Convert Miles per Hour to Feet per Second (Unit Cancellation)

Convert 2 miles per hour to feet per second:

$$\frac{2 \text{ miles}}{1 \text{ hour}} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} = 2.93 \text{ feet per second}$$

We want to show you a method for doing calculations that won't require you to memorize a lot of formulas. It's called **Unit Cancellation**, with units being the units of measurement, like inches, feet, seconds, ounces, you get the picture.

We can use unit cancellation to solve many problems or answer many questions, by using the relationship of one unit to another. For example, 12 inches = 1 foot. When you are working through a problem, always write the units. This will help you set up the units as fractions or ratios, and tells you whether to multiply or divide. Any whole number can be turned into a fraction by putting 1 under it

Convert 15 yards to inches, knowing that 1 yard = 3 feet, and 1 foot = 12 inches.

$$\frac{15 \text{ yards}}{1} \times \frac{3 \text{ feet}}{1 \text{ yard}} \times \frac{12 \text{ inches}}{1 \text{ foot}} = 540 \text{ inches}$$

Example: ***Convert 2 miles to inches***. We want our final answer in inches. We can use what we know to develop a path… we know how many feet in a mile, and how many inches in a foot. We start out by writing:

$$\frac{2 \text{ miles}}{1}$$ Any whole number can be turned into a fraction by putting 1 under it.

Then, we want to convert miles to feet, knowing that 1 mile = 5,280 feet. Here is where the trick starts. We want the units to cancel out, so set up the next ratio, or fraction, with miles on the bottom, so it will cancel out.

$$\frac{2 \text{ miles}}{1} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}}$$

$$\frac{2 \text{ miles}}{1} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}} = 10{,}560 \text{ feet}$$

The next step is to convert feet to inches. We know that 1 foot = 12 inches. Set up the next ratio (fraction) so that feet are on the bottom and inches on the top, so they again cancel out:

$$\frac{10{,}560 \text{ feet}}{1} \times \frac{12 \text{ inches}}{1 \text{ foot}} = 126{,}720 \text{ inches}$$

We just converted 2 miles to inches. We broke apart the problem so you can see the steps. To get the big picture, write the conversion like this:

$$\frac{2 \text{ miles}}{1} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}} \times \frac{12 \text{ inches}}{1 \text{ foot}} = 126{,}720 \text{ inches.}$$

To make sure you have it set up right, cancel out the units (mile on the top to match one on the bottom, and feet on the top, matching another on the bottom). You end up with the correct unit, inches. For this problem, you can even do the math in just a few steps: 2 X 5,280 X 12 = 126,720 inches. The top numbers (numerators) are multiplied, and we divide by the bottom numbers (denominators). Since we have only 1s on the bottom (denominator), we don't have to do any division. Any number divided by 1 = that number.

Next, we'll set up a unit cancellation problem where we need to do some division, as well. Some useful conversions to keep in mind: 1 mile = 5,280 feet. 1 hour = 60 minutes. 1 minute = 60 seconds

Convert 2 miles per hour to feet per second:

$$\frac{2 \text{ miles}}{1 \text{ hour}} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} = 2.93 \text{ feet per second}$$

Convert 12 yards to inches, knowing that 1 yard = 3 feet, and 1 foot = 12 inches.

$$\frac{12 \text{ yards}}{1} \times \frac{3 \text{ feet}}{1 \text{ yard}} \times \frac{12 \text{ inches}}{1 \text{ foot}} = 432 \text{ inches}$$

Practice:

Solve the following — Write your set up below:

1. 3 hours = _____ seconds

2. 2.5 yds = _____ inches

3. 14 mi = _____ feet

4. 63,360 feet = _____ miles

5. 1,160 yards = _____ inches

Answers: 1. 10,800 seconds 2. 90 inches 3. 73,920 ft 4. 12 miles 5. 41,760 inches.

You can use proportions and unit cancellation when you have to convert sq. ft. to acres. The label rate is 3 oz. of pesticide per 1,000 sq. ft. How much pesticide is needed to treat 2.5 acres? 1 acre = 43,560 sq. ft. Set up the problem by putting acres and sq. ft. in the problem so they cancel each other out, giving the answer in ounces.

$$2.5 \text{ acres} \times \frac{43{,}560 \text{ sq. ft.}}{1 \text{ acre}} \times \frac{3 \text{ ounces}}{1{,}000 \text{ sq. ft.}} = 326.7 \text{ ounces}$$

You can use proportions and unit cancellation to convert from acres to sq. ft. ***The label rate is 3 quarts of pesticide per acre. How many fluid ounces do you need to treat 4,200 sq. ft.?*** Set up the problem by putting sq. ft. and quarts in the problem so they cancel each other out, giving the answer in ounces. 1 qt = 32 fluid ounces.

$$4{,}200 \text{ sq. ft.} \times \frac{1 \text{ acre}}{43{,}560 \text{ sq. ft.}} \times \frac{3 \text{ quarts}}{1 \text{ acre}} \times \frac{32 \text{ ounces}}{1 \text{ quart}} = 9.3 \text{ ounces}$$

You can use unit cancellation to convert ounces per minute, collected while calibrating equipment, to gallons per minute. ***Suppose you collect an average of 67 ounces in one minute from the nozzles on your sprayer. What does that equal in gallons per minute?*** Set up your equation in ratios (proportions) so that ounces cancel each other out, giving you the result in gallons per minute. 1 gallon = 128 fluid ounces.

$$\frac{67 \text{ ounces}}{1 \text{ minute}} \times \frac{1 \text{ gallon}}{128 \text{ ounces}} = \frac{0.52 \text{ gallons}}{1 \text{ minute}}$$

How many acres can you treat with a 300-gallon spray tank, if the application rate is 20 gallons per acre? Set up your equation so that gallons cancel out, giving you the answer in acres per tank.

$$\frac{300 \text{ gallons}}{1 \text{ tank}} \times \frac{1 \text{ acre}}{20 \text{ gallons}} = \frac{15 \text{ acres}}{1 \text{ tank}}$$

Practice:

1. *If you travel 440 feet in 30 seconds, what is your speed in miles per hour?*

2. *A sprayer is calibrated to deliver 2.5 gallons per minute. You can spray 1 acre in 20 minutes. How many gallons per acre did you apply*?

3. *You put 2 gallons of water in a 4 gallon backpack sprayer. After spraying a 100-square foot test area, you must add 15 ounces of water to refill the tank to the 2-gallon mark. At this application rate, how much liquid will you need to treat an area that measures 75 by 100 feet?*

Answers: 1. 10 mph 2. 50 gpa 3. 1,125 oz or 8.79 gal

Liquid formulations such as emulsifiable concentrates (EC) and flowables (F) will give the amount of a.i. as the weight in pounds a.i. per gallon of product. A 4EC product will have 4 pounds a.i. in each gallon. This information is given in the ingredient statement, stating, "This product contains 4 pounds of active ingredient per gallon."

A 2.5-gallon container of a 4EC product has how many pounds of a.i.? Set up your equation so that gallons cancel out (on top and bottom) and you end up with gallons.

$$2.5 \text{ gallons} \times \frac{4 \text{ pounds a.i.}}{1 \text{ gallon}} = 10 \text{ pounds}$$

Practice:

1. A 1-gallon container of a 5EC product has how many pounds of a.i.?

2. A 5-gallon container of a 2EC product has how many pounds of a.i.?

3. A 1-gallon container of a 2 EC product has how many pounds of a.i.?

***4. How many pounds of active ingredient are in a 5-gallon container of Atrazine 4L*?**

Answers:

1. A 1-gallon container of a 5EC product has how many pounds of a.i.?

1 gallon X $\frac{5 \text{ pounds a.i.}}{1 \text{ gallon}}$ = 5 lbs a.i.

2. A 5-gallon container of a 2EC product has how many pounds of a.i.?

5 gallons X $\frac{2 \text{ pounds a.i.}}{1 \text{ gallon}}$ = 10 lbs a.i.

3. A 1-gallon container of a 2 EC product has how many pounds of a.i.?

1 gallon X $\frac{2 \text{ pounds a.i.}}{1 \text{ gallon}}$ = 2 lbs a.i.

4. How many pounds of active ingredient are in a 5-gallon container of Atrazine 4L?

5 gallons X $\frac{4 \text{ pounds a.i.}}{1 \text{ gallon}}$ = 20 lbs a.i.