Math With Significant Figures

In mathematical operations involving significant figures, the answer is reported in such a way that it reflects the reliability of the least precise operation. Let's state that another way: a chain is no stronger than its weakest link. An answer is no more precise that the least precise number used to get the answer. Let's do it one more time: imagine a team race where you and your team must finish together. Who dictates the speed of the team? Of course, the slowest member of the team. Your answer cannot be MORE precise than the least precise measurement.

Addition and Subtraction

For addition and subtraction, look at the decimal portion (i.e., to the right of the decimal point) of the numbers ONLY. Here is what to do:

1) Count the number of significant figures in the decimal portion of each number in the problem. (The digits to the left of the decimal place are not used to determine the number of decimal places in the final answer.)

2) Add or subtract in the normal fashion.

3) Round the answer to the LEAST number of places in the decimal portion of any number in the problem.

WARNING: the rules for add/subtract are different from multiply/divide. A very common student error is to swap the two sets of rules. Another common error is to use just one rule for both types of operations.

Multiplication and Division

The following rule applies for multiplication and division:

The LEAST number of significant figures in any number of the problem determines the number of significant figures in the answer.

This means you MUST know how to recognize significant figures in order to use this rule.

Example #1: 2.5 x 3.42.

The answer to this problem would be 8.6 (which was rounded from the calculator reading of 8.55). Why?

2.5 has two significant figures while 3.42 has three. Two significant figures is less precise than three, so the answer has two significant figures.

Example #2: How many significant figures will the answer to 3.10 x 4.520 have?

You may have said two. This is too few. A common error is for the student to look at a number like 3.10 and think it has two significant figures. The zero in the hundedth's place is not recognized as significant when, in fact, it is. 3.10 has three significant figures.

Three is the correct answer. 14.0 has three significant figures. Note that the zero in the tenth's place is considered significant. All trailing zeros in the decimal portion are considered significant.

Another common error is for the student to think that 14 and 14.0 are the same thing. THEY ARE NOT. 14.0 is ten times more precise than 14. The two numbers have the same value, but they convey different meanings about how trustworthy they are.

Four is also an incorrect answer given by some students. It is too many significant figures. One possible reason for this answer lies in the number 4.520. This number has four significant figures while 3.10 has three. Somehow, the student (YOU!) maybe got the idea that it is the GREATEST number of significant figures in the problem that dictates the answer. It is the LEAST.

Sometimes student will answer this with five. Most likely you responded with this answer because it says 14.012 on your calculator. This answer would have been correct in your math class because mathematics does not have the significant figure concept.

Example #3: 2.33 x 6.085 x 2.1. How many significant figures in the answer?

Answer - two.

Which number decides this?

Answer - the 2.1.

Why?

It has the least number of significant figures in the problem. It is, therefore, the least precise measurement.

Example #4: (4.52×10^{-4}) ÷ (3.980×10^{-6}).

How many significant figures in the answer?

Answer - three.

Which number decides this?

Answer - the 4.52×10^{-4}.

Why?

It has the least number of significant figures in the problem. It is, therefore, the least precise measurement. Notice it is the 4.52 portion that plays the role of determining significant figures; the exponential portion plays no role.