Connecting Science and Math

CSI In The Operating Room — Student Activity

Problem

A patient in a hospital has died following what should have been a fairly routine surgery. The death is clearly not related to the condition for which the patient had surgery. A thorough investigation was launched and it was determined that the death was caused by the anesthesia that was administered. Either it was a bad batch of the drug from the pharmaceutical company, TNS Drugs, or it was due to the improper administration of the drug by the anesthesiologist. The victim was the only patient to die after receiving the drug, so suspicion has shifted quickly to the anesthesiologist. The concentration of the anesthesia drug that is considered safe is 0.020M or less. Your task is to determine whether or not the anesthesiologist administered a safe concentration of the drug.

Introduction

Biochemically, there are two ways of analyzing substances: ***qualitatively*** and ***quantitatively***. In qualitative analysis, one determines whether or not the substance is present. In quantitative analysis, one determines how much of a substance is present. In this activity, quantitative analysis is used to determine the concentration of anesthesia administered. ***Spectrophotometry*** is a common quantitative method of determining sample concentrations. A tool that can be used with the TI-Nspire handheld is called a ***Colorimeter***.

You will be given a small amount of the anesthetic in question, and it is your job to determine its concentration by interpolating from a graph of known concentrations.

Materials

TI Nspire Handheld
Distilled water
6 Cuvettes
Vernier EasyLink™
Vernier Colorimeter
Samples of known concentrations from TNS Drugs (0.050M, 0.025M, 0.0125M, 0.00625M and 0.0M)
Sample from Hospital (Unknown Concentration)

Procedure

1. Using the 6 cuvettes fill each about ¾ full with the following samples:

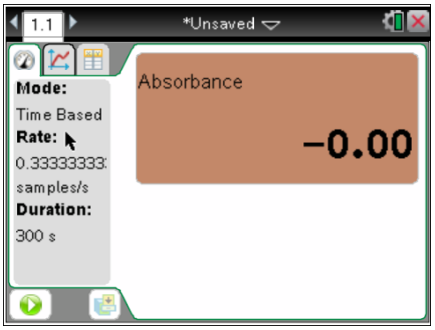
Sample	Concentration
Distilled Water	0.0M
TNS Sample 1	0.00625M
TNS Sample 2	0.0125M
TNS Sample 3	0.025M
TNS Sample 4	0.050M
Hospital Sample	Unknown

2. Turn on the TI-Nspire handheld

3. Connect the Colorimeter to the EasyLink and then connect the EasyLink to the mini-USB port in the top of the handheld. Once connected, a screen similar to that on the right should appear.

4. Using the arrow on the face of the Colorimeter, set the wavelength to 635nm. The green light indicates the selected wavelength.

5. You will need to calibrate the Colorimeter. Open the lid of the Colorimeter, and place the cuvette containing the ***distilled water*** into the Colorimeter slot, making sure a "smooth" side of the cuvette has the arrow pointed at it, and close the lid. Calibrate by pressing and holding the CAL button on the Colorimeter. Release the CAL button when the red light stops flashing on the Colorimeter—it takes about 5 seconds. That's it! You can keep the distilled water cuvette in the Colorimeter.

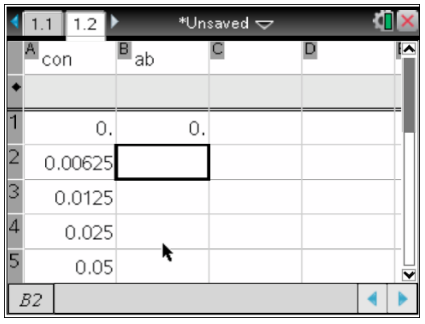


6. You are now ready to collect absorbance data for the four samples from TNS Drugs. Replace the distilled water cuvette with TNS Sample 1 and close the lid of the Colorimeter. Once the reading stabilizes, record the absorbance for the sample on your data table.

7. Repeat step 6 with the remaining samples (2, 3, 4 and the hospital sample). Record your absorbance values in this data table:

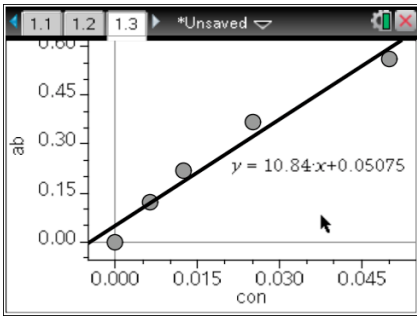
Sample	*Concentration*	*Absorbance*
Distilled Water	0.0M	0.00
TNS Drugs Sample 1	0.00625M	
TNS Drugs Sample 2	0.0125M	
TNS Drugs Sample 3	0.025M	
TNS Drugs Sample 4	0.050M	
Hospital Sample	Unknown	

8. You will now enter the data into a spreadsheet. Press ctrl→doc→4 to add a Lists and Spreadsheet page. On this page enter con (for concentration) at the top of column A and ab (for absorbance) at the top of column B (as indicated in the picture on the right). Enter the appropriate values for distilled water and TNS Samples 1 through 4.



9. You will now view and analyze the data. Press ctrl→doc→5 to add a Data & Statistics page. Move your cursor over the the center of the y-axis, click the center of the touchpad and then select ab for the y-axis variable. Move the cursor over the center of the x-axis, click the center of the touchpad and then select con for the x-axis variable.

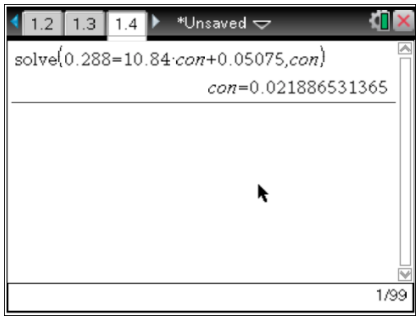
10. Press menu→Analyze→Regression→Show Linear(mx+b) to show the equation of the relationship between absorbance and concentration. Write down the equation of the line.



11. To determine the concentration of the hospital sample we will add a calculator page and use the solve function. Press ctrl→doc→1 to add a Calculator page. Use the solve function to determine the concentration of the hospital sample. An example is listed below:

    solve(.288=10.84***con**+0.05075,**con**)

    The formula used for the solve function is to enter the equation in parentheses followed by a comma followed by the variable you are interested in finding. The other variable is replaced by the numerical value that you measured (in this case it is absorbance).



12. You now know the concentration of the hospital sample. Did the anesthesiologist administer a safe concentration of the drug???

Analysis

1. Compile a laboratory technician report for the CSI Team that is investigating this case.

2. How were qualitative observations used in this investigation?

3. How were quantitative observations used?