Significant figures
Lesson 1

There are four rules on determining how many significant figures are in a number:
- Non-zero digits are always significant.
- Any zeros between two digits are significant.
- A final zero or trailing zeros in the decimal portion only are significant.
- Trailing zeros in a whole number with the decimal shown are significant**.** Placing a decimal at the end of a number, although not usually done, indicates a significant zero.
For example "680." indicates that the trailing zero is significant, hence, there are 3 significant figures in this value.
**** For the purpose of the* VCE Chemistry Study Design*, whole numbers will have the same significant figures as number of digits, for example 400 has three significant figures while 400.0 has four.***

Consider the following numbers

1) 4.0440 - five significant figures.

2) 0.0665 - three significant figures

3) 4.01×10^{-5} - three significant figures.

4) 5,600 - two significant figures.

5) 0.0010005- five significant figures

6) 1.9500×10^{13} - five significant figures

***** When multiplying or dividing measured values by a **constant** the constant is said to have infinite precision and so does not impact the number of **significant figures** in the answer.
Example 1 – circumference of a circle with measured radius 2.1485 m
=> $2\pi r = 2 \times \pi \times 2.1485 = 13.499$ m. Constants 2 and π do not determine the number of significant figures, hence the answer is 2.1485 (5 sig figs).

Rules for addition and subtraction

1) Add or subtract as you would normally.

2) Round the answer to the least number of decimal places of any number in the problem.
Example 1)
3.376898 + 12.1 + 0.25712 = 15.7334018
round to one decimal place 15.7
Example 2)
43.947 - 0.082125 = 43.864875
round to three decimal places 43.865
Example 3)
2,319 + 2,281 = 4,600
The answer, however, is given to two significant numbers but clearly the numbers that were

summed have 4 significant figures. Surely we are confident to express the answer to four significant figures. We use scientific notation to indicate that the trailing zeros in the answer are significant.
$4.600 \text{ X } 10^3$
Example 4)
418,231 - 218,431
Once again the correct answer is 200,000, but all of the significant figures are retained. The most correct way to write the answer would be, once again, in scientific notation $2.00000 \text{ x } 10^5$.

Rule for multiplication and division

The answer is expressed to the LEAST number of significant figures in any number of the problem

Example 1) 3.2 X 2.111 = 6.755 = 6.8

Example 2) 234.519 / 2.3 = 102 = $1.0 \text{ X } 10^2$

Important note. When having many multiplication and division steps in a calculation to avoid truncation error when performing a multiple step calculation always carry through all the digits you have available in a calculation until the very end where you express your final answer to the right number of significant figures.
When performing a calculation where the order of operations must be followed always apply the two rules above as needed. See the example below.
(12.4 + 1.342) X 2.1 =
=> 13.7 X 2.1 (the rule for addition and subtraction was applied in the brackets and hence the sum of 12.4 and 1.342 is expressed to one decimal place by rounding down 13.742 to 13.7).
=> 13.7 X 2.1 = 28.77 = 29 (the rule for multiplication and division was applied and the anser given to the least number of significant figures used in the calculation. In this case it is 2 significant figures)

Example
6 X 6 = 2.34 - 1.293 =

10.23 – 4 =

(6.31 X 3.391) + 5.77 =

(3.300 – 2.72) / 3.4412 =

3.12 + 0.8 + 1.033 =

345.009 - 23.009 =

34.530 + 12.1 + 1 222.34 =

2.33 x 6.085 x 2.1 =

$0.83 + 2.10 \times 0.5896 =$