Math in Our World

Section 9.1

Measures of Length: Converting Units and the Metric System

Learning Objectives

- Convert measurements of length in the English system.
- Convert measurements in the metric system.
- Convert between English and metric units of length.

English System of Measurement

Units of Length in the English System:

12 inches (in.) = 1 foot (ft)
3 feet = 1 yard (yd)
36 inches = 1 yard
5,280 feet = 1 mile (mi)
1,760 yards = 1 mile

Dimensional Analysis

A systematic, and reliable, method for converting units is known as **dimensional analysis.** It is based on one simple idea: if measurements in two different units represent the same length, like 1 yard and 3 feet, then a fraction formed with the two measurements is equal to 1. We call a fraction of this type a **unit fraction.**

$$\frac{1\text{ yd}}{3\text{ ft}} = 1 \text{ and } \frac{3\text{ ft}}{1\text{ yd}} = 1$$

Dimensional Analysis

Our procedure for converting units will be to multiply by one or more unit fractions in such a way that the units we don't want can be divided out, leaving behind the units that we do want.

EXAMPLE 1 Converting Yards to Feet

Convert 6 yards to feet.

Ex 1 Convert 6 yds to ft

Solution: $6\text{yd} \cdot \frac{3\text{ft}}{1\text{yd}} = 18\text{ ft}$

EXAMPLE 2 Converting Feet to Miles

The height of Mount Everest is 29,035 feet. How many miles is that?

Ex 2] Convert 29,035 ft to mi

Solution: $29035\,\text{ft} \cdot \frac{1\,\text{mi}}{5280\,\text{ft}} = 5.5\,\text{mi}$

EXAMPLE 3 Converting Measurements Using Two Unit Fractions

The distance by air from JFK airport to LaGuardia airport in New York is about 11 miles. How many inches is that?

Ex 3] Convert 11 mi to inches.

Solution: $11\,\text{mi} \cdot \frac{5280\,\text{ft}}{1\,\text{mi}} \cdot \frac{12\,\text{in}}{1\,\text{ft}}$

$= 696{,}960\,\text{in}$

EXAMPLE 4 Converting Units for Speed

A decent major league pitcher can throw a baseball 90 miles per hour. How fast is that in feet per second?

Ex4] Convert 90 mph to ft/sec

Solution: $\frac{90\ \text{mi}}{1\ \text{hr}} \cdot \frac{5280\ \text{ft}}{1\ \text{mi}} \cdot \frac{1\ \text{hr}}{60\ \text{min}} \cdot \frac{1\ \text{min}}{60\ \text{sec}}$

$$\frac{90 \cdot 5280}{60 \cdot 60} = 132\ \text{ft/sec}$$

Metric System

The metric system uses three basic units of measure: the *meter*, the *liter*, and the *gram*.

Length in the metric system is measured using **meters.** The symbol for meter is "m."

The basic unit for capacity in the metric system is the **liter.** The symbol for liter is "L."

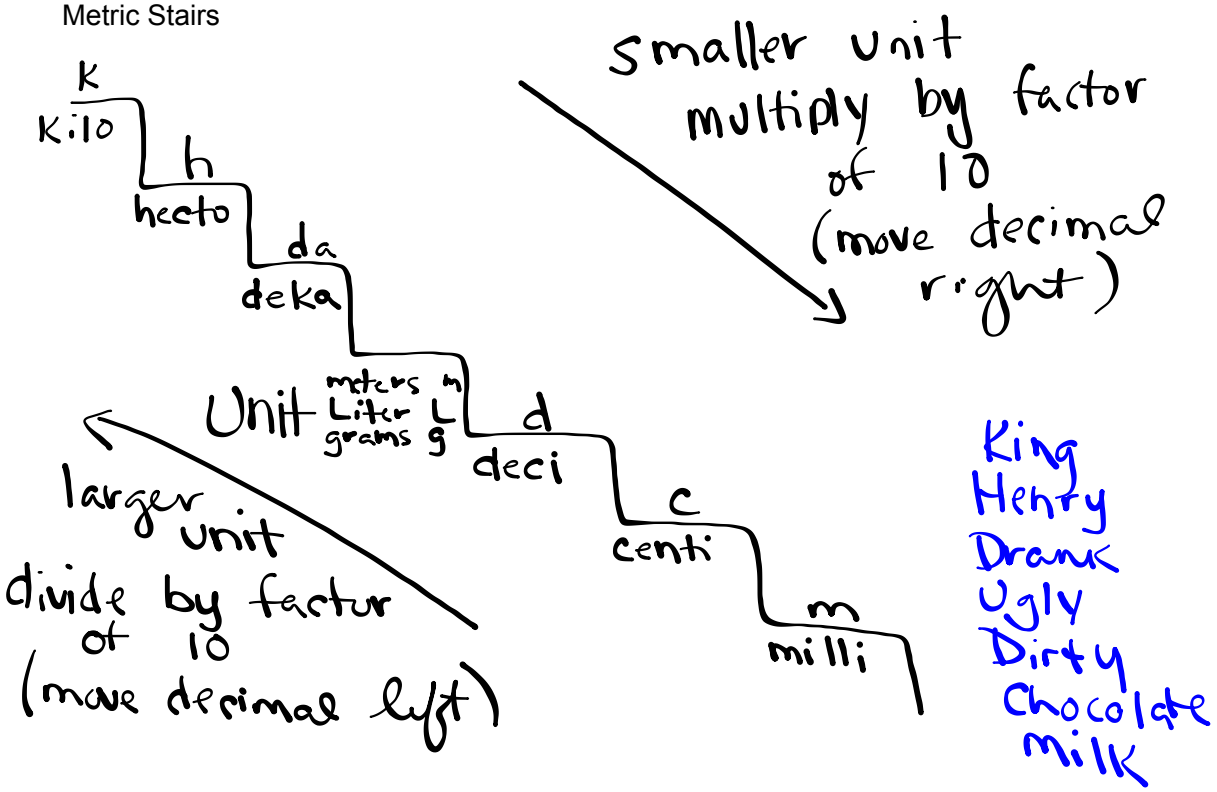
The basic unit for measuring weight in the metric system is the **gram.** This is a very small unit—a nickel weighs about 5 grams. The symbol for gram is "g."

Metric Prefixes

All units other than the three basic units are based on multiples of the basic units, with those multiples all being powers of 10.

Prefix	Symbol	Meaning
kilo	k	1,000 units
hecto	h	100 units
deka	da	10 units
	m, L, g	1 unit
deci	d	$\frac{1}{10}$ of a unit
centi	c	$\frac{1}{100}$ of a unit
milli	m	$\frac{1}{1,000}$ of a unit

Metric Stairs



EXAMPLE 5 Converting Metric Units

Convert 42.5 kilometers to centimeters.

42.5 km to ____ cm

5 steps down multiply 10^5

move decimal 5 places right

4,250,000 cm

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Convert 1,253.7 milligrams to grams.

1253.7 mg = ____ g

3 steps up divide 10^3

move decimal 3 places left

1.2537 g

English vs. Metric

Because most of the world uses the metric system while the United States uses the English system, it is often necessary to convert between the two systems.

English and Metric Equivalents for Length

1 in. = 2.54 cm	1 mm ≈ 0.03937 in.
1 ft = 30.48 cm = 0.3048 m	1 cm ≈ 0.3937 in.
1 yd = 91.44 cm = 0.9144 m	1 m ≈ 1.0936 yd = 3.2808 ft
1 mi ≈ 1.61 km	1 km ≈ 0.6214 mi

EXAMPLE 8 Converting Between English and Metric Lengths

Convert each.

(a) 135 feet to centimeters

(b) 87 centimeters to inches

(c) 213.36 millimeters to feet