

# Section 12.1

## Measurements

### CONVERSION TABLES

Conversion tables are the key to solving measurement problems.

#### Customary: Weight

	Tons	Pounds	Ounces
Tons	1	2,000	32,000
Pounds		1	16

#### Customary: Length

	Miles	Yards	Feet	Inches
Miles	1	1,760	5,280	63,360
Yards		1	3	36
Feet			1	12

#### Metric: Length

	Kilometers	Meters	Centimeters	Millimeters
Kilometers	1	1,000	10,000	100,000
Meters		1	100	1,000
Centimeters			1	10

#### Metric: Weight

	Metric Tons	Kilograms	Grams	Milligrams
Metric Tons	1	1,000	1,000,000	1,000,000,000
Kilograms		1	1,000	1,000,000
Grams			1	1,000

#### Customary: Capacity

	Gallons	Quarts	Pints	Cups	Ounces	Tablespoons	Teaspoons
Gallons	1	4	8	16	128	256	768
Quarts		1	2	4	32	64	192
Pints			1	2	16	32	96
Cups				1	8	16	48
Ounces					1	2	6
Tablespoons						1	3

#### Metric: Capacity

	Kiloliters	Liters	Milliliters
Kiloliters	1	1,000	1,000,000
Liters		1	1,000

**DIMENSIONAL ANALYSIS**

Dimensional analysis is the way to convert units by the use of ratios.

**Example:** Convert 78 inches to feet.

1. Write a ratio of the given unit over one

$$\frac{78 \text{ inches}}{1}$$

2. Multiply ratio by another ratio with the given unit in the denominator (bottom) and the unit "to convert to" in the numerator.

$$\frac{\text{foot}}{\text{inches}}$$

3. Using the conversion tables decide which unit is larger and place a 1 with the larger unit, and the conversion factor with the smaller unit.

$$\frac{1 \text{ foot}}{12 \text{ inches}}$$

$$\frac{78 \text{ inches}}{1} \times \frac{1 \text{ foot}}{12 \text{ inches}} = \frac{78}{12} = 6.5 \text{ feet}$$

4. Cancel the name of the given units, multiply and divide to get the answer.

**Example:** Convert 20 quarts to cups.

$$\frac{20 \text{ quarts}}{1} \times \frac{4 \text{ cups}}{1 \text{ quart}} = \frac{80}{1} = 80 \text{ cups}$$

**Example:** Convert 500 milligrams to grams.

$$\frac{500 \text{ milligrams}}{1} \times \frac{1 \text{ gram}}{1000 \text{ milligrams}} = \frac{500}{1000} = 0.5 \text{ grams}$$

**CONVERTING COMPOUND UNITS**

A compound unit has more than one unit. For example, speed, in *miles per hour*, is a compound unit because it contains *miles* and *hours*. Compound units may be also converted using dimensional analysis by converting one unit at a time.

**Example:** Convert  $\frac{55 \text{ miles}}{\text{hour}}$  to  $\frac{\text{feet}}{\text{second}}$ .

$$\frac{55 \text{ miles}}{\text{hour}} \times \frac{5280 \text{ feet}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{3600 \text{ seconds}} = \frac{55 \times 5280 \times 1}{1 \times 3600} = 80.7 \frac{\text{feet}}{\text{seconds}}$$

**CONVERTING FROM CUSTOMARY TO METRIC (OR METRIC TO CUSTOMARY) UNITS**

To convert between the two measuring systems, use dimensional analysis and the *metric-to-customary* conversion table. Only one unit per standard of measurement is needed (length, weight or capacity).

Customary to metric conversion table

Length	1 inch = 2.54 centimeters
Weight	1 pound = 454 grams
Capacity	1 quart = 0.946 liters

**Example:** Convert 8,000 feet to meters.

Because the table above uses inches for length, convert 8,000 feet to inches first:

$$\frac{8000 \text{ feet}}{1} \times \frac{12 \text{ inches}}{1 \text{ foot}} = \frac{96000}{1} = 96,000 \text{ inches}$$

Next, convert inches to centimeters:

$$\frac{96000 \text{ inches}}{1} \times \frac{2.54 \text{ centimeters}}{1 \text{ inch}} = \frac{243840}{1} = 243840 \text{ centimeters}$$

Finally, convert centimeters to meters:

$$\frac{243840 \text{ centimeters}}{1} \times \frac{1 \text{ meter}}{100 \text{ centimeters}} = \frac{243840}{100} = 2,438.4 \text{ meters}$$

**TEMPERATURE: Converting from °Celsius to °Fahrenheit**

To measure temperature using the metric system, the scale is called Celsius (°C), while the scale to measure temperature in customary units is called Fahrenheit (°F).

To convert and build a table from °C to °F, the following equation is necessary:

$$F = \frac{9}{5}C + 32$$

**Example:**

Convert 212 °F (H<sub>2</sub>O boiling point) to °C

$$212 = \frac{9}{5}C + 32 \quad \text{Subtract 32 from both sides}$$

$$180 = \frac{9}{5}C \quad \text{Multiply by 5 and divide by 9 both sides}$$

$$\frac{180(5)}{9} = C = 100 \text{ °C}$$

**Example:**

Convert 37 °C (body temperature) to °F

$$F = \frac{9}{5}(37) + 32 \quad \text{Multiply } 9 \times 37$$

$$F = \frac{333}{5} + 32 \quad \text{Divide by 5}$$

$$F = 66.6 + 32 = 98.6 \text{ °F}$$

**Practice:**

Convert or solve.

1. 25 kilometers to meters
  2. 250 milliliters to liters
  3. 1.4 miles to feet
  4. 3 tons to pounds
  5. 5.5 kilograms to grams
  6. 7 gallons to cups
  7. 600 yards to meters
  8. 330 feet to yards
  9. 50 ounces to pounds
  10. 550 centimeters to meters
  11. 900 milligrams to grams
  12. 6.5 cups to ounces
  13. 3.2 liters to milliliters
  14. 120 miles to kilometers
  15. 42 inches to feet
  16. 54 inches to yards
  17. 35 millimeters to meters
  18. 660 milligrams to grams
  19. 6 tablespoons to ounces
  20. 2 ounces to teaspoons
  21. 34 pints to quarts
  22. 9 inches to centimeters
  23. 3500 grams to kilograms
  24. 80 miles/hour to km/hour
  25. 1.75 meters to centimeters
  26. 0.8 grams to milligrams
  27. 32 ounces to cups
  28. 4700 milliliters to liters
  29. 174 kilometers to miles
  30. 7 feet to inches
  31. 3.8 yards to inches
  32. 3.5 meters to millimeters
  33. 2.4 grams to milligrams
  34. 3.5 ounces to tablespoons
  35. 12 teaspoons to ounces
  36. 8.5 quarts to pints
  37. 30 centimeters to inches
  38. 1.75 kilograms to grams
  39. 80 km/hour to miles/hour
40. A pitcher of water holds 3 liters. How many 250-millimeter containers may be filled?
  41. The oil capacity of a certain engine is 5 quarts. If oil is sold by the gallon and you have 4 engines to fill, how many gallons of oil must you buy?
  42. A bottle of aspirin has 58 pills left. If each pill holds 250 milligrams, how many grams of aspirin are left?
  43. A bag holding 32 pounds of jumping beans will be poured into small bags weighing 8 ounces each. How many small bags of jumping beans will you get?
  44. Maggie ran a 3-mile race but fell short of the finish by 300 feet. How many feet was she able to complete?
  45. A 200-gallon tank will be emptied into one pint jugs. How many jugs will be filled?
  46. A 1-ton shark ate 2000 fish each weighing an average of 3 ounces. How many pounds does the shark weigh now?
  47. A tank that holds 50 liters will be emptied into 500-millimeter bottles. How many bottles will be retrieved from the tank?
  48. To make 40 cookies, a recipe calls for 4 ounces of strawberry flavor. How many cookies will a pint container of strawberry flavor yield?
  49. At 2:30 in the afternoon of January 6, the temperature in Cambridge, MA, was 72 °F. By 2 AM of the following day, the thermometer was reading -4 °F. How many degrees °C did the temperature drop?
  50. An airplane flying at 11,546 meters lost half of its altitude in a recent mishap. How many kilometers of altitude did it lose? Round answer to nearest hundredth.
  51. An elephant that weighs 8 tons is carrying 4 baboons each weighing 40 pounds. What is the weight in pounds of all five animals?
  52. The outside distance between the front of the front tire and the back of the rear tire of a 1993 Ford Mustang is 76 inches. If the tires of the car measure 24 inches in diameter, find the wheelbase distance (from center of front tire to center of rear tire) of the car in feet.
  53. The Boston Marathon covers 26 miles and 385 yards. Convert this distance to kilometers. Round answer to the nearest tenth.
  54. After five seconds, the speed of a falling object is 49 meters per second. Convert to miles per hour.