

1. Calculate the results when 1) the number behind \pm is uncertainty 2) the number behind \pm is standard deviation. (8)
 - a) $(3.269 \pm 0.004) + (7.43 \pm 0.01) - (2.15 \pm 0.04)$
 - b) $(41.61 \pm 0.04) (0.0899 \pm 0.0001) (200.5 \pm 0.2) / (38.24 \pm 0.02)$
2. The signal to noise ratio (S/N) determines detection limit, sensitivity and accuracy of a measurement. For a fixed signal, how can one improve S/N value? (7)
3. In general, electroanalytical methods are divided into four categories: potentiometry, coulometry, voltametry, and conductometry. Briefly describe how each method can be used for analytical purpose. (12)
4. A student tried to separate a pair of closely related compound with a capillary column. The separation parameters he used resulted just sufficient resolution, and a very long retention time. Which of the following procedures do you think can reduce the retention time in half without affecting resolution significantly? Explain your choice. (10)
 - a) cutting the column in half
 - b) doubling the oven temperature
 - c) reducing the thickness of the stationary phase in half
 - d) doubling the flow rate of the mobile phase
 - e) injecting half sample volume
5. Which of the following methods will you take in order to obtain 1) melting point 2) heat of melting 3) bond energy of a compound. Explain your choice. (8)
 - a) thermogravimetric analysis (TGA)
 - b) differential thermal analysis (DTA)
 - c) differential scanning calorimetry (DSC)

6. Which of the following ionization methods for mass spectrometry give you better information of molecular weight? Why? (8)
- electron impact (EI)
 - chemical ionization (CI)
 - fast atom bombardment (FAB)
 - field ionization (FI)
7. Define the following terms : (12)
- photomultiplier
 - hollow cathode lamp
 - turbidimetry
 - Michelson interferometer
8. For a grating, how many lines per mm would be required in order for the first order diffraction line at $\lambda = 500\text{nm}$ be observed at a reflection angle of -40 degree when the angle of incidence is 60 degree. (6)
9. A chemist is attempting to determine strontium with an atomic absorption spectrometer equipped with $\text{N}_2\text{O}-\text{C}_2\text{H}_2$ burner. But the sensitivity associated with 460.7 nm resonance line is not satisfactory. Suggest at least three things that might be tried to improve sensitivity. (9)
10. What kinds of non-flame and non-oven sources can be used to excite atoms for emission spectroscopy. Mention at least three of them. (6)
11. The cell $\text{SCE} \parallel \text{H}^+ (a=x) \mid \text{glass electrode}$ has a potential of 0.2094 V when the solution in the right hand compartment is a buffer of $\text{pH } 4.006$. A potential of -0.3011 V is obtained when the buffer is replaced with an unknown.
- Calculate the pH .
 - Assuming an uncertainty of $\pm 0.002\text{ V}$ in the junction potential, what is the range of pH within which the true value might be expected to lie. (8)
12. Describe in detail how to prepare one liter 0.5 M NaOH standard aqueous solution used for acid-base titration. (6) (Na 22.9898 , O 15.9994 , H 1.00797)