Day 1 Worksheet: Converting Units

Summer STEM Academy:

Measuring things which are very fast or very small

In this workshop we will be measuring physical things like space and time. In order to do this, we need to understand a little bit about 'units': what they are and how to convert between them.

By 'units', I mean units of measurement, for example **distance** measurements like inches or kilometers, or **time** measurements like seconds or years. You can think about these as physical things that exist in the universe, and we have different ways of representing them. If you want, you can represent them anyway you want, but usually there is a best choice for every situation. Often, we need to be able to convert between them – for example you might want to convert the speed of sound measurement you will make tomorrow from cm/ms (centimeters per millisecond) to m/s (meters per second) or mi/hr (miles per hour).

By the way: in the metric system, there is a convenient way to represent really big and really small numbers by modifying units (e.g. centimeters or kilometers instead of meters). There is also 'scientific notation', which is another convenient way to represent really big and really small numbers. We'll talk more about both of these, and how they are related, tomorrow!

To get started, I found a nice YouTube video which explains basic unit conversion:
www.youtube.com/watch?v=HRe1mire4Gc

By the way: for this class we will mostly care only about distance and time units. Of course there are other types of units like energy, mass, power, etc., but we won't need to know anything about them. If you're curious: feel free to ask! The only other types of units we will use are Volts (V), which is a measure of electrical 'potential energy'. There's really only one way to represent them, unless you count milliVolts (1000 mV = 1V), but these are super easy to convert.

1 Distance

Now that we know how to convert between different types of units, all we really need to know is how all the different units are related. Here's a table to help you out:

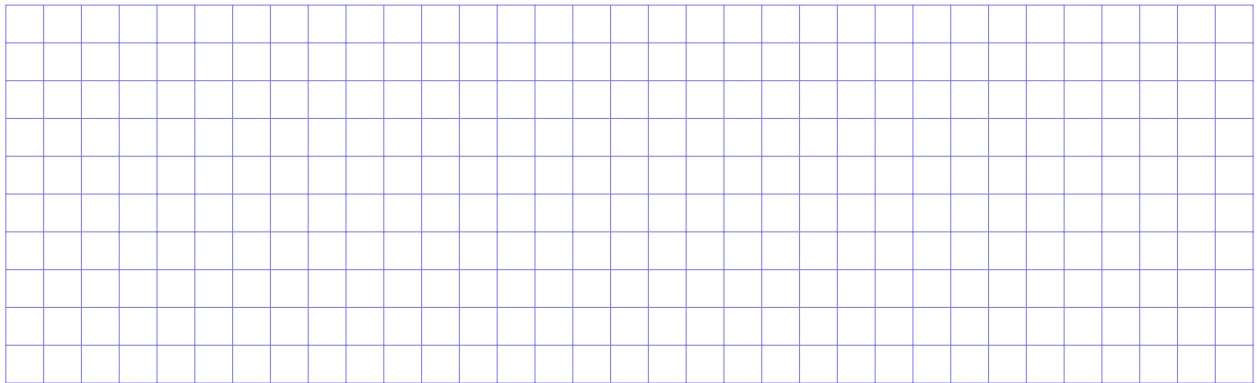| Unit	Symbol / Relation
inch	1 in = 25.4 mm
foot	1 ft = 12 in
yard	1 yd = 3 ft
mile	1 mi = 5,280 ft
meter	1 m
centimeter	100 cm = 1 m
millimeter	1,000 mm = 1 m
kilometer	1 km = 1,000 m

Exercises:

1. How many mm are in 1 ft?

Answer:

2. How many m are in 1 mi?

Answer:

2　Time

Time is even simpler, since we don't have to worry about conversion between metric and imperial units!

Unit	Symbol / Relation
nanosecond	1,000,000,000 ns = 1 s
microsecond	1,000,000 μs = 1 s
millisecond	1,000 ms = 1 s
second	1 s
minute	1 min = 60 s
hour	1 hr = 60 min
day	1 day = 24 hr
year	1 year = 365.25 days

Exercises:

1. How many seconds are in a day?

Answer:

2. How may minutes are in a year?

Answer:

3. How may μs are in 1 ms?

Answer:

3 Combinations of Units

We can also combine these to produce things like area (distance *times* distance) or speed (distance *divided by* time). Conversion is relatively straightforward, and is probably best illustrated by example.

Example:

The record for the 100 yard dash in 9.07 s. What is this in terms of km/hr?

$$100 \text{ yd} = 300 \text{ ft} \times \frac{1 \text{ m}}{3.28084 \text{ ft}} \tag{1}$$

$$= 91.44 \text{ m} \tag{2}$$

$$= 0.09144 \text{ km} \tag{3}$$

$$9.07 \text{ s} = 9.07 \text{ s} \times \frac{1 \text{ hr}}{3600 \text{ s}} \tag{4}$$

$$= 0.002519 \text{ hr} \tag{5}$$

$$\Rightarrow \frac{100 \text{ yd}}{9.07 \text{ s}} = \frac{0.09144 \text{ km}}{0.002519 \text{ hr}} \tag{6}$$

$$= 36.29 \text{ km/hr} \tag{7}$$

Exercises:

1. What is 1 m/s in mi/hr?

Answer:

2. What is 50 mi/hr in cm/ms?

Answer:

3. The earth orbits the sun at a speed of about 67,000 mi/hr. What is this m/ms?

Answer:

4. (continued) What about this speed in mm/μs?

Answer:

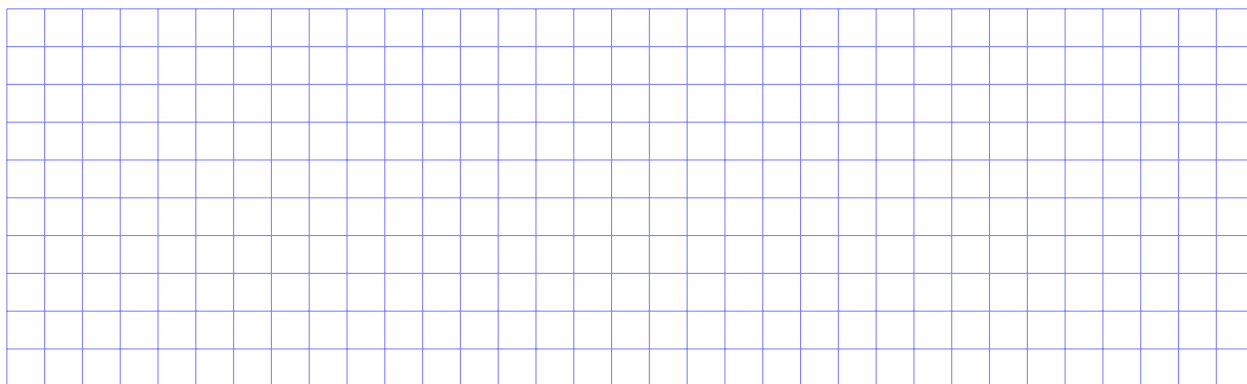5. (continued) What about this speed in μm/ns?

Answer:

6. For some reason, in the US we measure land area in terms of 'acres', which is one chain (66 ft) by one furlong (660 ft). What is this in terms of m^2 (meters squared)?

Answer:

7. What is 1 mi^2 (miles squared) in terms of m^2?

Answer:

8. How many acres are in 1 km^2?

Answer: