Rounding

Sometimes it is helpful to round numbers. It may be because we just aren't interested in a very detailed answer; we just want a rough idea. For example, if we were reporting on a rugby match which 49,847 people attended, we might report in a newspaper article that there were nearly 50,000 spectators.

On the other hand, it may be because reporting in too much detail would give a false impression of accuracy, so we reduce the accuracy of a result to reflect the accuracy of the data. Suppose, for example, that the height of students at a university were measured to the nearest centimetre. We could report that the average height was found to be 170.438252cm, but the information after the decimal point implies that we have measured to a greater degree of accuracy then we have. It would be more appropriate to report that the average height is 170.4cm.

Decimal Places

Example: round 38.472549 to 3 decimal places (dp).

We are interested in keeping the first 3 digits after the decimal place and discarding the rest, so let's draw a line at that point.

However, we must also look at the fourth digit after the decimal place to decide whether the third should be rounded up. In this case we have a 5 as the fourth digit, so we must round up from a 2 to a 3.

Answer: 38.473 to 3dp

When to Round Up
We round up if the next number is 5 or more. If the next number is 4 or less, we do not.

Example: round 7.42 to 3 decimal places.

This number isn't showing enough decimal places. We need to add a zero to show that we are interested in the value in the third decimal place, which happens to be zero in this case.

Answer: 7.420 to 3dp

Example: round 824.73 to 2 decimal places.

We already have the right number of decimal places, so we leave it exactly as it is.

Answer: 824.73 to 2dp

Significant Figures

The closer a digit is to the beginning of the number, the more information it tells us about the size of the number. For example, in the number 38.472549, the 3 is the most significant figure because it tells us the most about the value, *i.e.* that its value is approximately 30. We call this the *first* significant figure. If we were taking a reading this would also be the number which we were most confident about. The second significant figure is the 8, and so on.

What about the number 0.000000265? In this case the number 2 is the most significant figure because it tells us our number is round about 0.0000002. The zeros aren't significant because they tell us nothing about the value of our number.

Rounding by significant figures

- **The first significant figure is the left-most digit that is non-zero.**
- Count the number of places needed before drawing a line.
- Look at the next digit to decide whether to round up.

Example: round 30.4725849 to 3 sig figs.

The first significant figure is the 3, the second is 0 and the third is 4. Let's draw a line after the third significant figure. We aren't interested in showing all the detail that comes after the line, but as before, we do need to look at the value immediately after the line to decide whether to round up.

3 0 . 4 / 7 2 5 4 9

In this case we have a 7, so we must round up from a 4 to a 5.

Answer: 30.5 to 3sf

Example: round 0.001237 to 1 sig fig.

The first non-zero digit from the left is the 1, so this is the first significant figure. The next digit is 2, so no need to round up.

0.001 / 237

Answer: 0.001 to 1sf

Example: round 496394 to 3 sig figs.

The first significant figure is the 4, the second is 9 and the third is 6. As the next digit is a 3, there is no need to round up.

496 / 394

We aren't interested in the values which come after the line, but if we just ignored them we would end up with the answer 496, which is not the same size as the value we are trying to approximate. So although we're not interested in the values of these digits, we must replace them with zeros to ensure that the number we end up with is the right size.

Answer: 496000 to 3sf

Tip: Always check that your answer is approximately the same size as the number you started with.

Exercises

1) Round the following to three decimal places:

a) 12.32	b) 28.33333	c) 4.839
d) 389.29681	e) 0.001238	f) 2843164
g) 5.78954	h) 6.666666	i) 27846241.5
j) 0.0000467823	k) 2.30854	l) 1.0000056
m) 4.2396	n) 8773.9724	o) 999.9999

2) Round the numbers in question 1 to three significant figures.

Answers

1) Rounding to 3 dp

a) 12.320 to 3 dp	b) 28.333 to 3 dp	c) 4.839 to 3 dp
d) 389.297 to 3 dp	e) 0.001 to 3 dp	f) 2843164.000 to 3 dp
g) 5.790 to 3 dp	h) 6.667 to 3 dp	i) 27846241.500 to 3 dp
j) 0.000 to 3 dp	k) 2.309 to 3 dp	l) 1.000 to 3 dp
m) 4.240 to 3 dp	n) 8773.972 to 3 dp	o) 1000.000 to 3 dp

2) Rounding to 3 sf

a) 12.3 to 3 sf	b) 28.3 to 3 sf	c) 4.84 to 3 sf
d) 389 to 3 sf	e) 0.00124 to 3 sf	f) 2840000 to 3 sf
g) 5.79 to 3 sf	h) 6.67 to 3 sf	i) 27800000 to 3 sf
j) 0.0000468 to 3 sf	k) 2.31 to 3 sf	l) 1.00 to 3 sf
m) 4.24 to 3 sf	n) 8770 to 3 sf	o) 1000 to 3 sf