Questions are worth 25 points each. OMIT ONE QUESTION by clearly writing OMIT in the space provided for your work. If you fail to mark OMIT on a question I will omit the last question of the test. Show your work and circle your answers for full credit.

1. Consider the potentiometric determination of nitrate using a nitrate specific ion electrode. All samples were prepared by a 10x dilution with a constant ionic strength buffer, and the potential vs. the SCE was measured. The results were:

<table>
<thead>
<tr>
<th>[NO$_3$]</th>
<th>E (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 x 10$^{-3}$</td>
<td>-240.7</td>
</tr>
<tr>
<td>3.16 x 10$^{-3}$</td>
<td>-211.6</td>
</tr>
<tr>
<td>5.00 x 10$^{-3}$</td>
<td>-197.5</td>
</tr>
<tr>
<td>1.00 x 10$^{-2}$</td>
<td>-180.9</td>
</tr>
</tbody>
</table>

Calculate the following quantities for the **linearly related** data. [HINT: Do you have to manipulate any of the given values?]

\[ \Sigma x \quad \Sigma y \quad \Sigma x^2 \quad \Sigma y^2 \quad \Sigma xy \quad n \]

Determine the values for the following:

\[ S_{xx} \quad S_{yy} \quad S_{xy} \quad m \quad b \quad r \]

An unknown containing the nitrate ion was analyzed using the above method. If a 0.500 g sample of the unknown was dissolved and diluted to 50.0 mL with a constant ionic strength buffer and the potential of this solution was found to be -252.4 mV, what is the concentration of nitrate ion in the unknown?
2. A fluorimetric determination for chelates of morin and aluminum is performed by measuring the fluorescence for several standards. The following is a partial set of data was generated from the experimental data:

\[ \Sigma x = 90; \Sigma y = 771.7; \Sigma x^2 = 3250; \Sigma y^2 = 229974.71; \Sigma xy = 27331; n = 5 \]

What is the slope, the y-intercept, and the correlation coefficient from this data?

An unknown is prepared by dissolving 0.154 g of a compound containing aluminum and diluting the unknown to 1.000 L. 15 mL of this solution is obtained, chelated with the morin, and determined to have an average fluorescence of 175 after five measurements. What is the standard deviation for the results from the calibration curve?

If the x-values obtained were in units of ppm Al, what is the percent composition of aluminum in the unknown?
3. a) Calculate the missing $[\text{H}^+]$ for the following cell if the cell potential is -0.482 V.

$$\text{NHE} \ || \ \text{H}^+ (?) \ | \ \text{H}_2 (1.00 \text{ atm})$$

b) Calculate the standard cell potential for $\text{AgCl(s)} + \text{e}^- \rightarrow \text{Ag(s)} + \text{Cl}^- (aq)$, given the standard cell potential for the silver ion being reduced to silver metal is 0.799V, and that $K_{sp}$ for AgCl is $1.8 \times 10^{-10}$.
4. A 1.054 g sample of steel is dissolved in 6M HNO₃, and the solution is subsequently diluted to 500.0 mL. Two 25.00 mL aliquots of this solution are taken. The first aliquot is treated with phosphoric acid and potassium periodate to convert any Mn to MnO₄⁻. The second aliquot is 'spiked' with 10.00 mL of a 100.0 ppm solution of manganese, and then treated as the first aliquot. Both aliquots were diluted to 100.0 mL. The solutions were then measured in a Spec 21 spectrophotometer, with the first solution determined to have 68.4%T while the spiked aliquot had 31.5%T. Calculate the %Mn in the original sample.
5. a) A solution containing the complex formed between Bi(III) and thiourea has a molar absorptivity of $9.32 \times 10^3 \text{ L cm}^{-1} \text{ mol}^{-1}$ at 470 nm.

i) What is the absorbance of a $6.24 \times 10^{-5}$ M solution of the complex at 470 nm in a 1.00 cm cell?

ii) What is the percent transmittance of the solution described in (i)?

iii) What is the molar concentration of the complex in a solution that has the absorbance described in (a) when measured at 470 nm in a 5.00 cm cell?

b) A 2.50 mL aliquot of a solution that contains 3.8 ppm iron(III) is treated with an appropriate excess of KSCN and diluted to 50.00 mL. What is the absorbance of the resulting solution at 580 nm in a 2.50 cm cell, given the molar absorptivity is $7.00 \times 10^3 \text{ L cm}^{-1} \text{ mol}^{-1}$ at 580 nm.