Al-Mustaqbal University

College of Science

Analytical Chemistry I

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Significant Figures

By

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There are two kinds of numbers.

- Exact : The amount of money in your pocket.

- Approximate :Weight , height – Any thing MEASURED.

No measurement is perfect.

Every measurement involves the errors or we say uncertainty.

If we measure length of the rod

In this we are sure about the digit 3

This can be 2, or 3 or 1

We can say length of the cylinder is 3.2 ± 0.1
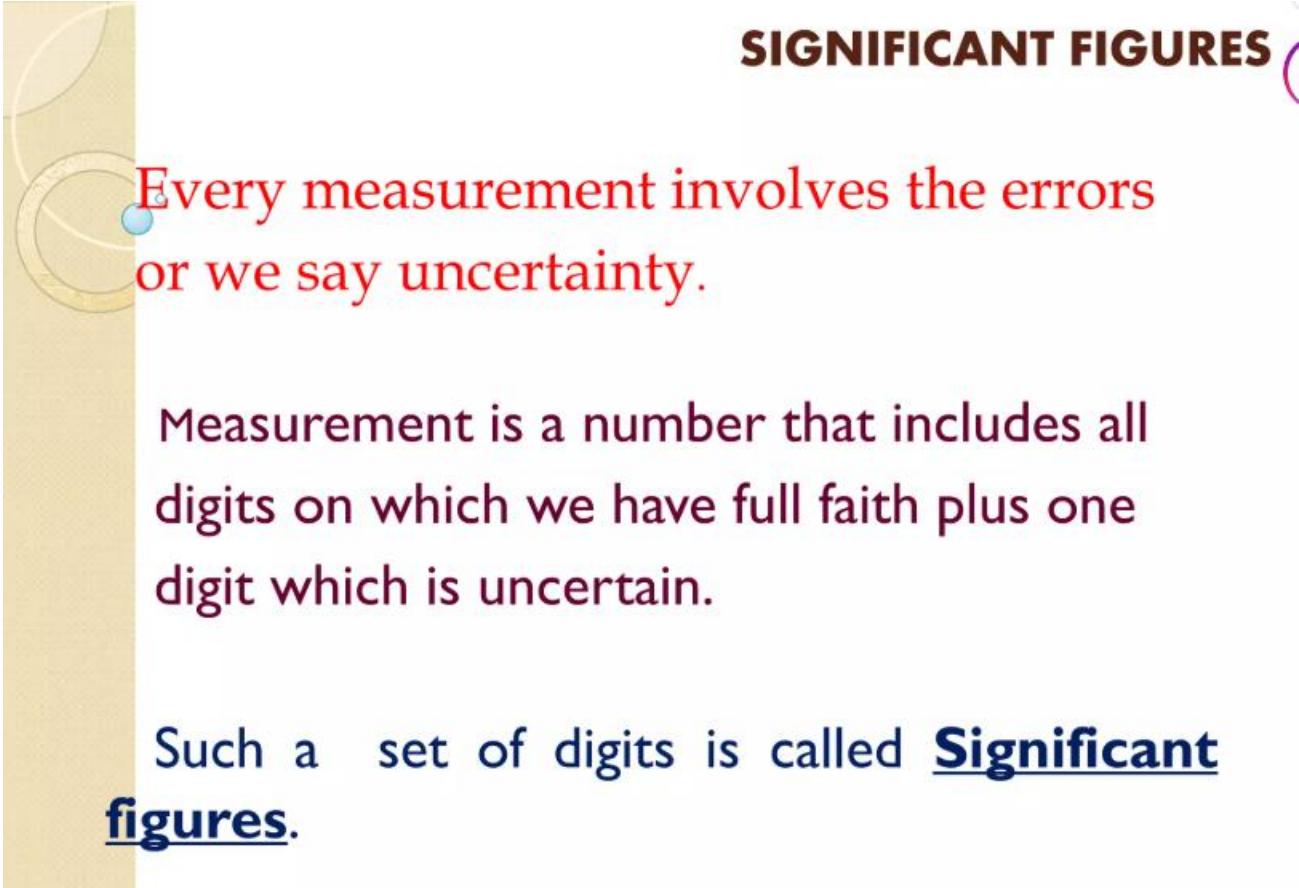
SIGNIFICANT FIGURES

Every measurement involves the errors or we say uncertainty.

Measurement is a number that includes all digits on which we have full faith plus one digit which is uncertain.

Such a set of digits is called **Significant figures**.
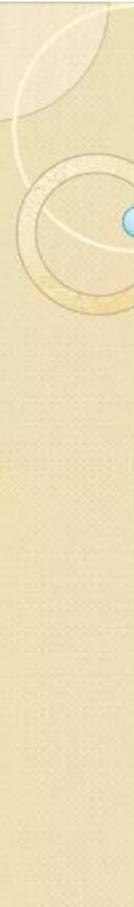
If we measure the length of the cylinder with our ruler , we might record 3.2 cm

For the mathematician 3.2, 3.20 , 3.200 is the same .

For a scientist , 3.200 means the measurement is accurate to within one thousandth of the cm.

So for him , 3.2 and 3.200 is not same.

How do We know how many sig. Figs?

Rule 1:

All the non-zero digits are significant

Measured value	Significant figures
231	3
3456	4
16789	5
267	3

Rule 2:

All the zeros between the two non-zero digits are significant , no matter where the decimal point is

Measured value	Significant figures
201	3
3006	4
16.0789	6
2.607	4

Rule 3:

If the number is less than one, the zeros on the right side of the decimal but left side of the non-zero number are non- significant.

Measured value	Significant figures
0.02	1
0.006	1
0.0789	3
0.00077	2

Rule 4:

The zeros after the last no zero number are non-significant.

Measured value	Significant figures
3000	1
4400	2
45670	4
333300000	4

Rule 5:

The trailing zeros in a number with the decimal point are significant.

Measured value	Significant figures
3.000	4
44.00	4
4567.0	5
3333.00000	9

SIGNIFICANT FIGURES

When we take of the zeros, whether it significant or non-significant , it is always a better to represent the number in scientific notation (powers of 10).
The powers of 10 are always non- significant.

Eg. 23500 can be written as
There are only three significant figures .

$$235 \times 10^2$$

10^2 represents the order of the magnitude

SIGNIFICANT FIGURES

A choice of the change of different units does not change the number of the significant digits or the figures of the measurement.

Example:
The length 2.308 cm has four significant digits. But in different units, the same value can be written as
0.02308 m, 23.08 mm 23080 μm

SIGNIFICANT FIGURES

Measured value	Significant figures
7	I
40	I
0.5	I
0.00003	I
7×10^5	I
7,000,000	I
1.2	2

Measured value	Significant figures
2100	2
56.76	4
4.00	3
0.0792	3
7,083,000,000	4
3401	4
2100.0	5

ROUNDING OFF THE UNCERTAIN DIGITS

The result of computation with approximate numbers, which should contain more than one uncertain digit, should be rounded off.

The rule by convention is that the preceding digit is raised by 1 if the insignificant digit to be dropped is more than 5, and left unchanged if the latter is less than 5.

SIGNIFICANT FIGURES

Measured value	Rounded Off value
2.467	2.47
2.33	2.3
2.46	2.5
3.41	3.4

SIGNIFICANT FIGURES

ROUNDING OFF THE UNCERTAIN DIGITS

But if the number is 2.745 in which the insignificant digit is 5, here the convention is if the preceding digit is even then insignificant digit is simply dropped off and if it is odd, the preceding digit is raised by 1.

In above example the preceding digit   is even then the number becomes 2.74.

SIGNIFICANT FIGURES

Measured value	Rounded Off value
2.465	2.46
2.735	2.74
2.45	2.4
3.75	3.8

ROUNDING OFF THE UNCERTAIN DIGITS

The insignificant digits are dropped from the result they are replaced by zeros eg. round off the number 23469 to three significant figures.

23469 will become

↓

23470 will become

↓ ↓

23500

RULES OF THE ARITHMETIC OPERATIONS WITH SIGNIFICANT FIGURES

In the multiplication or division , the final result should retain as many significant figures as there are in the original numbers with the least significant figures.

If we divide 12 by 7 ,

$$\frac{12}{7} = 1.7$$

The answer should contain only one significant figure it is = 2

SIGNIFICANT FIGURES

RULES OF THE ARITHMETIC OPERATIONS WITH SIGNIFICANT FIGURES

For addition or subtraction write the numbers one below the other with decimal points in one line .

Now locate the first column from the left that has a doubtful digit .

All the digits right to this column are dropped from all the numbers and rounding is done to this column .

The addition or subtraction is now performed.

Eg.

Add 24.36 , 0.0623 , 256.2

$$2\ 4\ .\ 3\ 6 \longrightarrow 2\ 4\ .\ 4$$

$$0\ .\ 0\ 6\ 2\ 3 \longrightarrow 0\ .\ 1$$

$$2\ 4\ 5\ .\ 2 \longrightarrow 2\ 4\ 5\ .\ 2$$

$$2\ 8\ 0\ .\ 7$$