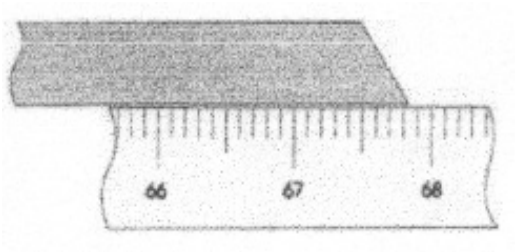
Science 1206
Physics Unit
Section One : Significant Digits and Measuring

Significant Digits

Look at the picture below.



The picture shows a metre stick and one end of a rather long object that appears to be almost 68 cm long. But we can do better than that. The object is 67.8 cm. But we can still do better. The very best we can do is estimate that the length of the object is 67.83 cm. The fourth digit is estimated.

We can see what is meant by recording a measurement in significant digits: It means that we use our measuring device so that we are sure of all digits but the last one. That is we write down all the digits that are certain and then we can estimate one and only one more.

In a measurement, significant figures in a number consist of:

Figures (digits) definitely known + One estimated figure (digit)

(Have students measure various items in the room or measure some figure on the smart board.)

Rules for significant digits:

1. All counted quantities are exact. (infinite number of significant digits)

2. All non-zero digits are significant.

3. "Trapped zeros" are significant.
   Ex. 9.04 cm - the zero is significant

4. In whole numbers, trailing zeros are not significant.

   Ex. 250 cm or 2500 cm - the zeroes are not significant
   In these two examples, it is unclear whether the zeroes were measured values or simply rounded.

Ex. If the zero(s) in the previous example were actually measured with due caution and not estimated then the measurement must be written in scientific notation, to indicate that the zeros are significant.

2.50×10^2 cm or 2.500×10^3 cm - the zeroes are significant

5. In decimal numbers, leading zeros are not significant, but trailing zeros are.

Ex. 0.46 cm and 0.07 kg - the zeroes are not significant
Ex. 25.0 cm - the zero is significant (the decimal is clearly indicated)

Example: How many significant digits are in the following numbers?

A	0.00 536	_____	B	46 850 000 m	_____
C	439 023	_____	D	0.07 580 m	_____
E	5000 m	_____	F	0.03002 m	_____
G	4200.0 m	_____	H	42 002. 020 m	_____
I	2.180×10^5 m	_____	J	7.320×10^{-5} m	_____

(Assignment 1 : Significant digits)

Scientific Notation

Very large or very small numbers are usually written in scientific notation. Numbers written in scientific notation have the following format...

$M \times 10^n$ where

$1 \leq M < 10$ and n is an integer

When rounding any number, it is only necessary to use scientific notation **IF** you need an extra significant digit, otherwise, just round numbers as you have always done.

Ex. Rewrite the following numbers to the number of significant digits indicated. It may be necessary to use scientific notation.

135 000 (4 sig figs)	_____	986.596 (5 sig figs)	_____
0.024 56 (2 sig figs)	_____	295.005 (4 sig figs)	_____

0.660 378 (3 sig figs) _____ 75 498 (3 sig figs) _____

How to Convert a Number into Scientific Notation

Large numbers....

ex. Change 21 243 100 into scientific notation.

Step 1 : move the decimal from its position at the end of the number to the left, until it gives you a number between 1 and 10.

21 243 100 becomes 2.1243100

Step 2 : Count the number of spaces the decimal moved, this becomes the exponent. Since you've moved the decimal left, the exponent is positive.

2.1243100 becomes 2.12431×10^{7}
(Note that the end zeros are dropped, as they were Not significant in the original number !)

Small numbers....

ex. Change 0. 000 000 657 into scientific notation.

Step 1 : move the decimal from its position at the beginning of the number to the right, until it gives you a number between 1 and 10.

0.000 000 657 becomes 6.57

Step 2 : Count the number of spaces the decimal moved, this becomes the exponent. Since you've moved the decimal right, the exponent is negative.

6.57 becomes 6.57×10^{-7}

Practice : Rewrite the following numbers in scientific notation.

a. 0.000 634 _____

b. 0.000 001 0 _____

c. 0. 000 000 78 _____

d. 0. 003 72 _____

e. 248 000 _____

f. 14 500 _____

g. 87 564 499 _____

h. 11 465 899 776 _____