Appendix F: Math Review

Calculations are an important part of the laboratory routine in order to turn raw data into meaningful information. Often these calculations simply involve finding the right numbers to plug into formulas that are known to be appropriate for the problem. Other times, dimensional analysis must be employed to find the right logic to solve a problem that has no specific formula for its solution. At all times, units of measurement should be carried with numbers in calculations to make sure that the units agree before numbers are used in a formula or in dimensional analysis. The final answer must also be analyzed to give the correct number of significant figures to give an appropriate estimate of the accuracy of the measurement (see Lab Exercise 1).

It is also best to fully record your work when making calculations, especially if the calculation is complex, in order to check your work and quickly locate any errors. To check your answer, you should ask yourself the following question:

- Is the answer of a realistic magnitude? Try rounding the raw data off into simpler numbers that you can do the calculation in your head.
- Do the units make sense and match up with the answer required? Manipulate your units of measurement algebraically (canceling, multiply, and dividing units as if they were numbers) to make sure that the final answer has the appropriate units of measurement.
- Do you get the same answer if you recalculate the problem another way? Sometimes an error in the way you input data into your calculator or a mistake in order of operations can be uncovered in this way.

The following sections are some summarizing mathematical definitions and algebraic processes that you may routinely encounter in the laboratory.

A. Definitions

numerator	The number written above the line in a fraction
denominator	The number written below the line in a fraction
ratio	The relationship between two quantities (i.e. "*x per y*" or "***x/y***")
percent	A fraction whose denominator is 100 (i.e. "*per 100*")
reciprocals	The reciprocal of a real number ***a*** is $1/\boldsymbol{a}$ ($\boldsymbol{a} \neq 0$); also referred to as the "inverse"
powers	$\boldsymbol{a}^{\boldsymbol{n}}$, i.e. "***a*** to the power of ***n***" or "***a*** to the ***n***th power"; means ***a*** times itself ***n*** times (e.g. a^2 = a x a = 'a squared")
logarithms	The common logarithm (log) of any number ***x*** is the power to which 10 would have to e raised to give ***x*** (i.e. the log of 100 is 2; the log of 10 is 1; the log of 1 is 0; the log of 5 is 0.699 which means that $10^{0.699} = 5$)
linear relationship	Two variables are linearly related if a plot of the two leads to a straight line: $\boldsymbol{y = mx + b}$ where *m* is the slope and *b* is the y-intercept of the line.
exponential relationship	Two variables are exponentially related if a plot of the two leads to a straight line only if using semilog paper (e.g. $y = 10^x$). Also, a plot of the log of one variable with the other will give a straight line: $\boldsymbol{\log y = mx + b}$ where ***m*** is the slope and ***b*** is the y-intercept.

least squares method	A statistical method used to calculate the equation for the line of best fit for a series of points.
best-fitting line	A line connecting a series of data points on a graph in such a way that the points are collectively as close as possible to the line.

B. Simple algebra – rules for manipulating equations

If $a = b + c$, then $b = a - c$ and $c = a - b$

If $a = b \times c$, then $b = a/c$ and $c = a/b$

If $a = b^c$, then $b = a^{1/c}$ and $c = \log a / \log b$

$a^{1/n} = \sqrt[n]{a}$

$a^{-n} = 1/a^n$

$a^b \times a^c = a^{(b+c)}$ and $a^b/a^c = a^{(b-c)}$

$(a^b)^c = a^{(bc)}$

$a \times b =$ antilog (log a + log b)

C. Descriptive Statistics

mean	The average value of a set of data; the best estimate of the true value the data is measuring when the data is equally distributed at either side of the mean.
median	The midpoint of observations when ranked in increasing order; the data point in which half of the measurements were higher and half of the measurements were lower values; the best estimate of the true value the data is measuring when the data is skewed to one side or other of the median.
range	The difference between the largest and smallest data values; a measure of how variable the data measurements were.
standard deviation	For symmetrical distributions of data measurements, this is a measure of the average deviation of the data from the mean; this is an indication of the degree of precision in the measurement (low standard