Technology Integrated Mathematics
Class Notes
Measurement: Metric Units (Section 5.3)

Only three countries in the world do *not* use metric units as their standard – U.S., Liberia, and Myanmar.

Metric units are ubiquitous and so we must know our way around them. There is a beautiful logic to them as we will see. We will define them and learn to convert among various metric units. If you travel 1500 kilometers, how far is that?

We will focus on units for length, speed, area, volume, weight, and temperature. The metric system uses the same units for time as we are used to.

Here is a table for the main metric units with which we will work.

Quantity Measured	**Unit (abbreviation)**	**Rough equivalent to U.S. Standard**	**Appropriate Things to Measure**
length (distance)	meter (m)	1 m is about 1 yard	your height, lumber length, room width
weight	kilogram (kg)	1 kg is about 2.2046 lbs	your weight, weight of metal casting
liquid capacity (or volume)	liter (L)	1 L is about ¼ of a gallon (or 0.264172 gallon)	milk
speed	kilometer per hour (km/h)	100 km/h is about 62 mph (miles per hour)	car speed
temperature	Celsius (°C)	0°C = 32°F and 100°C = 212°F	room or body temperature

A kilometer is 1000 meters. We will see the decimal system plays a large role in conversions.

Water freezes at 0°C and boils at 100°C .

So, meter measures length but we use kilometers to measure *really large* lengths, like the length of a road. Likewise, kilograms measure weight but what if we have a small object, like your pencil, to weigh?

One of the nicest things about the metric system is its dependence on the decimal system. It is not coincidence that 1 kilometer is 1000 meters, and *not* say, 1257 meters. We'll look into that more.

For metric units like meters, liters, or grams, we will attach prefixes to make the other units like centimeters, milliliters, or kilograms. On the next page, we see a picture of how these prefixes are organized.

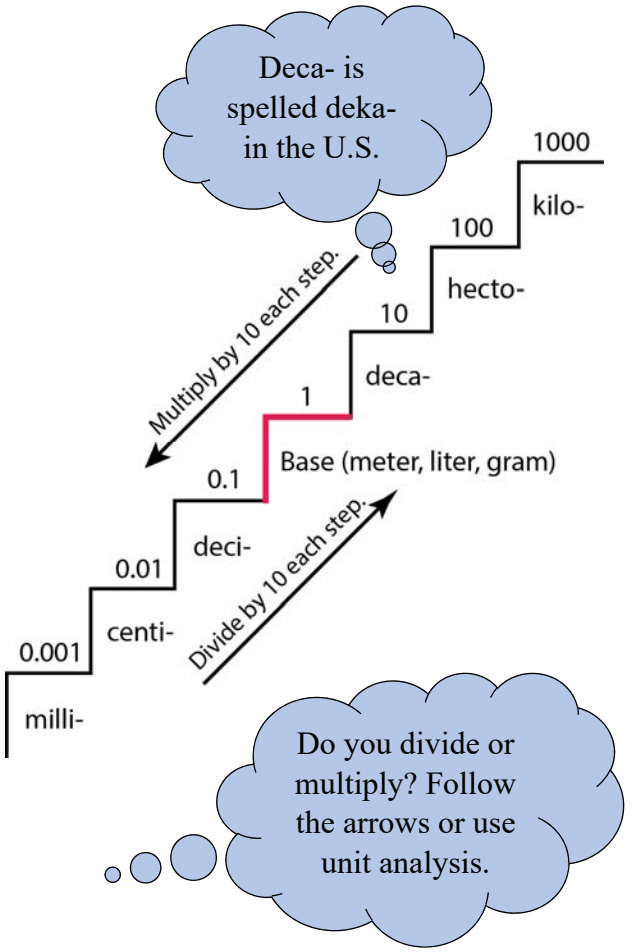
Metric Staircase for Conversions:

We see the bases in the middle of this staircase. We would choose whichever base makes sense for what we are measuring.

If you go up the stairs, you get bigger units. A decameter is equal to 10 meters.
A hectometer is equal to 100 meters.
A kilometer is equal to 1000 meters.

If you go down the stairs, you get smaller units.
A deciliter is 0.1 (or 1/10) of a liter.
A centiliter is 0.01 (or 1/100) of a liter.
A milliliter is 0.001 (or 1/1000) of a liter.

From left to right, we use the abbreviations m, c, d (mLg) da, h, and k. Always use the proper case (lower versus upper).



expl 1: Convert 6,500 meters to kilometers.

expl 2: Convert 0.035 kg to g.

expl 3: Convert 0.25 m/sec to cm/sec.

More Detail:
In reality, there are more prefixes than we saw on the last page. Here is a table from the book that shows more but leaves behind some which are *not* commonly used in the trades.

Metric Prefix	Multiplier	Common Example	Abbreviation
tera	1,000,000,000,000 (10^{12})	terabyte: one trillion bytes	T
giga	1,000,000,000 (10^{9})	gigahertz: one billion hertz	G
mega	1,000,000 (10^{6})	megawatt: one million watts	M
kilo	1,000 (10^{3})	kilopascal: one thousand pascal	k
centi	0.01 (10^{-2})	centimeter: one hundredth of a meter	c
milli	0.001 (10^{-3})	milliliter: one thousandth of a liter	m
micro	0.000001 (10^{-6})	microgram: one millionth of a gram	µ
nano	0.000000001 (10^{-9})	nanosecond: one billionth of a second	n
pico	0.000000000001 (10^{-12})	picofarad: one trillionth of a farad	p

You might find this graphic helpful as you convert among various units.

Length	Weight
1 cm = 10 mm	1 mg = 1000 µg
1 m = 100 cm = 1000 mm	1 g = 1000 mg
1 km = 1000 m	1 kg = 1000 g
	1 metric ton (t) = 1000 kg

If 1 g = 1000 mg and 1 g = 1,000,000 µg, do you see why 1 mg = 1000 µg?

Area	Volume/Liquid Capacity
1 ha = 10,000 sq m (m^2)	1 mL = 1000 µL
	1 cu cm (cm^3) = 1 mL
	1 liter (L) = 1000 cu cm
	1 L = 1000 mL

A hectare (or an area equal to 100 m x 100 m) is abbreviated ha.

expl 4: Margaret is dosing her patient with a medicine that only comes in 500 µg tablets. If the patient needs 2.5 mg per dose, how many tablets is that?

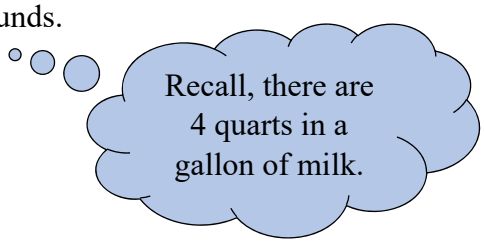
This is the lowercase Greek letter mu.

expl 5: Marcus has delivered 3.25 metric tons of sand to a worksite. How many kilograms is that?

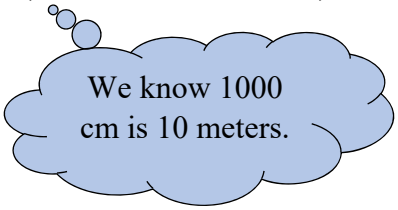
Thinking Metric:
You want to have some idea of these measures in your head. You will be asked to estimate various metric measurements. Very few calculations are needed.

We want to keep the following in mind.

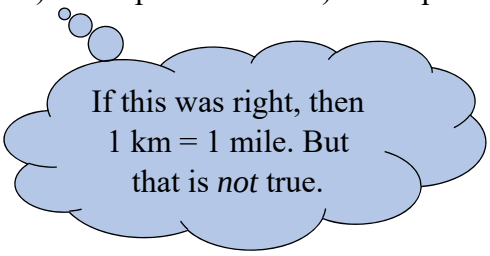
1. A meter is a little more (about 10%) than a yard (which is exactly 3 feet).
2. An inch is a little more than 2.5 centimeters.
3. A kilogram is a little more (about 10%) than 2 pounds.
4. A liter is a little more (about 6%) than a quart.
5. A kilometer is about 62% of a mile.



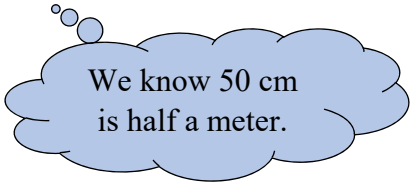
expl 6: Choose the measurement closest to 10 yards.
a.) 1000 cm b.) 900 cm c.) 1100 cm



expl 7: Choose the measurement closest to 150 km/h.
a.) 100 mph b.) 150 mph c.) 200 mph

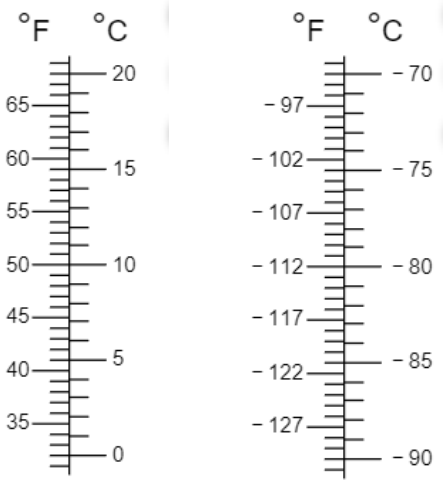


expl 8: Choose the measurement closest to the diameter of a frisbee.
a.) 25 cm b.) 3 cm c.) 50 cm



Temperature:

Here in the U.S., we use the Fahrenheit scale whereas Celsius is used in metric calculations. To the right, you'll see two pieces of a thermometer showing some equivalent Celsius and Fahrenheit readings. Use it to answer the following question.



Use the thermometer to estimate Fahrenheit equivalents to these Celsius readings.

expl 9: Estimate a cold day in Illinois.

a.) 20 ℃ b.) 0 ℃ c.) – 80 ℃

Greatest Possible Error:

We return to this idea. Recall that the greatest possible error of a measurement can be found by halving the precision (the right-most significant digit).

expl 10: A ball bearing is measured to be 0.65 cm. What is the greatest possible error of this measurement in millimeters?

Start by finding the error in centimeters.