I'm always getting questions about significant figures, especially dealing with addition and subtraction (the rule is the same for both). Hopefully the following explanations will help.

The rule for addition and subtraction is that the last place in the answer is the last place common to the numbers being added or subtracted. That is essentially the same as saying to use the number with the fewest digits after the decimal (i.e. your final answer shouldn't have any more digits to the right of the decimal than the number with the fewest digits to the right of the decimal). In any case, you must line up the decimal points to determine what the last place is that is common to the numbers (i.e. which number has the fewest digits, including leading zeros, after the decimal). This means the numbers MUST be the same SIZE.

Look at some examples.

  2.3**4**4
+ 0.4**5**

  2.7**9**4 => 2.79 (**3** sig. fig.)

This must be rounded to the 2^{nd} decimal place since that is the last place common to both the numbers added (the same number of digits after the decimal as in 0.45, the number with the fewest number of digits after the decimal).

1.34 + (1.1×10^{-2})

This might look like the answer should have only 1 digit to the right of the decimal since there is only 1 digit to the right of the decimal in 1.1×10^{-2}. However, that would be incorrect. You MUST make sure the numbers are the same size first (same power of 10).

Remember, 1.34 can be written as 1.34×10^{0}. The other number now needs to be converted so it has the same power of 10, 1.1×10^{-2} => 0.011 (0.011×10^{0}). Now "line up the decimal points" and add them (although you should do the addition on your calculator, at least for more complicated numbers).

  1.3**4**
+ 0.0**1**1

  1.3**5**1 => 1.35 (**3** sig. fig.)

This must be rounded to the 2^{nd} decimal place since that is the last place common to both the numbers added (the same number of digits after the decimal as in 1.34, the number with the fewest number of digits after the decimal).

Now look at a few of the questions on the calculator sheet. (See "Notes" or "Homework" links.)

3(c) $4.9921 \times 10^{-2} + 7.06182 \times 10^{2}$

First add them on the calculator to get 7.06231921×10^{2}. Then "line up the decimals" to see what is the last place common to both numbers. The first thing to do is to make sure both numbers have the same power of 10 in order to do this properly. What power of 10 should be used? It doesn't matter as long as the numbers have the same power of 10. Let's choose 10^{2} since that is what the answer comes out to be. It is necessary to change 4.9921×10^{-2} so it is expressed as 10^{2}. To do that the decimal point has to be moved to the left and for each place it is moved the power of 10 goes up by 1 (when moving the decimal point to the right the power of 10 decreases by 1 for each place it is moved).

So how many places must the decimal be moved all together? Well, to go from 10^{-2} to 10^{2} it is necessary to multiply 10^{-2} by 10^{4} ($10^{-2} * 10^{4} = 10^{2}$). That means the decimal point must be moved 4 places to the left.

$4.9921 \times 10^{-2} = 0.00049921 \times 10^{2}$

This can now be added to 7.06182×10^{2} and the decimal points lined up properly because both numbers have the same power of 10.

$$
\begin{array}{r}
7.0618\underline{\mathbf{2}} \times 10^{2} \\
+\ 0.0004\underline{\mathbf{9}}921 \times 10^{2} \\
\hline
7.0623\underline{\mathbf{1}}921 \times 10^{2}
\end{array}
$$

(note the answer has the same power of 10 as the numbers in the addition and is in sci. not.)

However, 7.06182×10^{2} is only known out to the 5^{th} decimal place (the last place common to both numbers) so that is where the answer must be rounded and the final answer is 7.06232×10^{2} (**6** significant figures).

3(d) $1.03724 \times 10^{-9} + 9.913 \times 10^{-11}$

First add them on the calculator to get 1.13637×10^{-9}. Now "line up the decimals" to see what place is common to both numbers. Again, either number can be changed so it has the same power of 10 as the other or even something different than either, as long as they wind up with the same power of 10. Change 9.913×10^{-11} so it's power of 10 is -9.

$9.913 \times 10^{-11} = 0.09913 \times 10^{-9}$

Now line up the decimal points:

$$
\begin{array}{l}
\;\;\;1.0372\underline{\mathbf{4}} \times 10^{-9} \\
+\,0.0991\underline{\mathbf{3}} \times 10^{-9} \\
\hline
\;\;\;1.1363\underline{\mathbf{7}} \times 10^{-9}
\end{array}
$$

(note the answer has the same power of 10 as the numbers in the addition and is in sci. not.)

Note the last place common to both numbers is the 5th decimal place (each number has 5 digits to the right of the decimal) so the answer is known to the 5th decimal place (5 digits to the right of the decimal). Thus $1.1363\underline{\mathbf{7}} \times 10^{-9}$ has **6** significant figures.

4(d) $1.025611 \times 10^{-17} - 9.9813 \times 10^{-18}$

Change 9.9813×10^{-18} so its power of 10 is -17

$$9.9813 \times 10^{-18} = 0.99813 \times 10^{-17}$$

Now line up the decimal points:

$$
\begin{array}{l}
\;\;\;1.0256\underline{\mathbf{1}}1 \times 10^{-17} \\
-\,0.9981\underline{\mathbf{3}} \;\;\times 10^{-17} \\
\hline
\;\;\;0.0274\underline{\mathbf{8}}1 \times 10^{-17}
\end{array}
$$

(note the answer has the same power of 10 as the numbers in the subtraction)

The last place common to both numbers is the 5th decimal place so the answer can be reported to only the 5th decimal place. Note that the number with the fewest number of digits to the right of the decimal is 0.99813×10^{-17} when it is the same size as the other number and it has 5 digits to the right of the decimal, as does the answer when it is the same power of 10 as the numbers subtracted.

$$0.0274\underline{\mathbf{8}}1 \times 10^{-17} \Rightarrow 0.02748 \times 10^{-17} \text{ (5th decimal place)}$$

Then put the number in proper scientific notation to get

$$2.74\underline{\mathbf{8}} \times 10^{-19}$$

and this final number has only **4** sig. figs.

Try 4(b). The same thing occurs for this problem.