Scientific Inquiry

Standard B – 1.3

Standard B-1

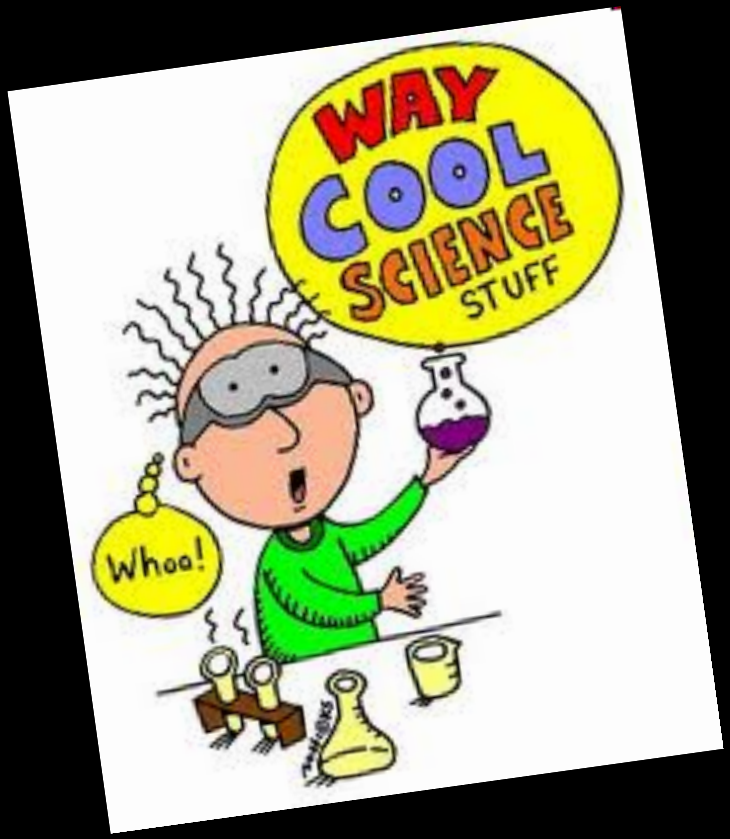
The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.

B-1.3
Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.

Key Concepts

- Reading scientific measuring instruments
- Metric Units
- Measurement Data
- Precision vs. Accuracy

What You Already Know!



In the ***1st grade*** you used a ruler. In the ***2nd grade*** you used thermometers and balances. By ***3rd grade*** you used meter tapes and graduated cylinders and by the ***6th grade*** you were using spring scales and beam balances. You have used various scientific tools for a long time.

What You Should Understand After This Lesson

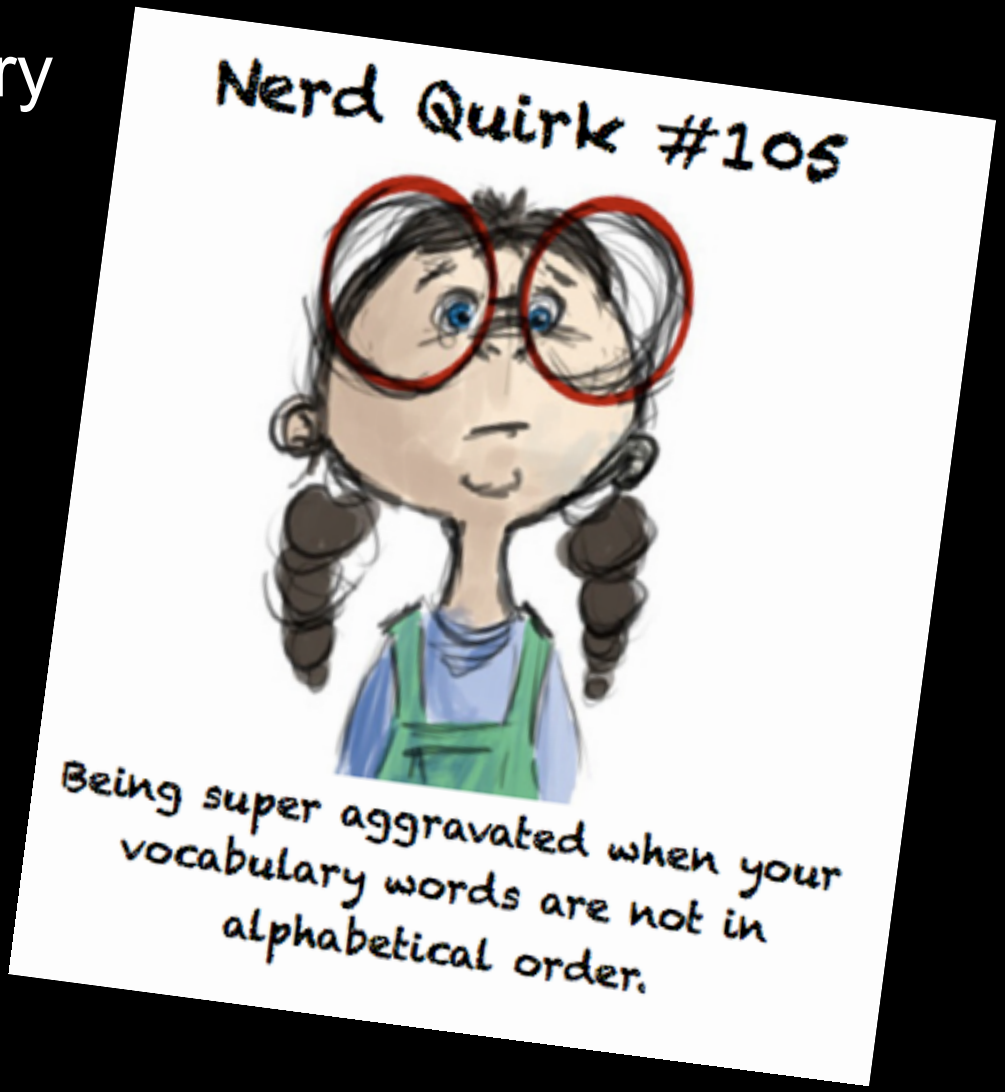
- Read scientific instruments using the correct number of decimals to record the measurements in appropriate metric units.
- The measurement scale on the instrument should be read with the last digit of the recorded measurement being estimated.
- Record data using appropriate SI units.
- Understand the difference between *precision* and *accuracy.*

Objective

- ***Compare*** precise vs. accurate measurement data.
- ***Summarize*** accuracy & precision with specific scientific instruments in making measurements.
- ***Identify*** the appropriate instrument that meets the measurement need and appropriate precision for a designed experiment.

Vocabulary

There are no vocabulary words for this section.



Measurement

Measurement is an important type of observation.

It is an observation that includes numbers and units.

SI or **metric system**

Based on multiples of **10**

Prefixes before the base

Prefix	Symbol	Multiplier	
exa	E	10^{18}	1,000,000,000,000,000,000
peta	P	10^{15}	1,000,000,000,000,000
tera	T	10^{12}	1,000,000,000,000
giga	G	10^{9}	1,000,000,000
mega	M	10^{6}	1,000,000
kilo	k	10^{3}	1,000
hecto	h	10^{2}	100
deka	da	10^{1}	10
deci	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
milli	m	10^{-3}	0.001
micro	μ	10^{-6}	0.000,001
nano	n	10^{-9}	0.000,000,001
pico micromicro	p μμ	10^{-12}	0.000,000,000,001
femto	f	10^{-15}	0.000,000,000,000,001
atto	a	10^{-18}	0.000,000,000,000,000,001

It's all about the prefix.

Prefix	Symbol	Multiplier	
exa	E	10^{18}	1,000,000,000,000,000,000
peta	P	10^{15}	1,000,000,000,000,000
tera	T	10^{12}	1,000,000,000,000
giga	G	10^{9}	1,000,000,000
mega	M	10^{6}	1,000,000
kilo	k	10^{3}	1,000
hecto	h	10^{2}	100
deka	da	10^{1}	10
deci	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
milli	m	10^{-3}	0.001
micro	μ	10^{-6}	0.000,001
nano	n	10^{-9}	0.000,000,001
pico micromicro	p μμ	10^{-12}	0.000,000,000,001
femto	f	10^{-15}	0.000,000,000,000,001
atto	a	10^{-18}	0.000,000,000,000,000,001

Answers

1. G
2. C
3. F
4. K
5. I
6. J
7. B
8. H
9. D
10. E
11. A

What if I want to convert?

Dimensional analysis is a way to convert measurements between different units to help compare them.

WHAT YOU WANT

WHAT YOU HAVE

Examples

1. 11 mm = _____ cm

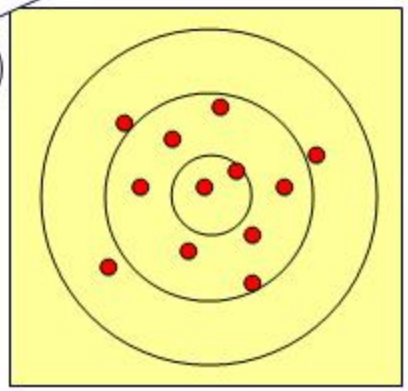
2. 261 g = _____ kg

3. 9474 mm = _____ cm

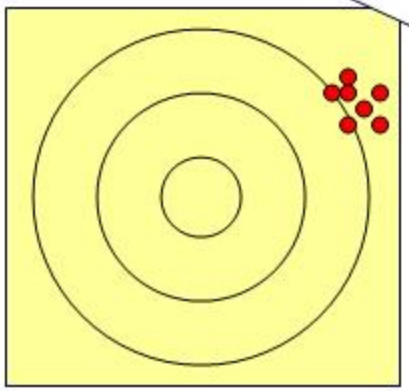
Accuracy vs Precision

Measure of bias

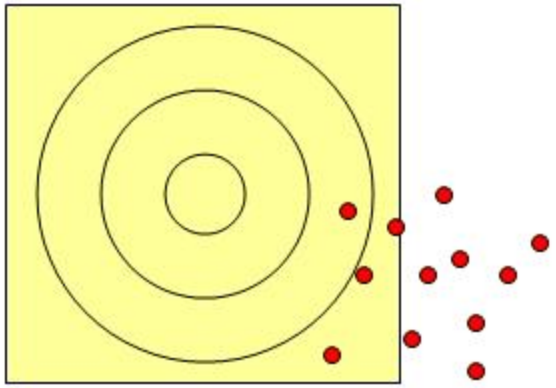
Measure of spread



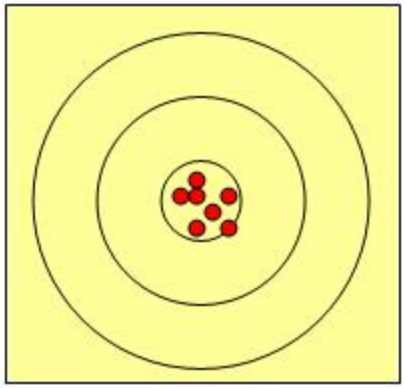
Accurate but not Precise



Precise but not Accurate



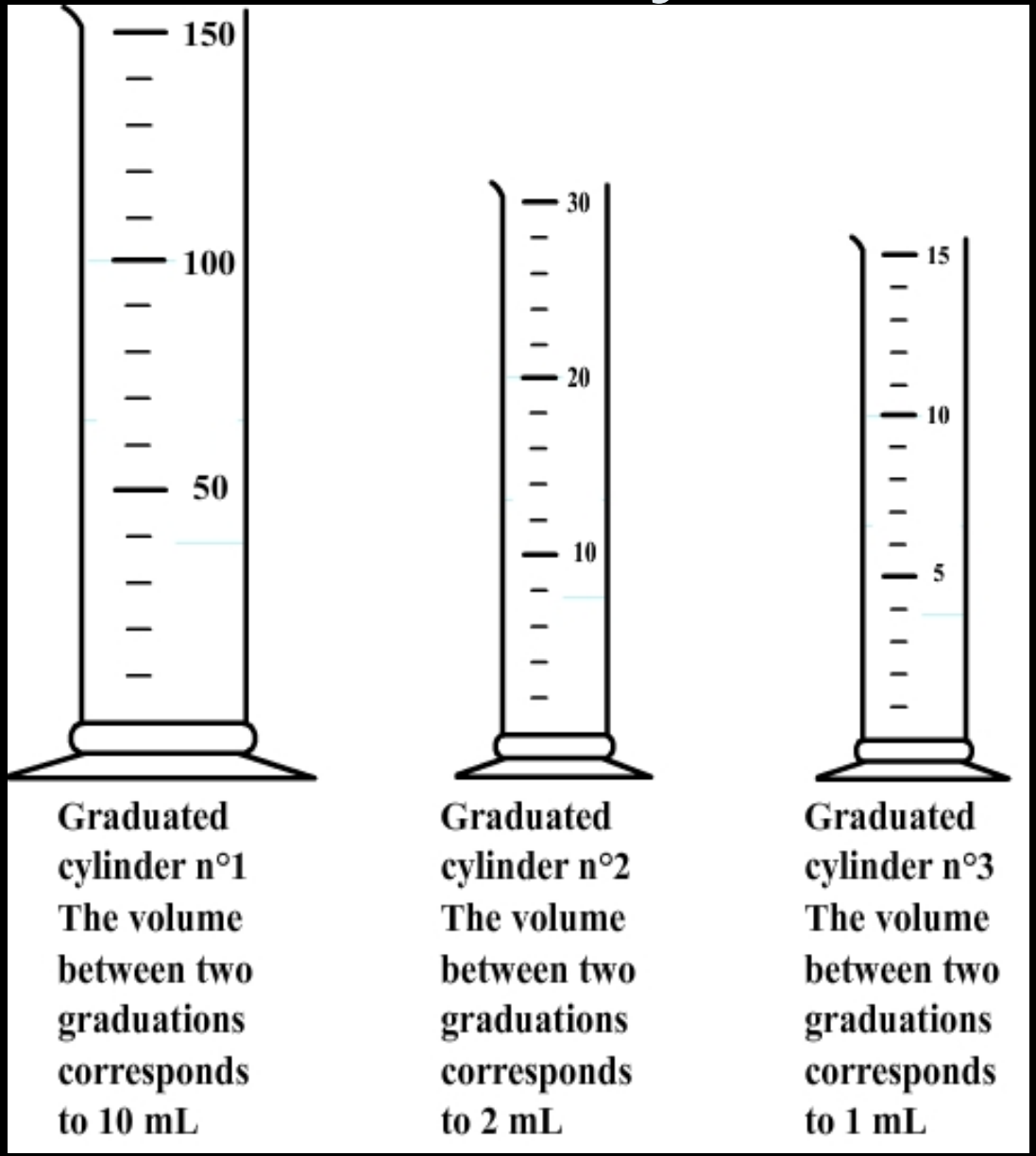
Not Accurate or Precise



Both Accurate & Precise

Precision vs. Accuracy

Precision is the amount of detail in measurements, or how closely two or more measurements agree.



Precision vs. Accuracy

Accuracy is how close a measurement is to the actual or accepted value for that measurement.

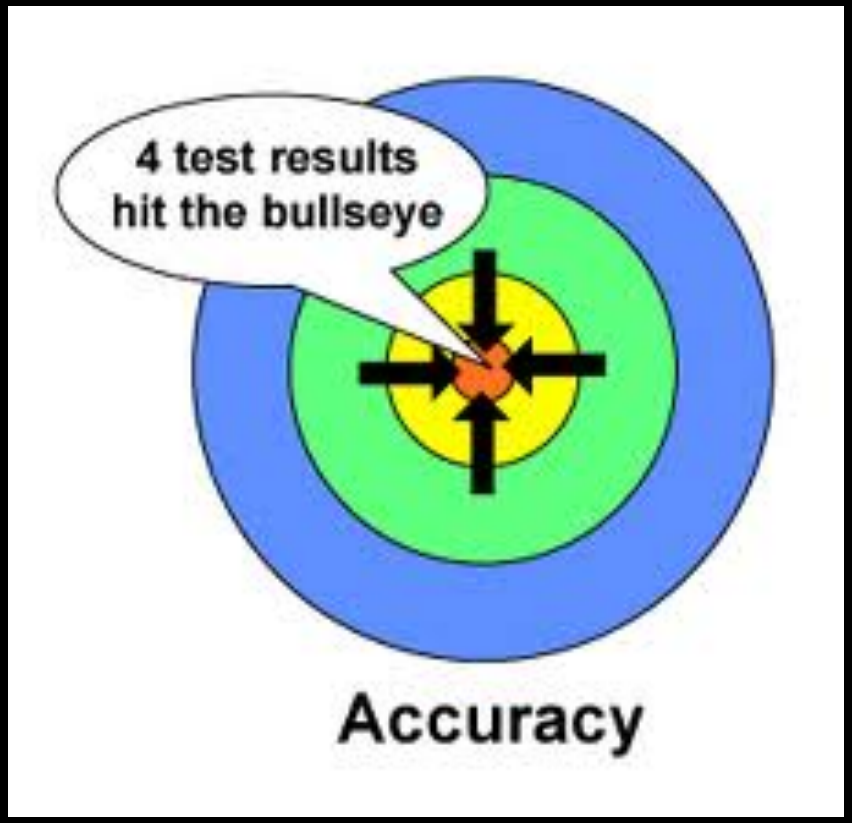


Table 1

Mass	Volume	Density
0.02 kg	0.013 L	1.5 kg/L
0.02 kg	0.018 L	1.1 kg/L
0.02 kg	0.016 L	1.3 kg/L

Table 2

Mass	Volume	Density
0.016 kg	0.013 L	1.2 kg/L
0.019 kg	0.017 L	1.1 kg/L
0.016 kg	0.015 L	1.1 kg/L