Quantitative Methods in Chemistry: Week 12 subjective assignment

1. An organic acid is expected to have the elemental composition of C = 68.850% and H = 4.935% in its pure form. It is analyzed by a method that has the relative standard deviation (s_r) $\rightarrow$ population standard deviation (σ), and the s_r values for C and H are 4 ppt and 6 ppt, respectively (ppt is parts per thousand). If the analysis of a pure sample of organic acid by this method gives C = 68.550% and H = 4.828%, then at 95% confidence level is there any error in the analysis of either element?

2. Two analytes, A and B are passed through a 20 cm chromatographic column with a dead time of 1.15 min. Analytes A and B show retention times of 12.40 and 13.52 min, and width at the base = 1.05 and 1.10 min, respectively, under a particular eluting condition. Based on the data provided, calculate the following:
   (a) Column Resolution
   (b) Plate heights for analyte A and B
   (c) Length of column required to achieve a resolution of 1.3
   (d) Time required to elute A on the column that gives the resolution of 1.3

3. A drug with formula $C_{10}H_{20}N_2S_4$ is being quantified in a sample by titration. For this, all the sulfur in the sample is oxidized to SO_2 and the gas is passed into H_2O_2 to form H_2SO_4. If the acid produced by 0.433 g sample required 22.13 mL of 40 mM NaOH, calculate the weight % of the drug in the sample.

4. Given the following reaction: $Na_2S_2O_3 + AgBr \rightarrow NaBr + Na_3[Ag(S_2O_3)_2]$

   a. How many moles of $Na_2S_2O_3$ are needed to react completely with 22.1 g of AgBr?
   b. What is the mass of NaBr that will be produced from 22.1 g of AgBr?

5. Answer the following questions:
   a. Write the functional form of the Gaussian distribution.
   b. Integrate the function between ±σ. You may use definite integral tables or online mathematical tools (such as wolfram alpha) to answer this (and subsequent) question(s)
   c. Integrate the function between ±2σ
   d. Integrate the function between ±3σ

6. For laminar flow of liquid in a capillary tube, viscosity coefficient (η) is obtained by Poiseuille equation: ($\boldsymbol{\rho}$, r, t, l and V are the density of the solution, radius of the capillary, time taken for the flow, length of the capillary and volume of the solvent, respectively)

$$\eta = \frac{\pi h \rho g r^4 t}{8 l V}$$

   Each of the parameters are associated with their respective error (i.e. $\Delta\boldsymbol{\rho}$, Δr, Δt, Δl and ΔV). Deduce the error in the measurement of viscosity coefficient applying the idea of error propagation.