Amount of Transmitted Light Relative to the Concentration of a Solution

Tarik Onalan

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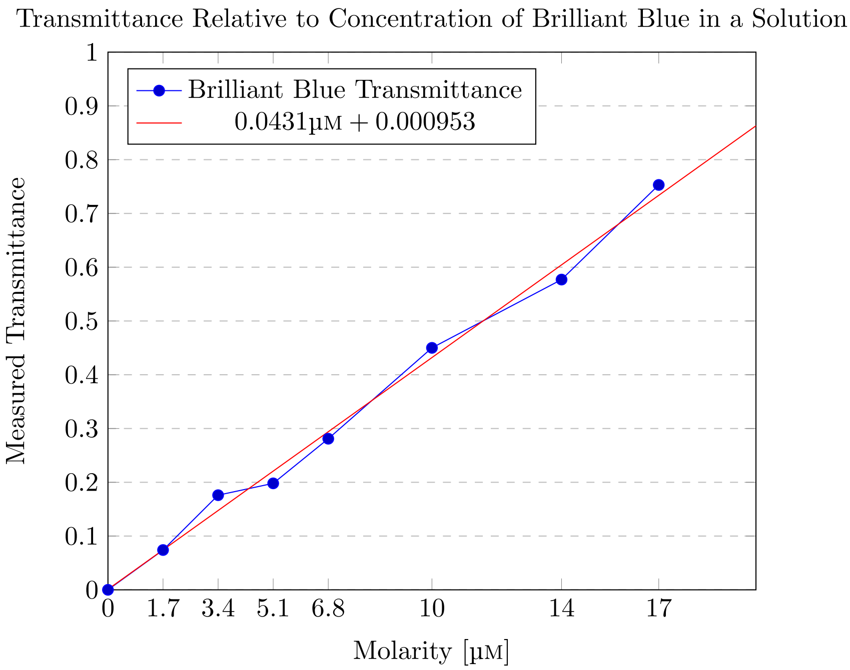
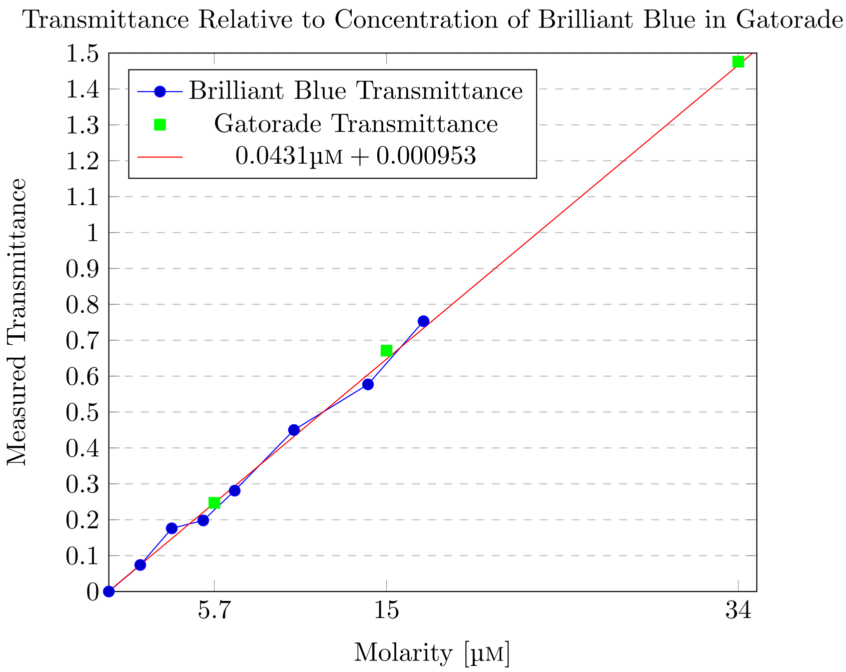
Purpose: Understand how relative concentration of a solution in water can affect its transmittance and absorbance.

1 Data

Solution	Dilution Ratio $\frac{\text{ml } stock}{\text{ml } water}$	Molar Concentration µM	Measured Percent Transmittance	Measured $\%T$ in Decimal Form
1. (stock solution)	10 ml/0 ml	$1.7 \cdot 10^1$µM	0.753	0.177
2.	8 ml/2 ml	$1.4 \cdot 10^1$µM	0.577	0.265
3.	6 ml/4 ml	$1.0 \cdot 10^1$µM	0.450	0.355
4.	4 ml/6 ml	$6.8 \cdot 10^0$µM	0.281	0.524
5.	3 ml/7 ml	$5.1 \cdot 10^0$µM	0.198	0.634
6.	2 ml/8 ml	$3.4 \cdot 10^0$µM	0.176	0.667
7.	1 ml/9 ml	$1.7 \cdot 10^0$µM	0.074	0.84
8.	0 ml/10 ml	$0.0 \cdot 10^0$µM	0.000	1.000
Glacier Freeze	3.35 ml/6.65 ml	$5.7 \cdot 10^0$µM	0.247	0.566
Cool Blue	8.82 ml/1.18 ml	$1.5 \cdot 10^1$µM	0.671	0.213
Berry	20.1 ml/−10.1 ml	$3.4 \cdot 10^1$µM	1.476	0.03342





Note the Gatorade is in order (from left to right):

- Glacier Freeze

- Cool Blue
- Berry

2 Calculations

- Molar Concentration for First Dilution ($M_1V_1 = M_2V_2$):

$$(1.7 \cdot 10^1 \mu\text{M}) \cdot 8\,\text{ml} = (x\mu\text{M}) \cdot 10\,\text{ml}$$

$$x = \frac{(1.7 \cdot 10^1 \mu\text{M}) \cdot 8\,\text{ml}}{10\,\text{ml}} = 1.4 \cdot 10^1 \mu\text{M}$$

- Percent Transmittance for Stock Solution ($\%T = 10^{-A}$)

$$(\%T) = 10^{-0.753} = 0.177 \rightarrow 17.7\%$$

3 Questions

1. Suppose a solution was too concentrated for an accurate reading with the spectrophotometer. The concentrated solution was diluted by placing 1.00 ml of the concentrated solution into 4.00 ml of water. The solution was then placed in the spectrophotometer, an absorbance was obtained, and after a few calculations the molar concentration was calculated to be $3.5 \cdot 10^{-6}\text{M}$. What was the concentration of the original stock solution before dilution?

$$(\text{M}) = \frac{(3.5 \cdot 10^{-6}\text{M}) \cdot 5.00\,\text{ml}}{1.00\,\text{ml}} = 1.8 \cdot 10^{-5}\text{M}$$

2. If a 0.10 M solution of a colored substance has a maximum absorbance at 500 nm and an absorbance of 0.26 at this wavelength, what will be the measured absorbance of a 0.20 M solution at 500 nm?

$$(A) = \frac{0.20\,\text{M}}{0.10\,\text{M}} \cdot 0.26 = 0.52$$

3. The spectrophotometer really measures the percent of light that is transmitted through the solution. The instrument then converts $\%T$ (transmittance) into absorbance by using the equation you determined in the prelab section. If the absorbance of a sample is 0.85, what is the percent light transmitted through the colored sample at this collected wavelength?

$$(A) = -\log(T)$$

$$(T) = 10^{-(A)} \rightarrow 10^{-0.85} = 0.14 \rightarrow 14\%$$