

# Unit 1: Scientific Measurement

*Mrs. Snyder*  
*Chemistry*

## Unit 1 Learning Objectives:

By the end of the unit students will be able to...

- Convert between scientific notation and standard form
- Measure and convert between metric units and temperature units
- Read metric scales to the correct number of digits and with appropriate units
- Solve conversion problems using units
- Determine and calculate density

Monday	Tuesday	Wednesday	Thursday	Friday
August 20	21	22	23	24
			Intro to Syllabus & Safety Contract  Mini Desalination Plant Activity	Mini Desalination Plant Activity
27	28	29	30	31
Notes: Scientific Notation & Metric Conversions	Notes: Metric Conversions	Notes: Metric Conversions  <b>Partner Quiz: Metric Conversions</b>	Notes: Temperature, Reading Instruments	Notes: Temperature, Reading Instruments  <b>Quiz: Lab Safety</b>
September 3	28	29	6	7
<b>No School! Happy Labor Day!</b>	<b>Lab:</b> Measurements of mass and volume	<b>Lab:</b> Measurements of mass and volume	Unit 1 Review	<b>Unit 1 Test HW packet Due</b>

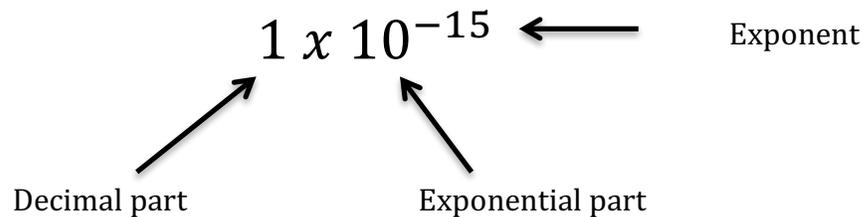
---

## Scientific Notation:

Scientists often measure very large and very small numbers. For example, scientists can measure time periods as short as 0.000000000000001 seconds. But writing all of the zeros in this number can take a long time, and if written incorrectly can result in error. Therefore, scientists use \_\_\_\_\_ *to write these numbers more compactly and more accurately.*

In scientific notation the above example (0.000000000000001) would be written as  $1 \times 10^{-15}$ .

Scientific Notation consists of the following three parts:



To convert from ***expanded notation to scientific notation:***

- Move the decimal to the right of the first integer.
- Count the number of spaces you moved the decimal (this number is the exponent)
- Numbers larger than 1 have a positive exponent
- Numbers smaller than 1 have a negative exponent

To convert from ***scientific notation to expanded notation:***

- Move the decimal the number of spaces indicated by the exponent
- Positive exponent indicates the number is greater than 1
- Negative exponent indicates the number is less than 1

**Practice:** Convert from expanded notation to scientific notation

1. 0.00393
2. 45,000
3. 10
4. 45.872

**Practice:** Convert from scientific notation to expanded form

1.  $7.4 \times 10^5$
2.  $6.34 \times 10^{-7}$
3.  $6.90 \times 10^3$
4.  $5.983 \times 10^9$

---

## The Metric System

The metric system is based on powers of 10, so it is easy to use.

Prefix	Symbol	Magnitude
Giga	G	$10^9$
Mega	M	$10^6$
Kilo	k	$10^3$
Hecto	h	$10^2$
Deca	da	10
Basic unit	-	1
Deci	d	$10^{-1}$
Centi	c	$10^{-2}$
Milli	m	$10^{-3}$
Micro	$\mu$ (greek letter)	$10^{-6}$
nano	n	$10^{-9}$

The Standard Units, and the ones that we will use in this class are:

Quantity	Unit	Symbol
Length	meter	m
Mass	Kilogram *gram	kg *g
Time	Second	s
Temperature	Kelvin	K

**Practice:** Fill out the following chart based on the metric system

Unit name	Symbol	magnitude
<i>Kilometer</i>	<i>km</i>	$10^3$ meters
	$\mu L$	
centigram		
	nm	
		$10^9$ grams
nanometer		
	dm	

---

### Converting Between Units:

*Units should always be written in calculations.* Using the metric system you can convert between metric units without changing the value of the measurement. Units can also be converted from the metric systems to other common units.

Conversion factors are constructed from any two quantities known to be equivalent. For example 1 m is known to equal 100 cm. This known fraction or ratio can be written in any of the following ways.

$$1 \text{ m} = 100 \text{ cm} \quad \text{or} \quad \frac{1 \text{ m}}{100 \text{ cm}} \quad \text{or} \quad \frac{100 \text{ cm}}{1 \text{ m}}$$

### Useful conversions to remember

$$1 \text{ inch} = 2.54 \text{ cm}$$

$$1 \text{ mile} = 1.61 \text{ kilometers}$$

$$1 \text{ kg} = 2.204 \text{ lbs}$$

$$1 \text{ oz.} = 28.35 \text{ g}$$

$$1 \text{ gallon} = 4.55 \text{ Liters}$$

$$1 \text{ mL} = 1 \text{ cm}^3$$

$$1 \text{ hectare} = 1000 \text{ m}^2 = 2.47 \text{ acres}$$

**Practice:** Convert each of the following

*One Step Problems:*

1. 548 mL into L
2. 10,000 kg into g
3. 8.5467 Mm into nm
4. 13.85 in into cm

*Multi-Step Problems:*

5. 0.33 cm into dm
6. 800 L into gallons
7. 176.8 ft into cm

*Conversions with squared and cubed units:*

In order for the units to cancel, the conversion factor must be squared or cubed in order for the units to cancel.

Example: Convert  $200 \text{ cm}^2$  into  $\text{m}^2$

Wrong:

Correct:

**Practice:** Convert the following

1.  $3.4 \times 10^8 \text{ cm}^3$  into  $\text{m}^3$
2.  $8.325 \text{ in}^2$  into  $\text{cm}^2$

**Real World Word Problems:**

*ONE STEP Conversion practice*

1. Your refrigerator probably contains  $8.5 \times 10^{24}$  molecules of ozone destroying CFCs. If each CFC molecule eventually results in the destruction of 100,000 Ozone molecules, how many Ozones will be destroyed when your fridge releases all of its CFC from a landfill?

*Multi STEP Conversion practice*

1. If a bulb is rated 100 Watts, this means that it uses 100 Joules of energy per second (100 J/s). An incandescent bulb typically can burn for 10,000 hours. How much energy will a 100 watt bulb use in its lifetime?
2. A 23 watt compact fluorescent lamp (CFL) will burn for about 15,000 hrs. How much energy will it use in its lifetime?

3. Use the following information to answer the next questions.

***A kilogram of coal can create  $2.4 \times 10^4$  kJ of energy (electricity)***

***A kilogram of coal also releases 2.93 kg of CO<sub>2</sub> greenhouse gas.***

- a. An average incandescent bulb will use  $3.6 \times 10^6$  kJ before it burns out. How many kg of CO<sub>2</sub> will be produced during the bulb's lifetime?
  
  
  
  
  
  
  
  
  
  
- b. An average compact fluorescent bulb (CFL) will use  $2.4 \times 10^6$  kJ in its lifetime. How many kg of CO<sub>2</sub> will be produced?

---

## Temperature

There are three scales for measuring temperature.

(1) **Fahrenheit (F)**, Gabriel Fahrenheit (1686-1736)

- a. 0 F was set as the coldest temperature that could be obtained in a liquid in the lab, a mixture of salt, ice, and water; 32 F was set as the temperature of a mixture of ice and water.

(2) **Celsius (C)**, Anders Celsius (1701-1744)

- a. 0 °C was set as the freezing point of water and 100 °C was set as the boiling point of water.

(3) **Kelvin (K)**, Lord Kelvin, William Thomson (1824 -1907)

- a. 0 K (also called "absolute zero") is the coldest temperature that is possible. At 0 K all molecular motion stops.

### Temperature Conversions

The following equations can be used to convert between the different temperature scales.

$$F = \frac{9}{5}(C) + 32$$

$$C = \frac{5}{9}(F - 32)$$

$$K = C + 273$$

Practice: Convert the following temperatures. Round to one decimal place.

1.  $80^\circ\text{F} = \underline{\hspace{2cm}}^\circ\text{C} = \underline{\hspace{2cm}}\text{K}$

2.  $310\text{K} = \underline{\hspace{2cm}}^\circ\text{C} \underline{\hspace{2cm}}^\circ\text{F}$

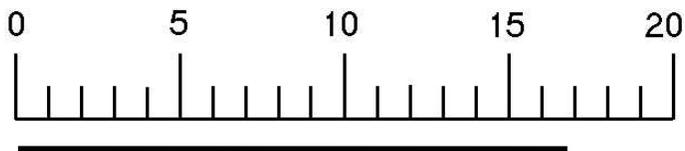
---

## Taking Measurements

Increment:

The accuracy of the apparatus (thermometer, ruler, graduated cylinder, etc.) is determined by the size of the smallest increment.

**Note: Always record data to one decimal place past the increment!**

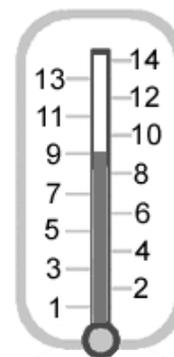


Increment: \_\_\_\_\_

Length: \_\_\_\_\_

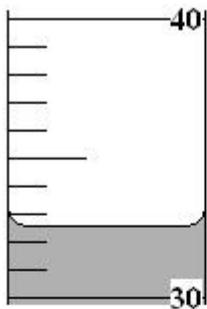
Increment: \_\_\_\_\_

Temperature: \_\_\_\_\_



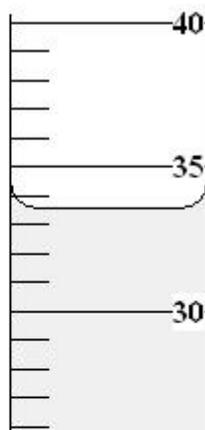
*How to read a graduated cylinder*

- Be eye level to the meniscus  
*Meniscus: The curved surface that a liquid forms in a narrow tube*
- Read the level to the bottom of the meniscus
- Holding a white paper behind the glassware
- Record measurement to one order of magnitude greater than the marks on the graduated cylinder



Increment: \_\_\_\_\_

Volume: \_\_\_\_\_



Increment: \_\_\_\_\_

Volume: \_\_\_\_\_