Ratios

The math name for a fraction is *ratio*. It is just a comparison of one quantity with another quantity that is similar. As a Landscape Horticulturist, you will use ratios often.

You can use ratios when you convert from one unit to another. Since 12 inches = 1 foot, the conversion ratio can be written as a fraction

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

You can see that these ratios relate inches and feet.

Example 1: Using a ratio to convert from 2.5 feet into an equivalent number of inches, we use the first ratio.

$$\left(2.5\ \text{feet}\right)x\left(\frac{12\ \text{inches}}{1\ \text{foot}}\right) = 30\ \text{inches}$$

So 2.5 feet equals 30 inches. Notice the feet units cancel (because $\frac{\text{feet}}{\text{feet}} = 1$; that is, anything divided by itself is equal to 1). Always arrange the number you want to convert and the unit conversion ratio so that the units you don't want cancel out and you are left with the units you do want in the numerator (along with some numbers).

Example 2: Using a ratio to convert from 42 inches into an equivalent number of feet, we use the second ratio.

$$\left(42\ \text{inches}\right)x\left(\frac{1\ \text{foot}}{12\ \text{inches}}\right) = 3.5\ \text{feet}$$

So 42 inches equals 3.5 feet.

Notice that in each case, you use the conversion ratio that forces the units to cancel (divide) out. The units tell you which form of the conversion ratio you must use.

Example 3: Use a ratio to convert 14.4 feet into yards. There are 3 feet in one yard. So the ratio to convert from feet to yards is

$\left(\frac{1\ \text{yard}}{3\ \text{ft}}\right)$. If you wanted to convert from yards to feet you would multiply by $\left(\frac{3\ \text{ft}}{1\ \text{yard}}\right)$. So for our problem:
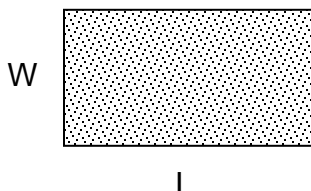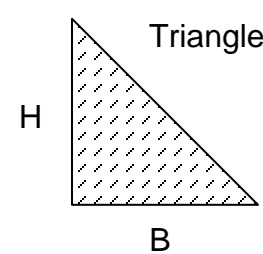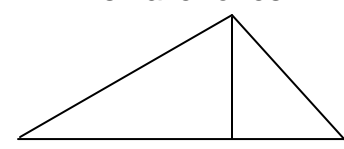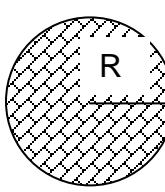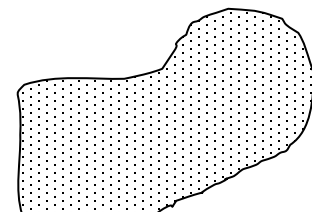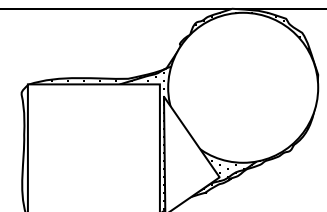
$$\left(14.4\ \text{ft}\right)x\left(\frac{1\ \text{yard}}{3\ \text{ft}}\right) = 4.8\ \text{yards.}\ \text{Most people would convert the .8 yards into feet and inches.}$$

To do that, first see how many feet there are in 0.8 yards:

$$\left(0.8\,\text{yards}\right)x\left(\frac{3\,\text{ft}}{1\,\text{yard}}\right)=2.4\,\text{ft}$$. Then convert the .4 ft into inches:

$$\left(0.4\,\text{ft}\right)x\left(\frac{12\,\text{inches}}{1\,\text{ft}}\right)=4.8\,\text{inches}$$. So there are 4 yards, 2 ft and 4.8 inches in 14.4 feet.

One of the most common calculations you will have to do is finding the *area* of a plot of ground in square feet or some other similar unit. We will look at how to calculate area and then how to convert from one area unit to another. To find the area of a plot, you first need to know the shape of the plot:

Shape	Formula	Comments
Rectangle or Square W L	Area of Square or Rectangle = Length x Width = L x W	It doesn't matter which side is called the length and which is called the width.
Triangle H B	Area of Triangle = ½ Base x Height = ½ B x H	Big triangles can be broken into smaller ones:
Circle R	Area of Circle $= \pi \times \text{radius}^2$ $= \pi \times R^2$	The radius is *half* way across the circle. You can always measure the *diameter* (all the way across) and divide by two to get the radius. $\pi = 3.14$
Irregular Shape	For an irregular shape, divide the shape into smaller, regular shapes. Then find the area of each regular shape and add them together to get the total area of the irregular shape. With careful measurements you can be accurate to within 5 or 10%.	Here, a square, a triangle, and a circle are used to estimate the area of the irregular shape.

Example 4: A rectangular flowerbed on a commercial property measures 15 feet by 32 feet. What is the area of the plot?
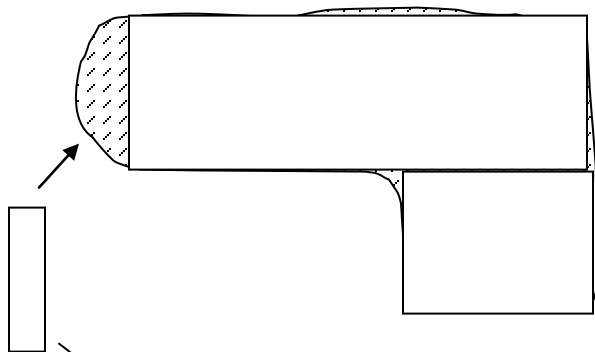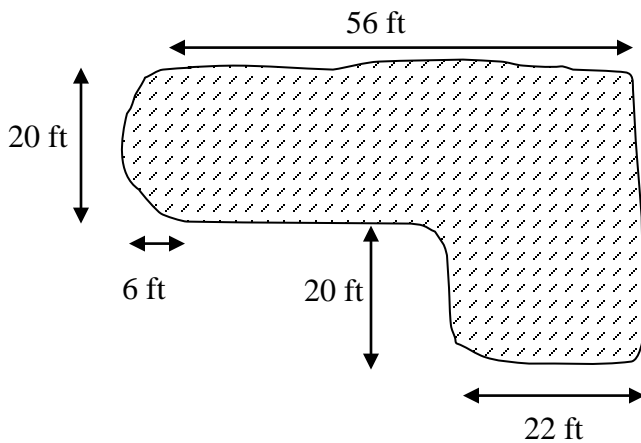
The area of a rectangular plot is length x width. So the area is (15 ft) x (32 ft) = 480 ft^2 = 480 square feet.

Example 5: The circular flowerbed at Acme corporate headquarters is 30 feet across. The label on a bale of compressed peat moss says it can cover an area of 86.4 square feet with a 1-inch deep layer of the moss. How many bales of peat moss should you buy for the job?

First find the area of the plot in square feet. Area of a circle = π x radius^2. But notice we are given the diameter of the circle, not the radius. To get the radius just divide the diameter by 2: radius = 30 feet/2 = 15 feet. So now: Area of a circle = π x radius^2 = (3.14) x (15 ft)^2 = 706.5 square ft.

Each bale of peat moss only covers an area of 86.4 square feet, so we will need (706.5 sq.ft)/(86.4 sq ft per bale) = 8.18 bales. So you better buy 9 bales of peat moss to do the job.

Example 6: Estimate the area of the following irregularly shaped plot of land:

56 ft

20 ft

6 ft   20 ft

22 ft

Two rectangles cover most of the area of the irregular plot. The smaller rectangle goes over the edge of the original plot (it's a little too big), but it misses the little piece on its right side and the little piece at its upper left corner. So it's just about perfect. Notice the large semicircular piece that remains on the left side of the original object. You can cover it with a skinny rectangle or maybe a semicircle (since you can find the area of a semicircle by simply dividing the area of a circle formula by 2).

You can use this rectangle to cover the last uncovered piece.

Now to find the total area of the irregular shape, just find the areas of each piece we covered it with and add those areas together. The area of the big rectangle is: length x width = (56 ft) x (20 ft) = 1120 sq.ft.
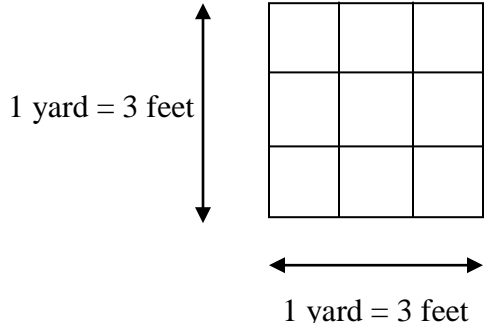
The area of the second biggest rectangle is length x width = (20 ft) x (22 ft) = 440 sq.ft.

The area of the smallest rectangle (the skinny one) is length x width = (20 ft) x (5 ft) = 100 sq. ft. Notice that the width is only 5 ft instead of 6 ft (the width of that semicircular area). That's because the corners of the rectangle stick out past the semicircular shape a bit. We can compensate for that bit of overestimation by making the rectangle a little narrower.

Therefore the total area of the irregular shape is approximately 1120 sq. ft. + 440 sq. ft. + 100 sq. ft. = 1660 sq. ft.

The next thing you might have to do is to convert from one area unit to another. For instance, say you made your measurements of a rectangular plot in yards: 12 yards by 21 yards. Then the area is (12 yards) x (21 yards) = 252 square yards. But say you need to know how many square feet that is. You need to first come up with the unit conversion ratio.

To figure out how many square feet there are in 1 square yard, consider the diagram below of a region that is 1 yard long on each side:

1 yard = 3 feet

1 yard = 3 feet

Since area of a square is length x width, the area of this region is (1 yard) x (1 yard) = 1 square yard. But since 1 yard is equal to 3 feet, we can rewrite this as

Area = (3 feet) x (3 feet) = 9 square feet. You can also count 9 squares, each 1 sq. ft., in the region.

Therefore, **1 square yard = 9 square feet.** This is our unit conversion that we can use to convert from sq. yards to sq. ft or vice versa.

So for a plot that is 252 square yards, we can find the number of square feet by

$$(252 \text{ square yards}) \times \left(\frac{9 \text{ square feet}}{1 \text{ square yard}} \right) = 2268 \text{ square feet}$$. This method is identical to

the method we used at the beginning of this document for converting units of length. Just arrange the unit conversion ratio so the units you want are on the top and the units you don't want anymore cancel out.

You can do a similar thing to find the unit conversions for other units as well. I will summarize the conversions in the table below. We'll save metric units for the last worksheet.

Distance Unit Conversions	Area Unit Conversions
1 yard = 3 feet	1 sq. yard = 9 sq. feet
1 yard = 36 inches	1 sq. foot = 144 sq. inches
1 foot = 12 inches	1 sq. yard = 1296 sq. inches
1 mile = 5280 feet	43,560 sq. feet = 1 acre
1 mile = 1760 yards	1 acre = 4840 sq. yard
	640 acres = 1 sq. mile

Example 7: A 1/8 acre piece of property needs topsoil. In order to figure out how much topsoil you will need, you would first have to find out how many square feet this lot is. Let's just do that.
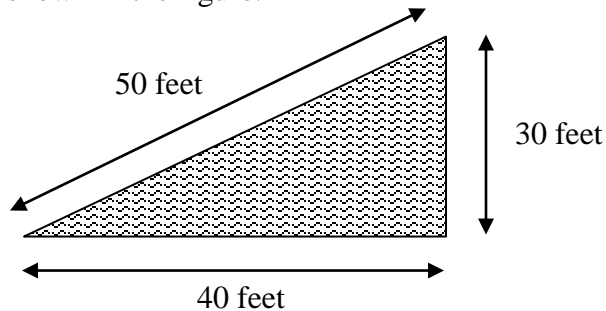
We need to convert from acres to square feet:

$$\left(\tfrac{1}{8}\ \text{acre}\right)\text{x}\left(\frac{43{,}560\ \textbf{sq.ft.}}{1\ \textbf{acre}}\right) = 5445\ \textbf{sq. ft.}$$ Then if you knew how many inches deep you
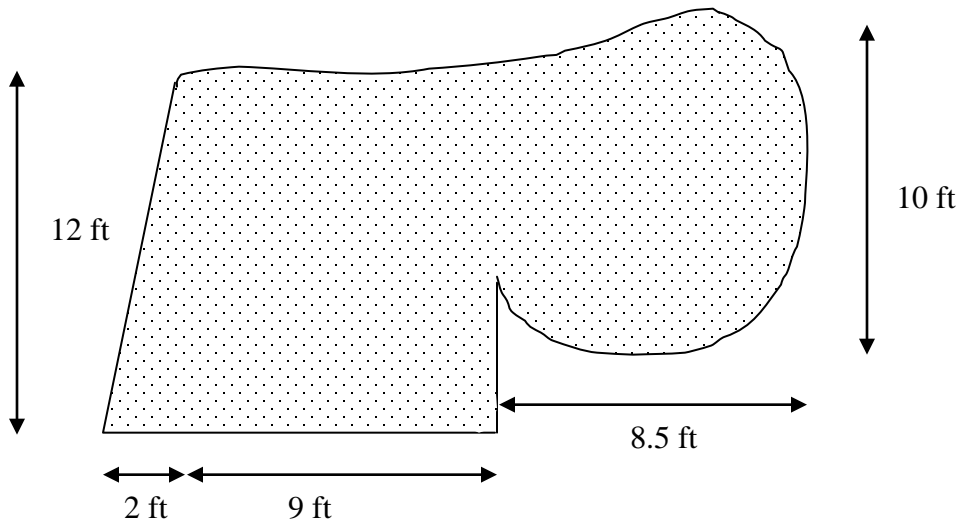
wanted the topsoil you figure out how much topsoil you would need (we'll save that kind of volume calculation for a later worksheet).

Homework Problems

1. How many inches are there in 22.5 feet?

2. How many inches are there in 7.3 yards?

3. How many feet are there in 125.9 yards?

4. How many square feet are there in 19.3 square yards? How many square inches are there?

5. A rectangular plot of land measures 40 yards and 2 feet on one side and 41.5 yards on the other. How many **square yards** is this plot?

6. Find the area of the plot of land shown in the figure.

50 feet

30 feet

40 feet

7. Estimate the area of the plot of land shown in the figure below.

12 ft

10 ft

8.5 ft

2 ft   9 ft

8. The directions say to mix 1 teaspoon of an emulsifiable concentrate liquid herbicide per gallon of water to cover 100 square **yards** of lawn. Your lawn actually covers 1,250 square **feet**. How many gallons of spray mix do you actually need?

9. The directions say to apply 2 pounds of an herbicide product per 1,000 square **feet** of area. The planting bed to be treated covers 390 square **yards**. How many pounds of product need to be applied to this planting bed?

10. The flowerbed shown needs to be covered with leaf compost to a depth of 3 inches. You have bales of compost that say each bale will cover 28 sq. ft. to that depth. How many bales of compost do you need for the job?

9 yards