

Problem Set 2 – Uncertainty and Statistics

Complete all problems on separate paper. Show all work for credit. Correct use of significant figures is required for full credit.

1. I've asked you to prepare 2.00 L of 0.109 M NaOH from a stock solution of $53.4 \pm 0.4\%$ by weight NaOH with a density of 1.52 ± 0.01 g/mL. Calculate the volume of stock solution necessary to make this solution. If the uncertainty in delivering the NaOH is ± 0.10 mL, determine the absolute uncertainty in the resulting molarite (0.109 M). Assume negligible uncertainty in the formula mass of NaOH and in the final 2.00 L volume.
2. For the NaOH from problem 1, determine the pH and its absolute uncertainty.
3. An atomic absorption method for the determination of copper in engine oil yielded copper contents of 8.35, 8.45, 8.23, 8.55, and 8.32 $\mu\text{g Cu/mL}$. Determine the sample mean, sample standard deviation and median for these data. Find the 95% confidence interval for these results. (You may use a calculator or computer to do the calculations but you should indicate how you found them (i.e. TI-83, Excel, etc.))
4. A titrimetric method for the determination of calcium in limestone was tested by analysis of a NIST limestone sample certified to contain 40.15 % CaO. The results of four analyses of the sample gave the following data: 40.27 %, 40.00 %, 40.28 %, 40.33 %. Use a Q-test to determine if a single point may be discarded at the 90 % confidence level. Use a Grubbs test to determine if a single point may be discarded at the 95 % confidence level. Do the data indicate the presence of systematic error at the 95 % confidence level?
5. Two methods were used to measure the specific activity of an enzyme. One unit of enzyme activity is defined as the amount of enzyme that catalyzes the formation of one micromole of product per minute under specified conditions. Determine if the two methods are giving the same results at the 95% confidence level. (You may assume that the precision is approximately the same for these two methods. Feel free to use a spreadsheet to streamline calculations, just be sure you understand how do to the calculations by hand.)

Method	Enzyme activity (five replications of a single sample)				
1	139	147	160	158	133
2	148	159	156	164	159