Case File: 1688
"A Game of Operating Room Concentration"

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. The patient's death was attributed to either a bad batch of the drug from the pharmaceutical company, XYZ Drugs or the improper administration of the drug by the anesthesiologist. The victim was the only patient to die after receiving the drug. Therefore, our suspicion has shifted quickly to the anesthesiologist. Your task is to determine whether or not the anesthesiologist administered a safe concentration of the drug, 0.020M or less.

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 (represented by green food coloring). **Spectrophotometry** is a common quantitative method of determining sample concentrations. A tool that can be used with the calculator is called a **Colorimeter**.

You will be given a small amount of the suspected drug and it is your job to calculate its concentration by interpolating from a graph of known concentrations.

Materials

TI-84 Plus SE Calculator   Distilled water
Vernier EasyLink™   6 Cuvettes
Vernier EasyData™ App   Vernier Colorimeter

Samples from XYZ Drugs (0.050M, 0.025M, 0.0125M and 0.00625M)
Sample from Hospital (Unknown Concentration)

Procedure

1. Use the 6 cuvettes to prepare the following samples:

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

2. Turn on the calculator.

3. Connect the Colorimeter to the USB port of the calculator. The calculator will automatically launch the EasyData APP.

4. Select [File] from the Main screen, and then select **1: NEW** from the menu to reset the application.

5. Set-up the calculator for the Colorimeter. Place the cuvette containing the distilled water into the Colorimeter slot and close the lid. Set the wavelength on the Colorimeter to 635 nm (Red) Calibrate by pressing the CAL button on the Colorimeter.

6. Set up the data-collection mode. Select [Setup] from the Main screen. Select **3: EVENTS WITH ENTRY** from the menu.

7. Select [Start] from the main screen.

8. You are now ready to collect absorbance data for the four samples from XYZ.

   a. You should now see a screen that directs you to "Choose Keep to collect data". With the distilled water cuvette STILL in the colorimeter, press **KEEP**. The calculator just recorded the absorbance of the distilled water.
   b. Now on the screen that says "ENTER VALUE", type in "0" as the concentration value for the distilled water and press **OK**.
   c. Open the lid of the colorimeter, remove the distilled water cuvette and replace it with the 0.00625M cuvette. Close the lid and watch the calculator screen. When the number stabilizes, press **KEEP**. Then type 0.00625 on the "ENTER VALUE" screen and press **OK**. You have now collected two data points, and you should see your data points plotted on a graph.
   d. Repeat this procedure until you have collected data on all 5 of the cuvette concentrations. DON'T DO ANYTHING WITH THE UNKNOWN CONCENTRATION CUVETTE YET!!!

9. After collecting data on all five of the cuvettes, and when you can see your graph with all five points displayed, press **STOP** and the data collection will end. You should now see a graph with the axes labeled.

10. Press **MAIN** and you should be back on the main menu. Place the "unknown" cuvette into the colorimeter and record the absorbance being displayed on the calculator screen in the space below.

Unknown absorbance = _____

11. You will now need to ask the calculator to make a best-fit line so you can determine the concentration of the unknown solution.

    a. Select $\boxed{\text{Graph}}$ from the Main Screen.

    b. Select **ANALYZE** from the graph screen. Select **2: LINEAR FIT** from the menu.

    c. The calculator will display the Curve Coefficients. Press **OK**. You should now see your graph with a best fit line drawn on it. Press (the up arrow key) and you should see a blinking cursor on the best fit line. Move the cursor to the right or left until the "Y" value most closely matches the absorbance of the unknown that you recorded above. The corresponding "X" value is the concentration of the unknown.

X-value = _____M

Analysis

1. Construct a table and a graph of the known values. Make sure you title your graph and label your axes, and draw in your best-fit line.

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

2. Compile your lab tech report on your findings.