Significant Digits

Science 1206

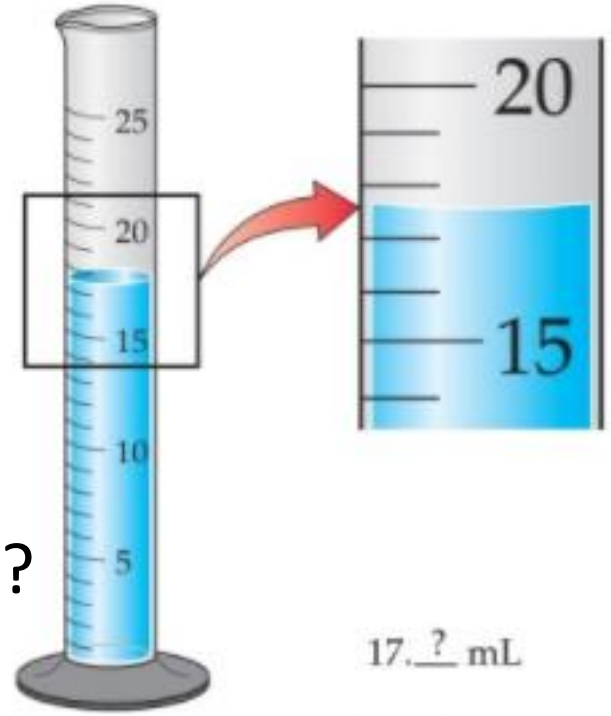
Measurement

Accuracy: How close a measured value is to the actual value.

Precision: How close measured values are to one another.

Significant Digits

Significant digits are the number of meaningful digits in a measured or calculated quantity. Significant digits indicate the certainty of a measurement. A measurement can only be as precise as the instrument measuring it.

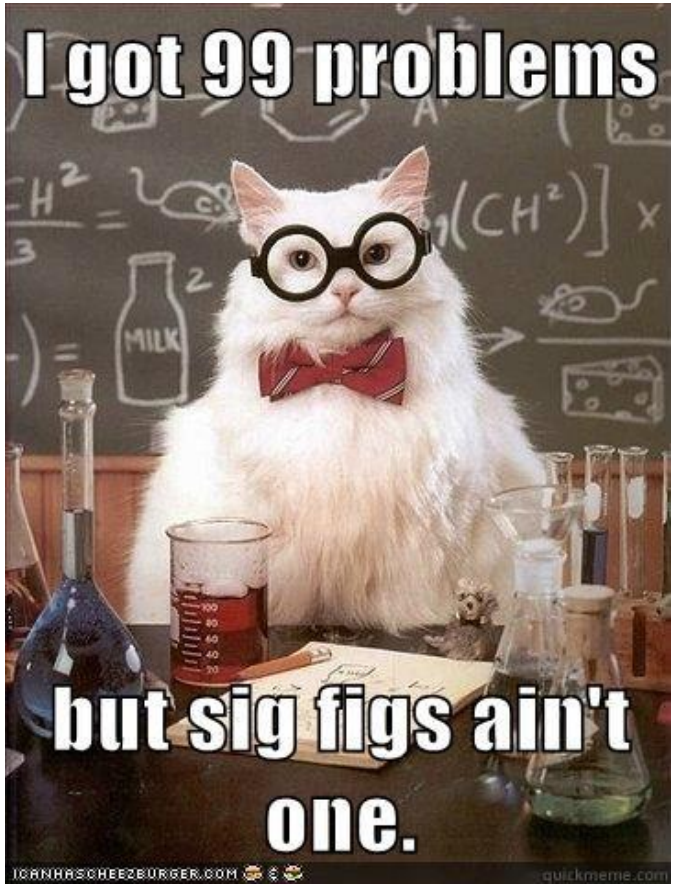


What would you estimate these measurements to be?

Significant Digits

Significant digits include all those numbers that are certain plus one uncertain or estimated digit.

The greater the number of significant digits, the higher the certainty of the measurement.



Counting Significant Digits

1. All nonzero digits are significant.

   eg. 2.34 m has 3 significant digits

2. Zeroes are significant when:
   - they are between other nonzero numbers.

     eg. 404 m has 3 significant digits.

   - they follow a decimal point with other nonzero numbers ahead of the decimal.

     eg. 2.0 m has 2 significant digits.

     eg. 410.50 has 5 significant digits.

Counting Significant Digits

3. Zeroes are not significant when:

- They are in front of a decimal with no other leading nonzero numbers.

  eg. 0.031 has 2 significant figures.

  eg. 0.00420 has 3 significant figures.

- They are trailing.

  eg. 250 has 2 significant figures.

  eg. 45600 has 3 significant figures.

Trailing zeroes may or may not be significant depending on the measuring instrument used. When dealing with trailing zeroes we use scientific notation if they are significant.

Counting Significant Digits

These zeros are not significant digits

3,200

0.004709

Counting Significant Digits

4. Exact or counting numbers have no error and are considered to have an infinite number of significant digits.

   eg. 25 chairs are exactly 25.000000…. on to infinity.

   eg. 54 coins is exactly 54.000000…

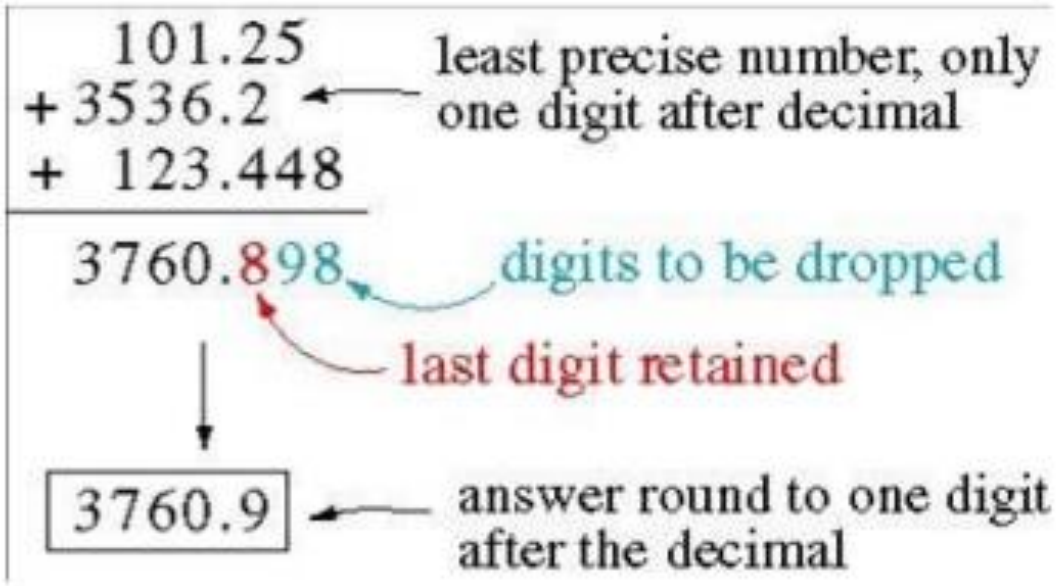
Counting Examples

1. 18 students _____
2. 1.23 m _____
3. 0.004 m _____
4. 1.004 m _____
5. 0.0040 m _____
6. 250 m _____
7. 250.0 m _____
8. 0.010 m _____
9. 10.010 m _____
10. 20 m _____

Adding & Subtracting Measurements

The rule for addition and subtraction is to express the final answer with the <u>least number of decimal places</u> found in the original measurements.

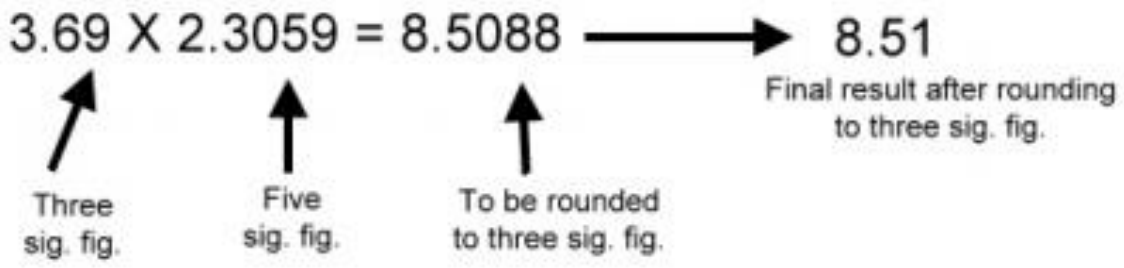
eg.



Multiplying & Dividing Measurements

The rule for multiplication and division is to express the final answer with the <u>least number of significant digits</u> found in the original measurements.

eg.



Multiplying & Dividing

$$\begin{array}{r} 4.36 \\ \times\ 0.00013 \\ \hline 0.0005668 \end{array}$$

rounds to 0.00057

$$\frac{12.300}{0.0230} = 534.78261$$

rounds to 535

Examples

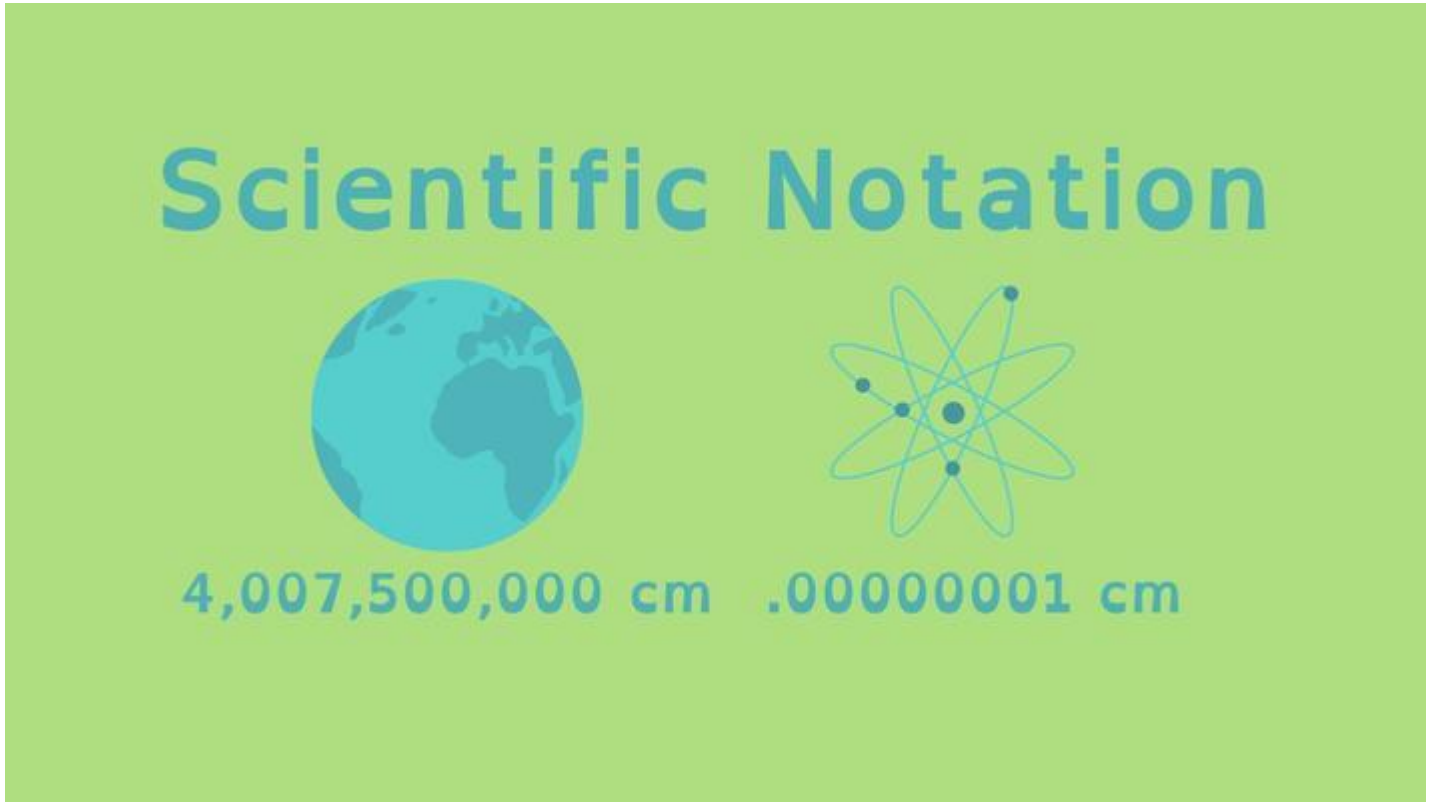
1. $2.89 \times 0.0042 =$ _____

2. $8.453 + 9.2 =$ _____

3. $120 \div 6.1 =$ _____

Scientific Notation

This is a useful way of expressing very large or very small numbers.



Scientific Notation

3250000000

3,250,000,000.

9 units
to the LEFT

LEFT → positive exponent

3.25×10^{9}

0.0000004

0.0000004.

7 units
to the RIGHT

RIGHT → negative exponent

4×10^{-7}

Scientific Notation

Scientific notation may be necessary to express a final answer to the correct number of significant digits.

eg. Suppose a final answer works out to 11000 m but you need three sig figs. The only way to do this is to use scientific notation.

$$11000 \text{ m} = 1.10 \times 10^4 \text{ m}$$

Examples

1. Convert to scientific notation (2 sf).
   a) 22000 = _____

   b) 0.0000102 = _____

2. Convert to decimal form (2 sf).
   a) 4.32×10^{-3} = _____

   b) 8.1×10^{4} = _____

Unit Conversions

The metric system uses base units with metric prefixes. In physics some common base units are:

"What about Instagram?"

Metric Units (SI system)

Time: seconds (s)

Distance: metres (m)

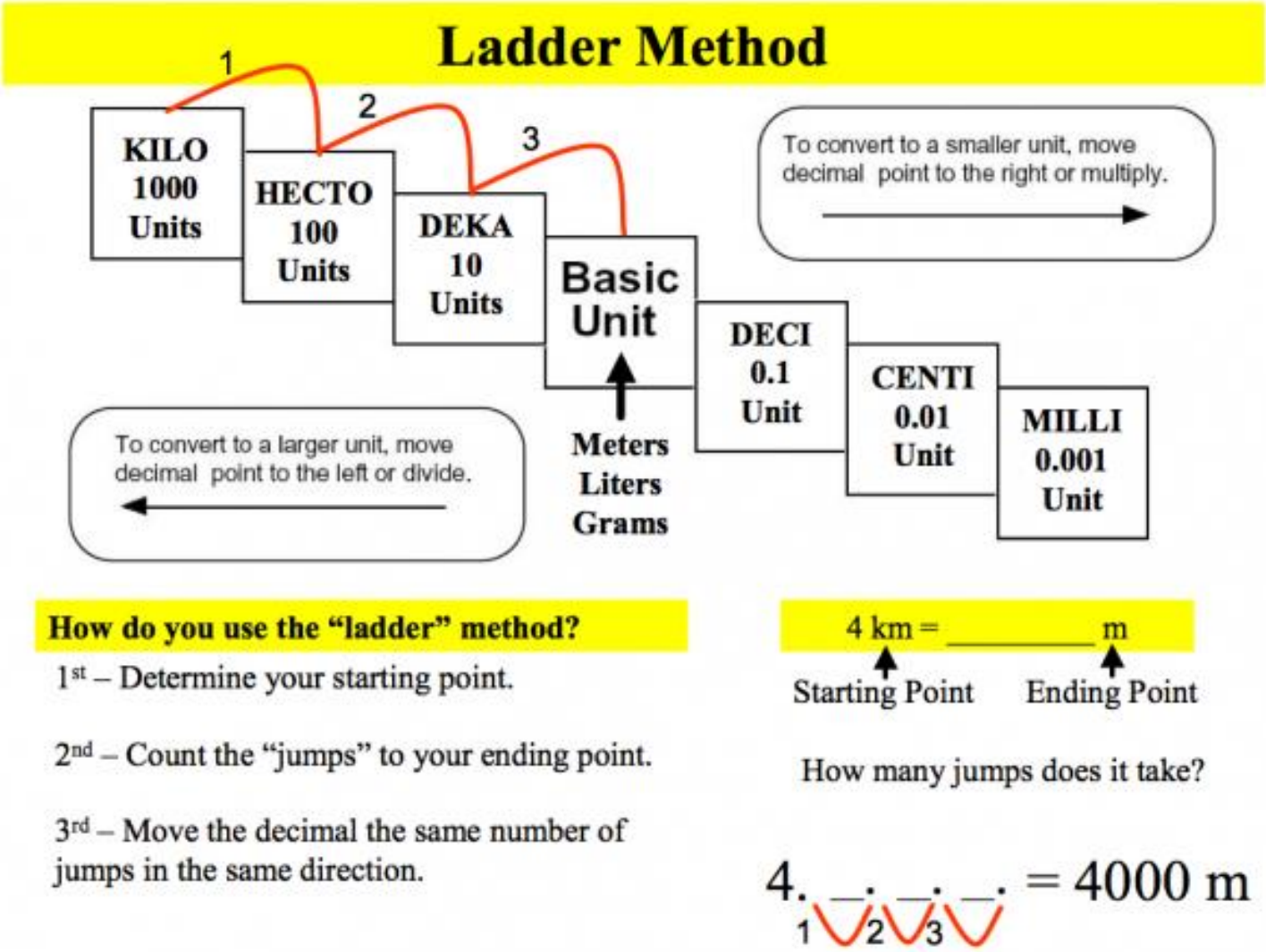
Speed: metres/second (m/s)

Mass: kilograms (kg)

Displacement: metres (m)

Velocity: metres/second (m/s)

Metric Conversions



Metric Conversions

When converting measurements keep the same number of significant digits.

Prefixes of the Metric System		
Factor	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

Metric Conversions

1. Calculate the number of seconds in 56 hours.

Metric Conversions

2. Convert 25 mm to m.

Metric Conversions

3. Convert 4.00 km to m.

Metric Conversions

4. Convert 25 km/h to m/s.