PREPARATORY MATH SKILLS LAB

Lab PMS 14

MATH ACTIVITY

Converting Units from One Form to Another

MATH SKILLS LAB OBJECTIVE

When you complete the math lab activity, you should be able to convert a physical quantity expressed in one set of units to an equivalent set of units.

Just as apples and oranges don't add up, neither do numbers that carry different units. For example, "2 inches + 1 foot" doesn't equal either 3 inches or 3 feet. To add 2 inches to 1 foot, you must ***first*** express both terms in the ***same*** units.

Thus, if you change 1 foot to 12 inches, then add "2 inches + 12 inches," you get a correct answer: 14 inches. So "2 inches + 1 foot" = 14 inches. If you change 2 inches to $\frac{1}{6}$ foot, then add "$\frac{1}{6}$ ft + 1 ft," you will get another correct answer: 1 $\frac{1}{6}$ ft.

Suppose you are asked to add:

1 meter + 40 centimeters = _____

Since the units aren't alike, you can't add the two numbers as they stand. But you can change 1 meter to 100 centimeters and then add.

100 cm + 40 cm = 140 cm (a correct answer)

Or, you can change 40 cm to 0.40 meter (since 40 cm equals $\frac{40}{100}$ of a meter, and $\frac{40}{100} = 0.40$), and then add.

1 m + 0.40 m = 1.40 m (also a correct answer)

To convert units from one form to another, such as feet to inches or kilograms to grams, follow the general conversion process shown in Figure 1. The letters A, B and C represent numbers.

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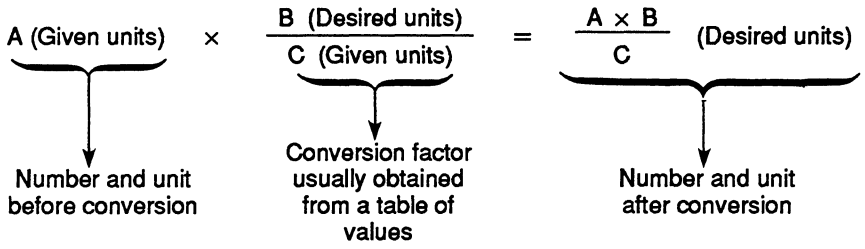


Fig. 1 Unit-conversion process.

Let's try some examples that show how the conversion process outlined in Figure 1 is applied.

Example 1:

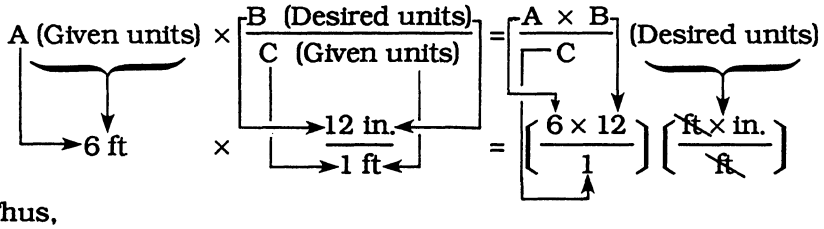
Given: A length of 6 feet.

Find: The equal length in inches.

Solution: From a table of conversion values, we find that 1 ft = 12 in. Therefore, we can form the conversion factor $\frac{\text{B (desired units)}}{\text{C (given units)}}$ as follows:

$$\frac{12 \text{ in.}}{1 \text{ ft}}$$

The ratio is equal to 1 because numerator and denominator are equal lengths. (***Note:*** Multiplying anything by 1 doesn't change it.) Now follow the process shown in Figure 1.



Thus,

$$6 \text{ ft} \times \frac{12 \text{ in.}}{1 \text{ ft}} = \left[\frac{6 \times 12}{1}\right]\left[\frac{\text{ft} \times \text{in.}}{\text{ft}}\right] = 72 \text{ in.}$$

Thus, the result is 6 ft = 72 in.

Note: In the conversion process of Example 1, we multiplied 6 ft by the ratio $\frac{12 \text{ in.}}{1 \text{ ft}}$. The ratio is equal to 1. Thus, the length of 6 ft wasn't changed, since it was multiplied by 1. It was only converted to an equivalent length expressed in inches—72 inches.

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Example 2:

Given: A distance of 10 miles.

Find: The equal length in feet.

Solution: From a conversion table for lengths, we find that:

$$1 \text{ mile} = 5280 \text{ feet}$$

With this equality we can form two conversion ratios, each equal to 1.

$$\frac{1 \text{ mile}}{5280 \text{ ft}} \quad \text{and} \quad \frac{5280 \text{ ft}}{1 \text{ mile}} \quad \Rightarrow \quad \frac{\text{B (desired units)}}{\text{C (given units)}}$$

Since we're converting from miles (given units) to feet (desired units), we'll use the ratio 5280 ft/1 mile for the conversion factor. Then, using the process shown in Figure 1, multiply and cancel units.

$$10 \text{ mi} \times \left[\frac{5280 \text{ ft}}{1 \text{ mi}}\right] = \left[\frac{10 \times 5280}{1}\right]\left[\frac{\cancel{\text{mi}}\cdot\text{ft}}{\cancel{\text{mi}}}\right] = 52{,}800 \text{ ft}$$

Therefore, 10 miles = 52,800 feet.

Example 3:

Given: A distance of 52,800 ft.

Find: The equal length in inches.

Solution: From a conversion table, we find 1 foot = 12 inches. Since we're changing feet (given units) to inches (desired units), we use the conversion ratio 12 in./1 ft. Multiply and cancel units.

$$52{,}800 \text{ ft} \times \left[\frac{12 \text{ in.}}{1 \text{ ft}}\right] = \left[\frac{52.800 \times 12}{1}\right]\left[\frac{\cancel{\text{ft}}\cdot\text{in.}}{\cancel{\text{ft}}}\right] = 633{,}600 \text{ in.}$$

Therefore, 52,800 ft = 633,600 in.

If we combine the results in Examples 2 and 3, we find that 10 miles = 633,600 inches. We found this in two steps. We could have done it in one step. See Example 4.

Example 4:

Given: A distance of 10 miles.

Find: The equal length in inches.

Solution: From a table of conversions between lengths, we are given:

$$1 \text{ mi} = 5280 \text{ ft} \quad \text{and} \quad 1 \text{ ft} = 12 \text{ in.}$$

We form the conversion ratios $\frac{5280 \text{ ft}}{1 \text{ mi}}$ and $\frac{12 \text{ in.}}{1 \text{ ft}}$.

Then multiply and cancel units.

$$10 \text{ mi} \times \left[\frac{5280 \text{ ft}}{1 \text{ mi}}\right] \times \left[\frac{12 \text{ in.}}{1 \text{ ft}}\right] = \left[\frac{10 \times 5280 \times 12}{1 \times 1}\right]\left[\frac{\cancel{\text{mi}}\cdot\cancel{\text{ft}}\cdot\text{in.}}{\cancel{\text{mi}}\cdot\cancel{\text{ft}}}\right]$$

So,

$$10 \text{ mi} = 633{,}600 \text{ in.}$$

The answer is the same one we found in two steps in Examples 2 and 3.

PRACTICE EXERCISES

Problem 1: Use the process given in Figure 1 to convert 150 centimeters to an equal length in millimeters. A table of conversions gives 1 cm = 10 mm.

Problem 2: Convert 21 liters to an equal volume in gallons. A table of conversions gives 1 gal = 3.785 liters.

Problem 3: Convert 40 centimeters to an equal length in meters. A table of conversions gives 1 m = 100 cm.

Problem 4: Convert 5 hours to an equal time in seconds. A table of conversions gives 1 hr = 3600 sec.

Problem 5: Convert 10.5 mi/hr to an equal speed in ft/sec. A table of conversions gives 1 mi = 5280 ft and 1 hr = 3600 sec. Solve this problem in one step, as was done in Example 4.

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