The practical is designed to assess the skill and knowledge of the chemical laboratory that you have acquired this semester. You are presented with a problem to solve using your chemical laboratory skills. As a pre-lab activity you are to describe how you plan to go about solving the problem. Once you are in lab you will conduct experiments to collect data on the problem then write a report summarizing your discoveries.

Unlike all other experiments performed in Chem 152 this will be an individual effort. Once experimental work has commenced, you will not be allowed to collaborate with other students. In addition, you should expect to be graded on the results you report.

Clinical Research

For this problem you are to consider a scenario where clinical researchers are investigating the effects of a new drug designed to raise hemoglobin levels in anemic patients. The researchers have been conducting animal studies using specially bred anemic rats to evaluate the new drug. Initially, before any drug had been administered, blood samples were taken and tested. The report of this clinical analysis is provided at the end.

Healthy rats will have hemoglobin concentrations of 18 mg/dL to 22 mg/dL or 2.8 x 10^{-3} M to 3.4 x 10^{-3} M. The anemic rats will have values that could be as much as half the normal values. For the drug to be judged usable the hemoglobin levels in anemic rats that have been treated with the drug will have to reach at least the lower normal limit.

One potentially adverse side effect is the lowering of blood pH. A healthy human will have a blood pH of 7.3 to 7.4. When the pH drops below 7 there is significant risk of fatigue, low bone density, stunted cell repair and an increased risk of infection. For the drug to be judged successful it needs to significantly increase the concentration of hemoglobin without significantly lowering blood pH. For the anemic rats the desired blood pH is between 7.3 and 7.4. If the blood pH in the rats drops to below 7.2 the drug will be judged to be unusable.
The Problem
The study was conducted using four different rats. Initially, before any drug had been administered, whole blood samples were taken and tested. The report of this clinical analysis is provided below.

Following the administration of the drug for what the researchers believe to be an appropriate time they submit another sample for analysis. You have been selected to do the analysis. Your assignment is to duplicate the initial analysis (described below) using the new samples, compare your results to those for the un-treated rat and then evaluate the drug’s effectiveness. You are to determine if the drug has effectively increased the concentration of hemoglobin in the blood while not significantly changing the pH.

Procedure
The researchers provide you with a sample of whole blood from a particular rat after treatment. You have access to (and are expected to use) the following materials and techniques, all of which have been employed this semester in Chem 152.

- the contents of your locker
- volumetric glassware kit
- a stock solution of hemoglobin (8.07 x 10⁻³ M)
- Red Tide USB 650 spectrometer
- A Vernier pH electrode.

Once you have completed your analysis you are to write a report to the researchers describing your results, your conclusions regarding the drug analysis and your recommendations as to what should be done next. Your report is to be submitted using the “Practical Midterm Worksheet”.

This report will be evaluated as all reports this semester with an emphasis on the quality of your data presentation, the credibility of your arguments, whether or not your conclusions are supported by the data you collect and whether or not your recommendations are appropriate. This report is to be submitted at the end of class.

Scroll down to access the clinical analysis report on the untreated rat samples.
Project Description:
Analysis of rat whole blood samples for hemoglobin and pH.

Analysis Performed By:
Dr. Bunsen Honeydew

Date Analysis Performed:
January 28, 2014

Project # 003936-57P-2014

Samples Analyzed
The whole blood sample consisted of a very dark red liquid.

Spectroscopic analysis of blood samples.
Due to the intensity of the color the blood sample was quantitatively diluted for further analysis. A 1:100 dilution was performed using distilled water.

Absorbance measurements were made at 500 nm using an Ocean Optics Red Tide USB 650 spectrometer and Vernier Logger Pro software. The spectrometer was calibrated using a cuvet of distilled water. Absorbance measurements were made at 500 nm. The values obtained are reported in the table.

pH measurement.
The pH of the whole blood sample was measured using a Vernier pH electrode connected to Logger Pro on a laptop computer.

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH in original sample</th>
<th>[hemoglobin] in diluted sample</th>
<th>[hemoglobin] in original sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample rat A</td>
<td>7.35</td>
<td>$1.36 \times 10^{-5}$ M</td>
<td>$1.36 \times 10^{-3}$ M</td>
</tr>
<tr>
<td>Sample rat B</td>
<td>7.34</td>
<td>$1.35 \times 10^{-2}$ M</td>
<td>$1.35 \times 10^{-3}$ M</td>
</tr>
<tr>
<td>Sample rat C</td>
<td>7.35</td>
<td>$1.34 \times 10^{-5}$ M</td>
<td>$1.34 \times 10^{-3}$ M</td>
</tr>
<tr>
<td>Sample rat D</td>
<td>7.33</td>
<td>$1.39 \times 10^{-2}$ M</td>
<td>$1.39 \times 10^{-3}$ M</td>
</tr>
</tbody>
</table>