

10510CHEM311000-Analytical Chemistry (I)

分析化學一

First Midterm Examination

Date: 15-11-2016, 10:10 am to 12:10 pm

Answer all 8 questions (total 105%). You have 2 hours to finish this paper.

- 1.** The following replicate weighings were obtained: 29.8, 30.2, 28.6, and 29.7 mg. Calculate the standard deviation and the standard deviation of the mean. Express these as absolute (units of the measurement) and relative (% of the measurement) values. **[10%]**
- 2.** A single quality control (QC) sample was run in replicates of eight to produce the following mass spectral peak area signals: 2.2, 1.7, 1.9, 2.3, 2.1, 1.8, 2.7, and 2.3 peak area. The slope of the calibration curve is $m=0.456$ peak area/ μM . Find the Limit of Detection (LOD) and Limit of Quantification (LOQ) values. **[5% each]**
- 3.** (a) You have received three shipments of Monazite sand of equal weight that contain traces of europium. Analysis of the three ores provided europium concentrations of 397.8 ± 0.4 , 253.6 ± 0.3 , and 368.0 ± 0.3 ppm, respectively. What is the average europium content of the ores and what are the absolute and relative uncertainties? **[10%]**

(b) You prepared a solution of HCl that based on three separate measurements and had a concentration of $(5.86 \pm 0.17) \times 10^{-3}$ M. What is the pH of the solution and its uncertainty? **[10%]**

4. A series of normally identical samples are taken for analysis. The mean weight of the samples is 9.78g, with a standard deviation being 0.09g for very few samples having been weighted. How many samples must be weighted so that the sample mean has an error 0.02g at 95% confidence interval (CI) from the population mean?

[10%]

5. Sewage and industrial pollutants dumped into a body of water can reduce the dissolved oxygen concentration and adversely affect aquatic species. In one study, weekly readings are taken from the same location in a river over a two-month period.

Week Number	Dissolved O ₂ , ppm
1	4.9
2	5.1
3	5.6
4	4.3
5	4.7
6	4.9
7	4.5
8	5.1

- (a) Some scientists think that 5.0 ppm is a dissolved O₂ level that is marginal for fish to live. Conduct a statistical test to determine whether the mean dissolved O₂ concentration is less than 5.0 ppm at the 95% confidence level. State clearly the null and alternative hypotheses. **[10%]**

- (b) The week 3 data in the table is suspected of being an outlier. Use the Q test to determine if the value can be rejected at the 95% confidence level. **[5%]**

6. A new gravimetric method is developed for iron(III) in which the iron is participated in crystalline form with an organoboron “cage” compound. The accuracy of the method is checked by determining the iron in ore sample and comparing with the results using the standard precipitation with ammonia and weighing the Fe_2O_3 formed after ignition of the $\text{Fe}(\text{OH})_3$ precipitated. The results, reported as % Fe for each analysis, were as follows:

Test Method (%)	Reference Method (%)
20.10	18.89
20.50	19.20
18.65	19.00
19.25	19.70
19.40	19.40
19.99	

(a) Is the test method significantly more precise than the reference method? [7%]

(b) Is there a significant difference between the two methods? [8%]

7. You are developing a new analytical method for the determination of blood urea nitrogen (BUN). You want to ascertain whether your method differs significantly from a standard method for determining a range of sample concentrations expected to be found in the routine laboratory. It has been ascertained that the two methods have comparable precision. Following are two sets of results for a number of individual samples. Do the following results confirm a difference in the two methods at the 95% confidence level? [10%]

Sample	Your Method (mg/dL)	Standard Method (mg/dL)
A	10.2	10.5
B	12.7	11.9
C	8.6	8.7
D	17.5	16.9
E	11.2	10.9
F	11.5	11.1

8. The data in the accompanying table represent the concentration of glucose in the blood serum of an adult patient. On four consecutive days, a blood sample was drawn from the patient and analyzed in triplicate.

DAY	Glucose Concentration, mg/100mL		
1	62	60	63
2	58	57	57
3	51	47	48
4	54	59	57

- (a) Perform an analysis of variance (ANOVA), and see whether the mean concentrations vary significantly from day to day. [10%]
- (b) Determine DAY 1 differs from which DAY using least significant difference method. [5%]