South Pasadena • Chemistry

Name ____________________________________
Date _________ Period _____

Unit 1 • Observations, Models, & Experiments

SIGNIFICANT FIGURES

A. When taking **measurements** all certain digits plus the **first** uncertain number are significant.

Example: Your bathroom scale weighs in 10 Newton increments and when you step onto it, the pointer stops between 550 and 560. Your look at the scale and determine your weight to 557 N. You are certain of the first two places, 55, but not the last place 7. The last place is a guess and if it is your best guess it also is significant.

B. When given measurements, the numbers that are significant are the digits 1-9 and the 0 when it is not merely a place holder.

1. When 0's are between sig. fig., 0's are always significant.

   Example: **101** has 3 sig. fig. and **34055** has 5 sig. fig.

2. When the measurement is a whole number ending with 0's, the 0's are never significant.

   Example: **21**0 has 2 sig. fig. and **71**,000,000 also has 2 sig. fig.

3. When the measurement is less than a whole number, the 0's between the decimal and other significant numbers are never significant (they are place holders).

   Example: .00**21** has 2 sig. fig. and .0000**332** has 3 sig. fig.

4. When the measurement is less than a whole number and the 0's fall after the other significant numbers, the 0's are always significant.

   Example: .**310** has 3 sig. fig. and .**3400** has 4 sig. fig.

5. When the measurement is less than a whole and there is a 0 to the left of the decimal, the 0 is not significant.

   Example: 0.0**2** has only 1 sig. fig. and 0.**110** has 3 sig. fig.

6. When the measurement is a whole number but ends with 0's to the right of the decimal, the 0's are significant.

   Example: **20.0** has 3 sig. fig., **18876.000** has 8 sig. fig.

   <u>In case 4 and 6 the 0's have no effect on the value (size) of the measurement. Therefore, these 0's must have been included for **another** reason and that reason is to show precision of the measurement. Since these 0's show precision they must therefore be significant.</u>

   <u>In cases 2 and 3 removal of the 0's DO change the value (size) of the measurement, the 0's are place holders and are thus not significant.</u>

   <u>In case 5 the 0 is completely unnecessary, it is neither a place holder nor adds to the accuracy of the measurement.</u>

U N C E R T A I N T I E S   I N   C A L C U L A T I O N S

1. When adding or subtracting numbers written with the ± notation, **always add the ± uncertainties** and then round off the ± value to the largest significant digit. Round off the answer to match.

   Example: (22.**4** ± .5) + (14.7**6** ± .25) = 37.**16** ±.75 = 37.**2** ± .8
   The uncertainty begins in the **tenths** place… it is the last significant digit.

2. When adding or subtracting numbers written in significant figures, show the uncertainty by rounding the answer to match the largest place with uncertainty.

   Example: 26**7** + 11.**8** = 27**8.8** = 27**9**
   The least accurate original measurement is only accurate to the **ones** place.

3. When multiplying or dividing with numbers written with ±, do a base calculation and a maximum calculation. Find the difference between the base calculation and the maximum calculation to give you your calculated ± value. Round the calculated ± value to the largest significant digit and the answer to match the ± value.

   Example: (20.4 ± .6) x (17.70 ± .25) base calculation (20.4 x 17.70 = 361.08)
   maximum calculation, add the ± value ----- (21.0 x 17.95 = 376.95)
   difference = 15.87, initial answer = 361.08 ± 15.87 final answer = 360 ±20.
   The tens place is the first uncertain digit and therefore the last significant figure.

4. When multiplying or dividing measurements written in significant figures, show the uncertainty of your calculations by rounding off your answer to **match the same number of significant figures as your *least* precise measurement (the measurement with the least number of significant figures).**

   Example: 477.85 ÷ 32.6 = 14.657975 = 14.7
   32.6 is the least accurate measurement with only 3 significant figures.

   NOTE: There are two types of precision: "absolute precision" and "relative precision."

   Example: 322.45 x 12.75 x 3.92 = 16116.051 = **161**00

   All the measurements are accurate to the hundredth place (absolute precision) but the answer is rounded to 3 significant figures because 3.92 has only 3 significant figures (relative precision).

In Summary:

	Adding and Subtracting	**Multiplying and dividing**
#'s with ± notation	Rule 1	Rule 3
#'s with significant figures	Rule 2	Rule 4