

In-class portion (1-6):Pledge:

When you have completed this portion of the exam, please consider the following:

I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this portion of the exam.

Signed _____

Answer the following on separate sheets of paper. Each problem is worth 10 points. All work must be shown for full credit.

1. A city's water supply is fluoridated by adding NaF. The desired concentration of F^- is 1.6 ppm. How many milligrams of NaF should be added per gallon of treated water if the water supply already is 0.2 ppm in F^- ? (1 gal = 4 qt, 1 qt = 0.946 L)
2. To test a spectrophotometer for its accuracy, a solution of 60.06 ppm $K_2Cr_2O_7$ in 5.0 mM H_2SO_4 is prepared and analyzed. Under the conditions of the experiment this solution has a known absorbance of 0.640. Several aliquots of the solution are analyzed with the following results:
0.639 0.638 0.640 0.639 0.645 0.640 0.639 0.638
 - a) Can any of the points be rejected?
 - b) Determine whether there is a significant difference between the experimental mean and the expected value at the 99% confidence level.
3. Report the answer to the following, along with the error in the answer:

$$\left(\frac{(12.18 \pm 0.08) + (23.04 \pm 0.07)}{3.247(\pm 0.006)} \right) - 9.91(\pm 0.08)$$

4. When 15.00 mL of a 12.50% (w/w) $NiCl_2$ solution is diluted with DI water to a final concentration of 75.00 mL, the resulting Ni^{2+} concentration is 0.2216 M. Calculate the density (in g/mL) of the 12.50% $NiCl_2$ solution. [Note: w/w is an abbreviation for weight percent.]
5. A forensic chemist is asked to compare the zinc content of a brass pipe found at a crime scene to the zinc content of a similar pipe found in the possession of a suspect. Nine separate analyses are carried out on the pipe found at the crime scene, and a result of 1.5884 (± 0.0080) % Zn is calculated. Six analyses are performed on the suspect sample, with a result of 1.5982 (± 0.0082) % Zn. Based on these findings, is it possible that the two pipe samples come from the same source at the 95% confidence level?
6. In chapter 0 of our text, two students from Bates College undertake an analytical class project. What was their project and how do the different steps they carried out illustrate the general steps in a chemical analysis?

Name _____

Take-home portion (7-8), due Monday (1/28) at 5:00pm:

Pledge:

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Signed _____

This portion of the exam is open-book. Use any reference material available to you. Where applicable, let a spreadsheet do as much work for you as possible, **then turn in a hard copy of the spreadsheet**. I ask only that you do not consult with another person regarding any of the following questions.

7. (40 pts) In the first lab we used both volumetric and gravimetric titrations to determine the amount of KHP in an unknown mixture. Our answers were 35.81% and 35.79% for the volumetric and gravimetric determinations, respectively. The certified correct answer was 35.55 % KHP. Use the class data to answer the following.
- Does either method give the correct result at the 95% confidence level? What about the 99% confidence level?
 - Do the two methods give similar variances at the 95% confidence level?
 - Do the two methods give similar results at the 95% confidence level?
 - You may have realized that the standard deviations we calculated for our final results are incorrect because they don't take into account the error in the concentration of the standard solution. Use propagation of error to calculate the true errors for both the volumetric and gravimetric unknown determinations.

Hints for d:

- Our standardization results (average \pm std dev) for both the volumetric and gravimetric cases should be fine, since the only source of error we don't account for is the error in the molecular weight of KHP, which should be negligible.
 - In the volumetric unknown determination, the mass of unknown per volume of NaOH should be the same for every run. This calculation is free of other error terms, so calculate a class average and standard deviation for this quantity. Then use this average to calculate the % KHP, and use propagation of error to calculate the true standard deviation.
 - In the gravimetric unknown determination, the mass of unknown per mass of NaOH should be the same for every run.
8. (12 pts) The following table gives calibration data for an instrumental technique. An unknown was measured three times and gave signals of 60.355, 61.199, and 60.747. Give the concentration of the unknown, **along with its standard deviation**.

[analyte], (ppm)	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
Signal	3.66	17.66	30.12	41.99	60.17	71.50	87.81	100.31	115.16	128.71	144.59