1B.4 Units

Learning intention

I will be able to record data to the correct number of significant figures.

Success measure

I can report measurements to the correct number of significant figures using correct units.

Content descriptor

Select and use appropriate equipment and technologies to systematically collect and record accurate and reliable data, and use repeat trials to improve accuracy, precision and reliability.

Elaboration

- applying specific skills in the use of scientific instruments

Connecting the dots

Building on prior knowledge

Year 7
Scientific investigations record data using standardised units. This allows the values to be understood by other scientists.

Year 8
Data can be displayed to a certain number of decimal points or by using scientific notation.

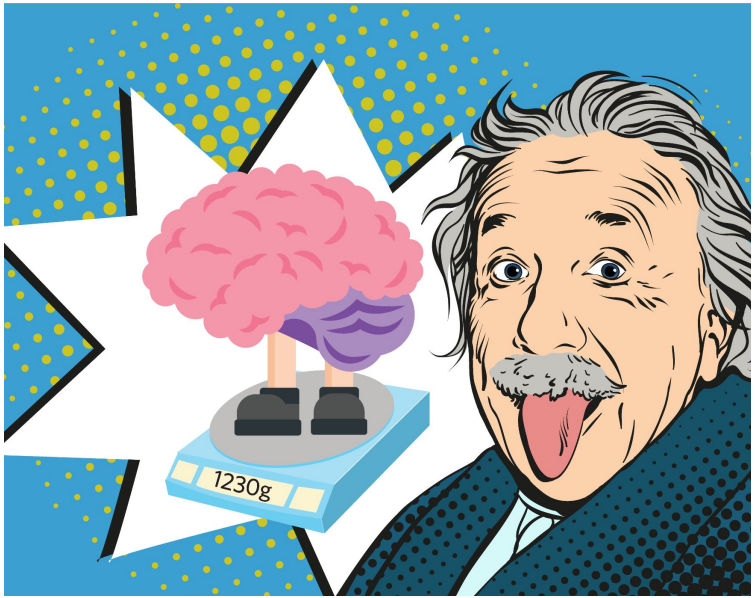
Year 9
The number of significant figures shown implies a certain degree of uncertainty in data collection.

The importance of significant figures

Einstein was a significant figure. His brain had a mass of 1230 g; a measured value that contains 4 **significant figures**.

It is important to report the value to the correct number of significant figures to show the level of **uncertainty** involved in taking measurements.

If an electronic balance has an uncertainty of ±1 gram, then the true mass may be up to 1g heavier or lighter than the display shows. If the scale has an uncertainty of ±0.01 grams, then the true mass may be up to only 0.01 grams heavier or lighter than the reading.



The higher the resolution an instrument has, the more certain we can be in the measured value. The finer the resolution, the smaller the increments in which measurements can be made, reducing the potential for rounding errors or approximation. This can lead to more precise results.

KEY TERMS

significant figures the number of digits required to express a value to a level of certainty

uncertainty the range within which the true value is likely to lie

DID YOU KNOW?

If the uncertainty is not shown on a measuring tool then use ± half the smallest increment.

Significant figures express uncertainty

Significant figures (sf) express the level of uncertainty you have in a measured value.

A value with more significant figures implies a measuring tool with a finer resolution was used to take the measurement.

For example, a measurement of 1230.12 g (6 sf) has a higher resolution than 1230 g (4 sf).

If you report a measurement with 6 significant figures then you are saying that your measuring tool was able to measure to that degree of exactness and you have a higher level of certainty in measured value.

1 significant figure: 1 g

2 significant figures: 1.3 g

3 significant figures: 1.23 g

4 significant figures: 1.233 g

Identifying significant figures

All **non-zero** (i.e. 1–9) numbers and **any zeroes in between are significant**

Leading zeroes (before non-zero numbers begin) are **not significant**. These zeroes help to locate the decimal point.

Zeroes at the end of a value **are significant.**

DON'T GET TRICKED

Zeroes before a non-zero number are not significant.

Zeroes between non-zero numbers are always significant.

Zeroes following non-zero numbers are always significant.

Putting a value into scientific notation helps to easily identify the number of significant figures.

In this value there are **seven** significant figures.

Significant figures in scientific notation

Scientific notation is any easy way to express very large or small numbers.
This can be used to simplify calculations or to easily identify the number of significant figures (and so the level of certainty) in a measurement.

Every digit in the coefficient is significant.

304.0 in scientific notation is 3.040×10^2

coefficient

power of ten

In this value there are 4 significant figures.

DID YOU KNOW?

In scientific notation the first digit is a number between 1 and 9.

The decimal place is located after the first digit.

The value is expressed to a power of 10.

All digits in the coefficient are significant.

Examples

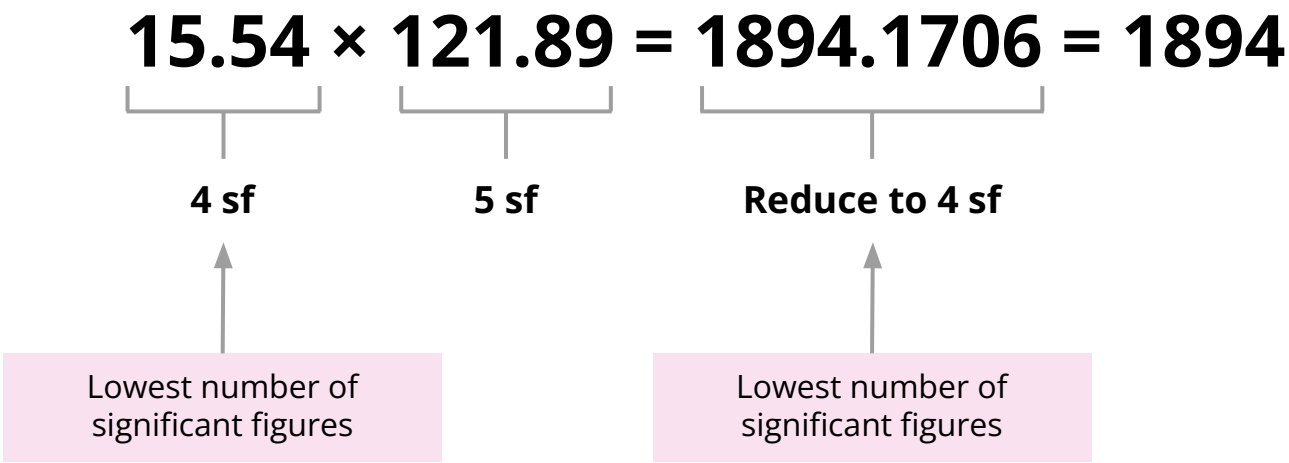
	Value	Number of significant figures	Explanation
A	219	3	All non zero numbers are significant.
B	1.007×10^{-2}	4	All digits in the coefficient are significant.
C	1.00900	6	Zeroes to the right of a decimal are significant (unless they are leading zeroes).
D	0.0080	2	Leading zeroes are not significant.
E	2.04×10^{2}	3	All digits in the coefficient are significant.
F	700	3	Zeroes at the end of a whole number are significant.

Significant figures in multiplying or dividing

When multiplying or dividing with significant figures, the rule is to count the number of significant figures in each value and keep your answer to the lowest number of significant figures (least certain) of the two values. This is because you can only be as certain as the value measured with the lowest resolution.

DON'T GET TRICKED

Multiplying a precise number by an imprecise one won't improve the precision of the latter

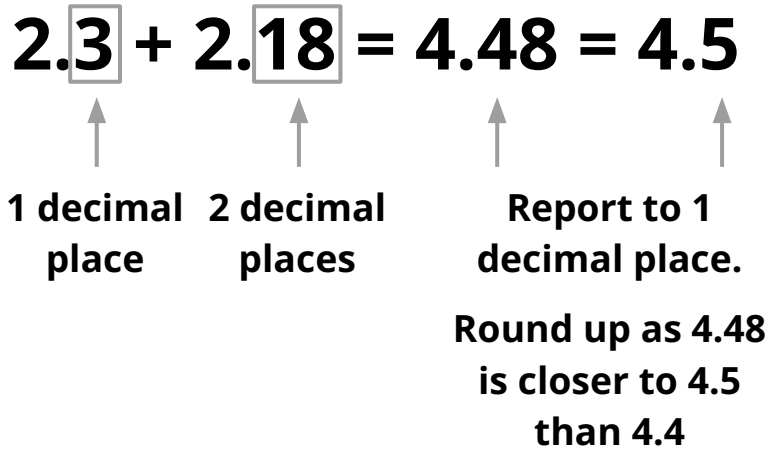


Significant figures in addition or subtraction

Reporting significant figures when adding or subtracting is similar to multiplication and division in that you must report to the least precise measured value. However, instead of matching the lowest number of significant figures we match the lowest number of decimal places.

DON'T GET TRICKED

The value shown on a calculator is frequently reported to the incorrect number of significant figures.



Tools to sharpen this skill

Rules for significant figures:

- All non-zero digits are considered significant.
- Zeros between non-zero digits are significant.
- Leading zeros are not significant and only indicate the position of the decimal point.
- Trailing zeros are significant.

Science features many facts and figures, most are significant.
Image Colorized by Sanna Dullaway/

Question 1

How many significant figures are in the measurement 0.00203040?

A 6

B 7

C 8

D 9

Question 1 – answer

How many significant figures are in the measurement 0.00203040?

A 6

7

C 8

D 9

The leading zeros are not counted as significant figures. The zeros between and after the non-zero digits are counted, making a total of seven significant figures.

Question 2

Which number has three significant figures?

A 0.056

B 0.456

C 45.60

D 4560

Question 2 – answer

Which number has three significant figures?

A	0.056
✓	**0.456**
C	45.60
D	4560

0.456 has three significant figures, and all are counted because they are after the leading zero, which is not significant.

Success measure

I can report measurements to the correct number of significant figures using correct units.

Acknowledgements & attributions

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