SIGNIFICANT FIGURES

Hebden 11→ Unit II p. 27-40

are "born" from

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All ***Measurements*** have some degree of uncertainty to them (due to the instrument used.)

To indicate the degree of certainty in a measurement (or a number derived from a measurement), scientists use ***significant figures***. Or numbers they know to be 100% accurate.

* There is NO rounding errors in SCIENCE, as there is NEVER a measured value that is "PERFECT".

**** Significant figures are important in the way we report different kinds of data!**

- A significant figure is a **measured** or **meaningful digit**

A. What is Not Significant?

Defined or counting numbers: A number which involves things which cannot realistically be subdivided.

Example:
1 book; 4 students (cannot have 1.5 books or 4.78 students)
Conversion factors are assumed to be an exact relationship (cannot have 1 kg = 1000.5 kg)

} * "PERFECT" NUMBER

Rules for identifying # of sig figs:

a) An exact number (e.g. 25 students) has an infinite number of significant figures because the number was not rounded off. Exact numbers are not used to determine the significant digits.
b) For all measurements, the following rules apply to count the number of significant figures a number has.

1. Any digit between 1-9 is significant.

   e.g. 234.566 has ***6*** sig figs

   7.4586 has 5 sig figs

2. A '0' at the beginning of a number is ***not significant*** because it only holds the decimal place. ***Leading zeros are NOT significant***

   e.g. 0.00045 has ***2*** sig figs

   0.02333 has 4 sig figs

* Zeroes give the NUMBER "meaning"!

makes it small... ↙ ↘ makes it big...

0.000003 300000

3. A '0' between two other sig figs is significant.

   e.g. 50034.03 has ***7*** sig figs

   e.g 534.034201 has 9 sig figs

4. A '0' at the end of a number is only significant IF a decimal point occurs in the number otherwise it is not significant. ***Be careful with this one!***

   Trailing zeroes are NOT significant UNLESS there's a decimal!

   e.g. 750000 has ***2*** sig figs 20000000 has 1 sig fig

   e.g. 750.000 has 6 sig figs

Example:

If a balance gives a reading of 97.53 g when a beaker is placed on it, the reading is considered to have 4 significant figures. If the beaker is then put on a different balance and gives a reading of 97.5295 g, there are more significant figures to the measurement (6 significant figures).

How many significant figures do each of the following measurements have?

1. 1.25 kg ___3___
2. 1255 kg ___4___
3. 11s ___2___
4. 150 m ___2___
4b. 150.00 m = ___5___
5. 1.283 cm ___4___
6. 365.249 days ___6___
7. 2 000 000 years ___1___
8. 17.25 L ___4___

8(b). - 17.25 L = 4

* if it is greater than |1| ... → if there is a decimal, then ALL digits are Significant!

* it does NOT matter if the value is (+) or (-)!

B. Scientific Notation

Scientific Notation is a way of writing numbers for values too large or small to be conveniently written in standard decimal notation.

#.## ... × 10^?

Example:

$10 = 1.0 \times 10^1$

$25 = 2.5 \times 10^1$

$250 = 2.5 \times 10^2$

$0.000\ 0350\ 000 = 3.5000 \times 10^{-5}$

proper scientific notation

Write the following numbers in scientific notation:

1. 3570 ___3.57×10^3___ (1 1 1 = +3)
2. 41.400 ___4.1400×10^1___ (1 = +1)
3. 0.000 572 ___5.72×10^{-4}___ (-1-1-1-1 = -4)
4. 41.50×10^{-4} ___4.150×10^{-3}___ (1 = -4+1 = -3)
5. $0.000\ 410 \times 10^7$ ___$4.10 \times 10^{+3}$___ (-1-1-1-1+7 = -4 = +3)

SHOULD ONLY include digits that are SIGNIFICANT!!!

Bad scientific notation!

C. Adding or Subtracting Significant Figures

When adding or subtracting significant figures, round off the answer to the least number of decimal places contained in the calculation.

OR → WORST VALUE PLACE

Example:

12.56 cm *(2 SF after decimal)* + 125.8 cm *(1 SF after decimal)* = 138.36 cm → 138.4 cm *(1 SF after decimal)*

Exercise:

1. 15.1 + 75.32 → 90.4

15.1
+ 75.32
90.42

2. 178.904 56 – 125.8055 → 53.0990

178.90456
− 125.8055

3. $4.55\ 10^{-5} + 3.1 \times 10^{-5}$ → 7.7×10^{-5}

4. $1.805 \times 10^{4} + 5.89 \times 10^{2}$ → 1.864×10^{4} or 18640

$180.5 \times 10^{2} + 5.89 \times 10^{2}$ OR $18050 + 589$

"worst value" place ... try this...

3000
+ 311.46
+ 81
+ 0.00582
3392.46582

∴ 3000 or 3×10^{3}

FINAL ANSWER!

Multiplying or Dividing Significant Figure

When multiplying or dividing significant figures, round off the answer to the least number of significant figures contained in the calculation.

Example:

2.00 *(3 SF)* x 3.000 00 *(6 SF)* = 6.00 *(3 SF)*

Exercise:

1. 12.5 x 0.50 (3, 2) → can only have → 6.3 (2)
2. 0.15 x 0.0016 (2, 2) → 2.4×10^{-4} or 0.00024 (2)
3. 40.0 / 30.000 (3, 5) → 1.33 (3)
4. 2.5 x 7.500 / 0.150 (2, 4, 3) → 120 (2)
5. (6.40 x 10^{8}) x (5 x 10^{5}) (3, 1) → 3×10^{14} (1)
6. 4.37 x 103 / 0.008 560 0 (3, 5) → 5.11×10^{5} (3)
7. 0.51 x 10^{-4} / 6 x 10^{-7} (2, 1) → 90 (1)
8. 0.000 01 / 0.1000 (1, 4) → 1×10^{-4} or 0.0001 (1)

Summary Practice Exercises:

In the following mixed calculations, perform multiplications and divisions before doing the additions and subtractions. Keep track of the number of significant figures at each stage of a calculation.

BEDMAS

1. 25.00 x 0.100 – 15.87 x 0.1036

(4) (3) (4) (4)

(3) (4)

2.50 − 1.644132 = 0.855868 → 0.86

(or 2.50 − 1.644)

2. 35.0 x 1.525 + 50.0 x 0.975 → 102.2

53.4 + 48.8

3. (0.865 – 0.800) x (1.593 + 9.04) → 0.69

0.065 × 10.63 =

4. (0.3812 - 0.4176) / (0.0159 – 0.0146) → −28

−0.0364 ÷ 0.0013 =

5. 9.34 x 0.071 46 – 6.88 x 0.081 15 → 0.109

(3) (4) (3) (4)

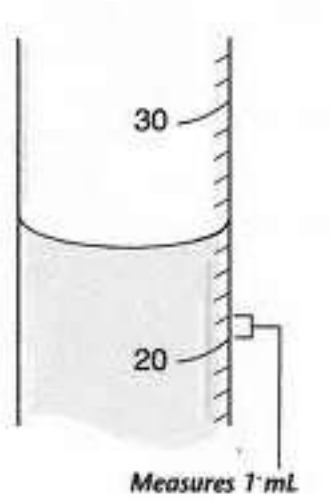
(3) (3)

0.667 − 0.558 ⇒

0.667
−0.558
0.109

D. Reading A Scale

The number of significant figures is equal to all the certain digits PLUS the first uncertain digit.



In the figure to the left, the liquid level is somewhere between 24 mL and 25 mL. You know that it is at least 24 mL so you are "certain" about the first two digits.

As a guess, it could be 24.9 mL. There is some significance to the last digit but but not completely certain. For example, there are the reading is not 24.1 mL. As a result, there are two certain digits, (2 and 4) and one uncertain (9).

* MORE PRACTICE TO COME...
LOTS MORE PRACTICE ☺