than water, while molasses is heavier.
- You cannot weigh liquid ingredients. You have to use a cup which measures fluid ounces.

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.*

Units of weight

Pound and ounces are the units you will use most often in the kitchen.

Example: Convert 40 ounces to pounds.

To convert ounces to pounds (a **smaller** unit to a **bigger** one), **divide** the quantity by the conversion factor 16.

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

Example: Convert 2 pounds to ounces.

To convert pounds to ounces (a **larger** unit to a **smaller** one), **multiply** the quantity by the conversion factor 16.

$$2 \text{ lb} \times 16 = 32 \text{ oz}$$

Units of capacity or volume

Example: Change 4 cups to pints.

To change cups to pints (a smaller unit to a larger unit), divide the quantity by the conversion factor 2.

$$4 \text{ cups} \div 2 = 2 \text{ pints}$$

Example: Change 3.5 gallons to quarts.

To change gallons to quarts (a larger unit to a smaller one), multiply the quantity by the conversion factor 4.

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

Units of length

Example: Convert 48 inches to feet.

To change 48 inches to feet (a smaller unit to a larger one), divide the quantity by the conversion factor 12.

$$48 \text{ in.} \div 12 = 4 \text{ ft.}$$

Example: Convert 8 yards to feet.

To convert yards to feet (a larger unit to a smaller one), multiply the quantity by the conversion factor 3.

$$8 \text{ yd.} \times 3 = 24 \text{ ft.}$$

To convert between units that aren't next to each other on the chart if you don't know all the conversion factors, work from one unit to the next until you reach the unit you need. To convert tablespoons to pints, you can first convert tablespoons to cups, then cups to pints.

Example: Convert 8 cups to quarts.

Using the equivalency chart for volume, convert cups to pints, then pints to quarts.

$$\begin{aligned} 8 \text{ cups} \div 2 &= 4 \text{ pints} \\ 4 \text{ pints} \div 2 &= 2 \text{ quarts} \end{aligned}$$

Or:

Using the conversion factor 4 cups = 1 quart, you can convert directly. Divide 8 cups by 4 to get 2 quarts.

To summarize the steps in converting from one imperial unit to another:

- ◆ if you are going from a smaller unit to a larger one, divide by the conversion factor
- ◆ if you are going from a larger unit to a smaller one, multiply by the conversion factor
- ◆ the conversion factor that relates two units on an equivalency chart is the number in front of the smaller unit

Mixed Units

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 40 ounces to pounds.

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

Example: Convert 46 fluid ounces to a mixed unit with cups and fluid ounces.

$$\begin{aligned} 46 \div 8 &= 5 \text{ R } 6 && \text{the whole number is the amount of the larger unit.} \\ &= 5 \text{ c } 6 \text{ fl. oz.} && \text{the remainder is the amount of the smaller unit} \end{aligned}$$

46 fl oz is 5 cups 6 fluid ounces.

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.

OPERATIONS WITH MIXED UNITS

You will be asked to solve questions involving measurements that are in mixed units.

Example: You have to find the total weight of two packages of beef, one weighing 3 lb 12 oz and the other weighing 6 lb 10 oz.

Example: You are given a measurement such as 4.5 qt, and you will change it to a form easier for use in a recipe, either a fraction, $4\frac{1}{2}$ qt or a mixed measurement, 4 qt 2 cups.

Method 1 for working with mixed units

1. Convert all the amounts expressed in units to the unit easiest to work with.
2. For each number, add the two amounts, now both expressed in the same unit.
3. Then do the necessary mathematical operations.
4. Change the answer back to mixed units if you want by *dividing* by the conversion factor.
5. The whole number answer is the amount of the larger unit. Any remainder is the amount of the smaller unit.

Example: Find the total length of two counter tops, one measuring 3 ft 4 in and the other measuring 6 ft 10 in.

Choose to change all measurements to inches so calculations can be done with whole numbers.

The first counter is 3 ft 4 in.

1. Change the 3 ft to 36 in ($3 \times 12 = 36$ in).
2. Add the 4 inches to the 36 inches to get 40 in.

The second counter is 6 ft 10 in.

1. Change the 6 ft to 72 in ($6 \times 12 = 72$ in).
2. Add the 10 inches to get 82 in.
3. The total length of the two counters is $40 + 82 = 122$ in.
4. To convert the inches to mixed units, divide by the conversion factor 12.
 $122 \div 12 = 10$ remainder 2.
5. The whole number 10 in the division answer is the amount in feet.
The remainder 2 is the amount in inches.

122 inches expressed as a mixed number is 10 ft 2 in.

Example: Add 3 qt 3 C to 1 qt 2 C.

Change all the measurements to quarts. The conversion factor for cups to 4:

$$3 \text{ qt} + (3 \text{ C} \div 4) = 3\frac{3}{4} \text{ qt}$$
$$1 \text{ qt} + (2 \text{ C} \div 4) = 1\frac{1}{2} \text{ qt}$$

$$3\frac{3}{4} + 1\frac{1}{2} \text{ qt} = 5\frac{1}{4} \text{ qt}$$

To change the $\frac{1}{4}$ qt back to cups, multiply by the conversion factor 4.

$$\frac{1}{4} \text{ qt} \times 4 = 1 \text{ C}$$

$5\frac{1}{4}$ qt is the same as 5 qt 1 cup

Method 1 works, whether you are adding, subtracting, multiplying or dividing. Change the all of the amounts to one unit. Then carry out whatever operations you need to do.

Often you do this automatically when working in the kitchen.

Example: If you need 7 teaspoons of an ingredient, you probably just measure 2 tablespoons and 1 teaspoon of the ingredient. You converted 6 teaspoons to 2 tablespoons (conversion factor 3) and left the remainder as 1 teaspoon.

You can use the first method to do all operations with mixed numbers, but we will also look at other methods so you will have a choice.

Method 2 for working with mixed units

In this method work with the units separately. In other words you will work with all of the inches together, and all of the feet together. Only after you have done the operations (add, subtract, multiply or divide) will you recombine the units.

The steps for using Method 2:

1. Do the operation separately with the amounts in each unit.
 - a. The answers will be in the two different units.
2. If the amount of the smaller unit is equal to or greater than the conversion factor to the larger unit, divide the number of the smaller unit by the conversion factor.
3. Add the answer to the division question to the amount of the larger unit. Any remainder forms the amount of the original, smaller unit.

Example: Add the two weights of meat, 3 lb 12 oz and 6 lb 10 oz.

1. First add the pounds together and then add the ounces together.

$$\begin{array}{r} 3 \text{ lb} \quad \text{add the pounds} \\ \underline{6 \text{ lb}} \\ 9 \text{ lb} \end{array}$$

$$\begin{array}{r} 12 \text{ oz} \quad \text{add the ounces} \\ \underline{10 \text{ oz}} \\ 22 \text{ oz} \end{array}$$

2. The amount of the smaller unit, 22 ounces, is more than the conversion factor 16.
3. Divide the number of ounces by the conversion factor 16:

$$\begin{array}{l} 22 \div 16 = 1 \text{ with } 6 \text{ remainder} \quad \text{the remainder is the number of ounces} \\ = 1 \text{ lb } 6 \text{ oz} \end{array}$$

4. Add the answer of the division question (1) to the number of pounds:

$$9 \text{ lb} + 1 \text{ lb } 6 \text{ oz} = 10 \text{ lb } 6 \text{ oz}$$

If the amount of the smaller unit is less than the conversion factor to the larger unit, leave the amounts of the units as they are.

Example: Add 4 pounds 5 ounces to 2 pounds 7 ounces.

$$4 \text{ lb} + 2 \text{ lb} = 6 \text{ lb} \quad \text{Add the pounds:}$$

$$5 \text{ oz} + 7 \text{ oz} = 12 \text{ oz} \quad \text{Add the ounces:}$$

The conversion factor from ounces to pounds is 16.
The number of ounces, 12, is less than the conversion factor.
The number of the two units can remain as they are. The answer is:
The answer is: 6 lb 12 oz

Example: Add 3 gallons 2 quarts to 7 gallons 2 quarts.

$$3 \text{ gal} + 7 \text{ gal} = 10 \text{ gal} \quad \text{Add the gallons.}$$
$$2 \text{ qt} + 2 \text{ qt} = 4 \text{ qt} \quad \text{Add the quarts.}$$

The number of the smaller unit is equal to 4 which is the conversion factor.
Divide the number of quarts by the conversion factor:

$$4 \text{ qt} \div 4 = 1 \text{ gal (There is no remainder)}$$
$$10 \text{ gal} + 1 \text{ gal} = 11 \text{ gal}$$

Subtracting mixed units using Method 2

Subtract like units, starting with the smallest unit:

1. If the answer of a smaller unit is equal to or greater than the conversion factor to the next larger unit, convert it.
2. Keep any remainder as the smaller unit.

You may have to borrow when you subtract two measurements

Example: 6 c 1 oz – 4 c 2 oz

1. You can't subtract 2 ounces from 1 ounce but you can borrow 1 cup from the number of cups in the larger number, making the number of cups now smaller by 1. The 6 c is now c.
2. Convert that borrowed 1 c to 8 ounces and add it to the 1 ounce already there, changing the first number into its equivalent 5 c 9 oz..

Now you can subtract:

$$\begin{array}{r} 5 \text{ c } 9 \text{ oz} \\ - 4 \text{ c } 2 \text{ oz} \\ \hline 1 \text{ c } 6 \text{ oz} \end{array}$$

Multiplying mixed units using Method 2

To multiply measurements with mixed units:

- Multiply each unit by the multiplier.
- If the answer to any smaller unit is equal to or greater than the conversion factor convert it to the larger unit, it is divided in the same way as an addition answer.

Example: Multiply 7 qt 1 pt by 5

$$\begin{aligned} 1 \text{ pt} \times 5 &= 5 \text{ pt} \\ 7 \text{ qt} \times 5 &= 35 \text{ qt} \end{aligned}$$

5 pints is bigger than the conversion factor 2

$$\begin{aligned} 5 \text{ pt} \div 2 &= 2 \text{ qt } 1 \text{ pt} \\ 35 \text{ qt} + 2 \text{ qt } 1 \text{ pt} &= 37 \text{ qt } 1 \text{ pt} \end{aligned}$$

Dividing mixed units using Method 2

If you can divide the amount of each unit evenly by the divisor, divide the amount of each unit separately, keeping the separate units in the answer.

Example: 12 lb 6 oz \div 3

$$\begin{array}{ll} 12 \text{ lb} \times 16 = 192 \text{ oz} & \text{change lb to oz} \\ 192 \text{ oz} + 6 \text{ oz} = 198 \text{ oz} & \text{add to the number of ounces already in the question} \\ 198 \text{ oz} \div 3 = 66 \text{ oz} & \text{divide} \\ & \text{convert to pounds:} \end{array}$$

$$\begin{aligned} 66 \text{ oz} \div 16 &= 4 \text{ lb remainder } 2 \text{ oz} \\ 12 \text{ lb} \div 3 &= 4 \text{ lb } 2 \text{ oz} \end{aligned}$$

Method 3 for working with mixed units

The third method of doing operations with mixed numbers is to convert the smaller unit, usually inches, to a decimal part of the larger unit, which is usually feet.

To convert mixed units to *decimal units*, as this conversion is called:

1. Divide the smaller unit by the conversion factor 12.
2. The division answer is added to the whole number the larger unit.

Example: Change 6.25 pounds to pounds and ounces.

$$\begin{aligned} &\text{Multiply the decimal part, .25 by the conversion factor 16.} \\ 16 \times .25 &= 4 \text{ oz} \\ 6.25 \text{ lb} &= 6 \text{ lb } 4 \text{ oz} \end{aligned}$$

To change a decimal amount to a fraction or a mixed number (a whole number with a fractional amount), put the decimal part of the number as the numerator over a denominator that starts with

1 and has as many zeros following the 1 as there are decimal places in the decimal number (example 10, 100, 1000).

Example: Change 6.25 lb to a mixed number.

The decimal, .25, is the numerator of the fraction. The denominator is 100. It has two zeros because there are two decimal places. The fraction is $\frac{25}{100}$. Reduce to lowest terms. 6.25 as a mixed number is $6 \frac{1}{4}$

Answer the following questions. The answers are on the last page.

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)
3 teaspoons (tsp) = 1 _____
16 tbsp = 1 cup (C) = ___ fluid oz (fl oz)
___ C = 1 pint (pt)
2 pt = 1 _____
___ qt = 1 gallon (gal)

2. Convert:

- | | |
|-----------------|-------------------|
| a) 128 oz to lb | f) 12 C to qt |
| b) 4 lb to oz | g) 2.5 qt to C |
| c) 3.2 lb to oz | h) 16 fl oz to C |
| d) 12 C to pt | i) 1.75 gal to qt |
| e) 6 pt to qt | j) 78 in to ft |

3. Add:

- a) 5 ft. 2 in. + 3 ft. 8 in
- b) 1 gal 3 qt + 2 gal 1 qt
- c) 5 lb 12 oz + 6 lb 9 oz

4. Subtract:

- a) 6 lb. 10 oz. - 4 lb. 8 oz.
- b) 6 ft. 5 in. - 3 ft. 10 in.

5. Multiply:

- a) 4 gal. 2 qt x 2
- b) 9 lb 8 oz x 3

6. Divide:

- a) 2 lb 8 oz \div 2
- b) 1 lb 3 oz \div 5

7. Change:

- a) 5.5 gal to gal and qt
- b) 2.25 lb to lb and oz
- c) 8 tsp to tbsp and tsp

8. Change the following decimal numbers to mixed numbers (a whole number and a fraction):

- a) 15.4 lb
- b) 2.5 C
- c) 3.75 qt

ANSWERS

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)
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)

2.

a) 8 lb	f) 3 qt
b) 64 oz	g) 10 C
c) 51.2 oz	h) 2 C
d) 6 pt	i) 7 qt
e) 3 qt	j) 6.5 ft

3. a) 8 ft 10 in
b) 3 gal 4 qt = 4 gal
c) 11 lb 21 oz = 12 lb 5 oz
4. a) 2 lb 2 oz
b) 2 ft 7 in
5. a) 8 gal 4 qt = 9 gal
b) 27 lb 24 oz = 28 lb 8 oz
6. a) $40 \text{ oz} \div 2 = 20 \text{ oz} = 1 \text{ lb } 4 \text{ oz}$
b) $19 \text{ oz} \div 5 = 3.8 \text{ oz}$

7. a) 5 gal 2 qt
b) 2 lb 4 oz
c) 2 tbsp 2 tsp
8. a) $5 \frac{4}{10} = 15 \frac{4}{5}$ lb
b) 2 $\frac{1}{2}$ C
c) 3 $\frac{3}{4}$ qt