

Significant Digits

Significant digits are widely used in science to communicate the *preciseness* of a measurement. The more significant digits a stated measurement has, the more precise it is.

Which digit(s) in a number are significant?

Rule 1

All non-zero digits (i.e. digits from 1 to 9) are significant.

Example 1

14.5 has three significant digits. All the digits in this number are significant.

Rule 2

Zero digit(s) located between two non-zero digits are significant.

Example 2

10.05 has four significant digits. The digits 1 and 5 are significant because they are non-zero digits. The two 0s are significant because they are located between two non-zero digits.

Rule 3

Zero digit(s) located to the **right** of a decimal point is/are significant.

Example 3

98.0 has three significant digits. The digits 9 and 8 are significant because they are non-zero digits. The 0 is significant because it's located to the right of the decimal point.

TIP: A good way to remember this rule is that without the 0, the value of the number would remain the same (i.e. 98 is the same value as 98.0). The reason for including the trailing 0 is to show that it's significant.

Rule 4

Zero digit(s) located to the **left** of significant digits is/are NOT significant.

Example 4

0.0067 has two significant digits. The digits 6 and 7 are significant because they are non-zero digits. The 0s are NOT significant because they are located to the left of the significant digits 6 and 7.

TIP: In this case the 0s are included to show the *value* (i.e. how small) the number (measurement) is. The 0s do NOT show us the preciseness of this measurement. The 0s are simply place holders.

Rule 5

Zero digit(s) located to the **right** of other significant digits in the **whole number part** is/are NOT significant.

Example 5

9800 has two significant digits. The digits 9 and 8 are significant because they are non-zero digits. The 0s are NOT significant because they are in the whole number part of this number and are to the right of significant digits.

TIP: Again, the 0s are included to show the *value* (i.e. how large) the number (measurement) is. The 0s do NOT show us the preciseness of this measurement. The 0s are simply place holders.

Rule 6

A zero digit with a dot underneath the zero is significant.

Example 6

950000 number has four significant digits. The digits 9 and 5 are significant because they are non-zero digits. The zero with the dot underneath is significant. The zero between 5 and the 0 with the dot underneath is also significant because it's located between two significant digits.

Operations with Significant Digits

Operations with measurements can change the number of significant digits the final answer has. The following rules should be followed when rounding the final answer to the correct number of significant digits:

Rule 1

For **adding and subtracting**, round the final answer to the **least number of decimal places** in the measurements being added or subtracted. Note: If you are adding or subtracting whole numbers, round to the same number of significant digits as the least precise measurement.

Rule 2

For **multiplying and dividing**, round the final answer to the **least number of significant digits** in the measurements being multiplied or divided.

Rule 3

For **multiple operations**, perform the entire calculation carrying all the digits. Then, determine the number of significant digits or decimal places at EACH step (following the correct order of operations). It is helpful to underline the “extra” decimal places or significant digits being carried to the next step. Round the final answer to the same number of significant digits or decimal places as the least precise component of the calculation.

Practice Questions:

1) For each measurement below state the number of significant digits it has.

- a) 53.409
- b) 1.20
- c) 0.0038
- d) 90000
- e) 4307
- f) 105000.0
- g) 0.00809

2) Perform each calculation and round to the correct number of significant digits.

- a) $14.578 + 34.2 =$
- b) $54.76 - 1.999 =$

c) $58.31 \div 2.5 =$

d) $0.054 \times 19.3 =$

e)
$$\frac{32.09 + 1.2 - 17.035}{19.8} =$$

Answers:

1) a) five

b) three

c) two

d) one

e) four

f) seven

g) three

2) a) 211.6

b) 17

c) 17.6

d) 233.9

e) 7200