Conversions by Cancelling Units

Cancelling units is a handy way to convert one unit to another, such as miles to inches, seconds to weeks, or grams to kilograms. It’s based on the principle that multiplying or dividing both the numerator and denominator of a fraction by the same value doesn’t change the fraction’s value.

Example: Change 80 miles per hour into feet per second.

$\frac{80 miles}{1 hour}$ x $\frac{1 hour}{60 minutes}$ x $\frac{1 minute}{60 seconds}$ x $\frac{5,280 feet}{1 mile}$ 🡨 We multiply $\frac{80 miles}{1 hour}$ by 3 different **conversion factors**. Notice that the fraction for each conversion factor is equal to “1”.

$\frac{80 miles}{1 hour}$ x $\frac{1 hour}{60 minutes}$ x $\frac{1 minute}{60 seconds}$ x $\frac{5,280 feet}{1 mile}$ 🡨 Next, we cancel the units

$\frac{80 x 1 x 1 x 5,280 feet}{1 x 60 x 60 seconds x 1}$ = $\frac{422,400 feet}{3600 seconds}$ = 117 $\frac{1}{3}$ feet/second 🡨 Then, we multiply the numerators & denominators, and simplify the result

One common mistake is choosing the correct conversion factor, but writing it upside down.

Example: Change 43 gallons into quarts.

|  |  |
| --- | --- |
| ***Incorrect:***$\frac{43 gallons}{1}$ x $\frac{1 gallon}{4 quarts}$ = $\frac{43 gallons^{2}}{4 quarts}$ = ?!?! | ***Correct:***$\frac{43 gallons}{1}$ x $\frac{4 quarts}{1 gallon}$ = $\frac{43 x 4 quarts}{1}$ = 172 quarts |

Canceling of units is part of what is called **unit analysis**, or **dimensional analysis**. So if your parents ask about your Math Club homework this week, you can tell them it’s all about dimensional analysis. They’ll be impressed.

Metric System of Measurement:

|  |  |  |
| --- | --- | --- |
| Basic Unit of Length | **meter (m)** | 1 m = 100 cm = 1000 mm = .001 km |
| Basic Unit of Mass (weight) | **gram (g)** | 1 g = 1000 mg = .001 kg |
| Basic Unit of Capacity (liquid measurement) | **liter (L)** | 1 L = 1000 ml = .001 kl |

Important Metric System Prefixes:

|  |  |  |  |
| --- | --- | --- | --- |
| **Prefix** | **Symbol** | **Meaning** | **Order of Magnitude** |
| *giga-* | G | 1,000,000,000 | $$10^{9}$$ |
| *mega-* | M | 1,000,000 | $$10^{6}$$ |
| *kilo-* | k | 1,000 | $$10^{3}$$ |
| *hecto-* | h | 100 | $$10^{2}$$ |
| *deka-* | da | 10 | $$10^{1}$$ |
|  | base unit | 1 | $$10^{0}$$ |
| *deci-* | d | 0.1 | $$10^{-1}$$ |
| *centi-* | c | 0.01 | $$10^{-2}$$ |
| *milli-* | m | 0.001 | $$10^{-3}$$ |
| *micro-* | µ | 0.0000001 | $$10^{-6}$$ |
| *nano-* | n | 0.000000001 | $$10^{-9}$$ |

Some Common Metric Conversions

|  |
| --- |
| **Length** |
| 1 meter (m) = 100 centimeters (cm)1 cm = 0.01 m1 m = 1000 millimeters (mm)1 mm = 0.001 m1 kilometer (km) = 1000 m1 m = 0.001 km | 1 megameter = 1,000,000 m1 hectometer = 100 m1 dekameter = 10 m1 decimeter = 1/10 m1 micrometer = 1/1,000,000 m1 nanometer = 1/1,000,000,000 m |
|  |  |
| **Weight** | **Capacity** |
| 1 gram (g) = 1000 milligrams1 kilogram (kg) = 1000 grams1 milligram (mg) = 0.001 g1 g = 0.001 kg | 1 liter (L) = 1000 mL1 milliliter (mL) = 0.001 L1 kiloliter (kL) = 1000 L |

U.S. System of Measurement

Some common U.S. Measurement Conversions:

|  |  |  |  |
| --- | --- | --- | --- |
| **Length** | **Weight** | **Capacity** | **Area** |
| 1 foot = 12 inches1 yard = 3 feet1 yard = 36 inches1 mile = 5,280 feet | 1 lb. = 16 oz. 1 ton = 2,000 lbs. | 1 cup = 8 fl. oz.1 pint = 2 cups1 quart = 2 pints1 gallon = 4 quarts | 1 $ft^{2}$ = 144 $in^{2}$1 $yard^{2}$ = 9 $ft^{2}$1 acre = 43,560 $ft^{2}$1 $mile^{2}$ = 640 acres |

Conversions between Systems

Some Common Conversions between U.S. & Metric Systems:

|  |  |  |
| --- | --- | --- |
| **Length** | **Weight** | **Capacity** |
| 1 inch = 2.54 cm.1 meter = 3.28 feet1 meter = 1.09 yards1 mile = 1.61 km. | 1 ounce (oz.) = 28.35 grams1 pound (lb.) = 454 grams1 kilogram = 2.2 pounds | 1 liter (L) = 1.06 quarts1 gallon = 3.79 L |

Temperature Conversions:

|  |  |
| --- | --- |
| **To Convert Fahrenheit to Celsius:**1. Subtract 32
2. Multiply by 5
3. Divide by 9

Example: 75˚F = \_\_ degrees Celsius?75 – 32 = 4343 x 5 = 215215 $÷$ 9 = 23.975˚F = 23.9˚C | **To Convert Celsius to Fahrenheit:**1. Multiply by 9
2. Divide by 5
3. Add 32

Example: 32˚C = \_\_ degrees Fahrenheit?32 x 9 = 288288 $÷$ 5 = 57.657.6 + 32 = 89.632˚C = 89.6˚F |