I. (2 pts each) Match the following terms and definitions.

1. ______ Measure of chromatographic columns to separate two analytes.

2. ______ Electrochemical cell that requires an external source of electrical power.

3. ______ Electrode at which reduction takes place.

4. ______ Loss of electrons.

5. ______ Type of HPLC column in which the stationary phase is a second liquid that is immiscible with the liquid mobile phase and is held in place by adsorption or chemical bonding.

6. ______ Prompt emission of photons is measured following absorption.

7. ______ Term used to describe chromatographic column efficiency.

8. ______ Closeness of measured values to one another.

9. ______ Process by which a coagulated colloid returns to its dispersed state.

10. ______ Molecular absorption transition in the IR range.

A. Accuracy
B. Adsorption Column
C. Anode
D. Cathode
E. Digestion
F. Electolytic Cell
G. Fluorescence
H. Galvanic Cell
I. Oxidation
J. Partition Column
K. Peptization
L. Phosphorescence
M. Plate Height
N. Precision
O. Reduction
P. Resolution
Q. Rotational Transition
R. Vibrational Transition
II. For the following cell:

\[
\text{Zn} \mid \text{Zn}^{2+} (0.0364 \text{ M}) \parallel \text{Tl}^{3+} (9.06 \times 10^{-3} \text{ M}), \text{Tl}^{+} (0.0620 \text{ M}) \mid \text{Pt}
\]

1. (2 pts) Write each half reaction as a reduction.

2. (5 pts) Calculate the theoretical potential of the cell.

3. (3 pts) Calculate the change in free energy.

III. For an x-ray photon with a wavelength of 2.70Å calculate:

1. (3 pts) the frequency in Hz

2. (3 pts) the energy in Joules.
IV. (5 pts) Calculate the potential of a platinum electrode immersed in a solution that is 0.0353 M VOSO$_4$, 0.0586 M $\text{V}_2(\text{SO}_4)_3$ and 0.100M HClO$_4$.

V. 2.50 mL aliquot of a 3.38 ppm Fe$^{3+}$ solution is treated with excess KSCN and diluted to 500 mL.

1. (5 pts) What is the absorbance of the solution at 580 nm in a 2.50 cm cell? (Molar absorption coefficient = $7.00 \times 10^3$ L/mol cm.)

2. (2 pts) Calculate the % transmittance.

VI. (8 pts) A 0.17989 g sample of an organic compound was burned in a stream of oxygen and the CO$_2$ produced collected in a solution of barium hydroxide. Calculate the percent carbon in the sample if 0.5613 g BaCO$_3$ (MW = 197.34 g/mol) was formed.
VII. Consider the following set of data. Show all calculations.

<table>
<thead>
<tr>
<th>Trial Number</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.624</td>
</tr>
<tr>
<td>2</td>
<td>0.613</td>
</tr>
<tr>
<td>3</td>
<td>0.596</td>
</tr>
<tr>
<td>4</td>
<td>0.607</td>
</tr>
<tr>
<td>5</td>
<td>0.582</td>
</tr>
</tbody>
</table>

1. (2 pts) Calculate the 95% confidence limit if \( s \rightarrow \sigma = 0.015 \).

2. (2 pts) If the accepted value is 0.625 g calculate the relative error of the mean.

3. (3 pts) Use the appropriate statistical test to determine if the 0.582 value is an outlier at the 95% confidence limit.

VIII. The homogeneity of a batch of chloride standards was tested by analyzing samples taken randomly from two bottles. The following results were obtained.

<table>
<thead>
<tr>
<th>Bottle 1 (% Chloride)</th>
<th>Bottle 2 (% Chloride)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.32</td>
<td>26.28</td>
</tr>
<tr>
<td>26.33</td>
<td>26.25</td>
</tr>
<tr>
<td>26.38</td>
<td>26.38</td>
</tr>
<tr>
<td>26.39</td>
<td></td>
</tr>
</tbody>
</table>

Is there a significant difference between the two bottles at the 95% confidence limit if the pooled standard deviation = 0.51%?
IX.  1. (3 pts) Calculate the solubility product constant for a $8.6 \times 10^{-4}$M SrF$_2$ solution.

2. (3 pts) Calculate the solubility of the solution if the F concentration = 0.05M.

X.  (5 pts) Draw a block diagram of a fluorescence instrument.

XI.  (4 pts) Describe two reasons for deviations from Beer’s Law.
XII. (5 pts) Draw a block diagram of a typical Gas Chromatograph. List two common detectors used for gas chromatography.

XIII. (4 pts) What transitions occur when a sample is irradiated with:

1. Radiation in the IR
2. Radiation in the UV

Answer ONE of the following two questions. Clearly mark the question you want graded.

XIV. (8 pts) (Use activities to calculate the solubility of Mg(OH)\(_2\) \((K_{sp}) = 7.1 \times 10^{-12}\)) in a 0.0167 M Ba(NO\(_3\))\(_2\) solution.
XV.  (8 pts) What is the pH of a solution prepared by dissolving 9.20 g lactic acid (90.08 g/mol) and 11.15 g sodium lactate (112.06 g/mol) and diluting to 1L? $K_a = 1.38 \times 10^{-4}$. (DO NOT USE APPROXIMATIONS)