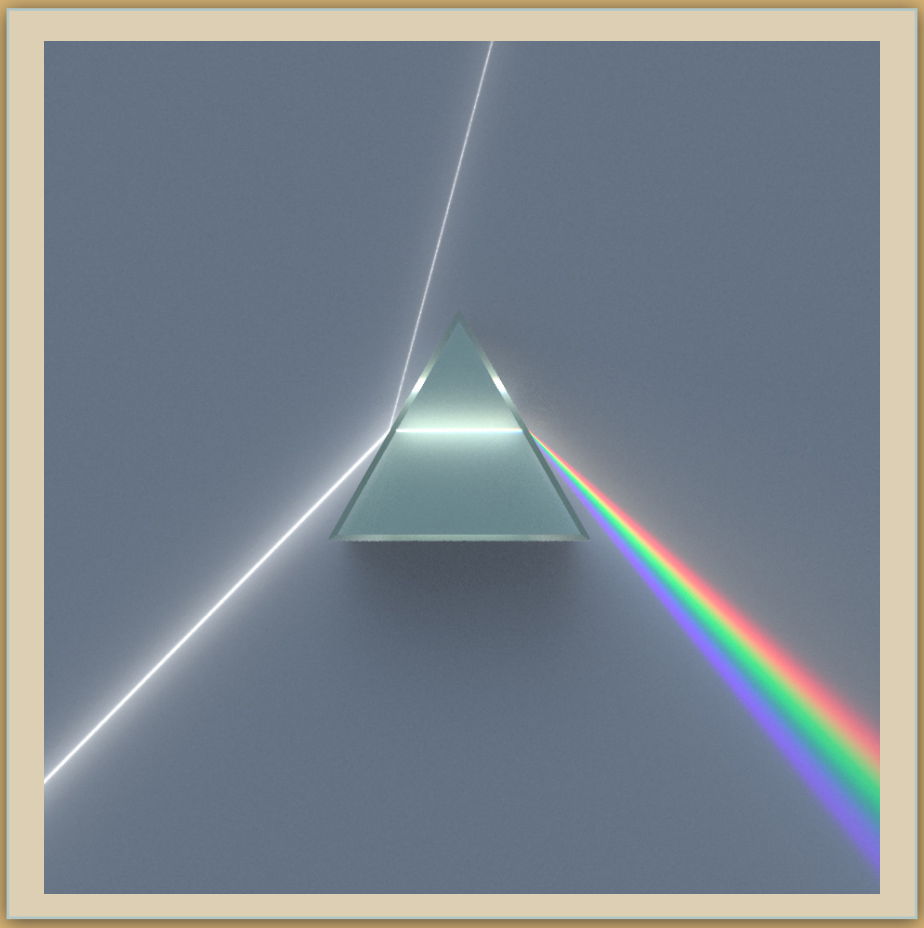
STEM Sims™

Spectroscopy



STEM Sims™

Spectroscopy

Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Start learning right now about how a simple spectroscope is used to find the concentration of a solution. Take the following brief quiz to see how much you already know about how to determine the concentration of a solution. See the bottom of page 4 to check your answers.

1. Spectroscopy is best defined as the study of the:
   a. sound waves moving through matter.
   b. absorption of light by matter.
   c. reflection of sound by matter.
   d. amplification of light by matter.

2. A solution undergoes serial dilution. What happens to the relative amount of solute in the solution as the dilution progresses?
   a. the amount of solute decreases.
   b. the amount of solute increases.
   c. the amount of solute remains unchanged.

3. What is the *log* of 10^4?
   a. 1
   b. 4
   c. 40
   d. 400

4. Which two basic devices are required for a simple spectroscope?
   a. reflector and detector
   b. emitter and reflector
   c. emitter and detector
   d. reflector and refractor

5. The cuvette used in a spectroscope should be:
   a. made of frosted glass.
   b. ridged and opaque.
   c. rounded and transparent.
   d. smooth, clean, and clear.

Logarithms: Giving it to You Straight

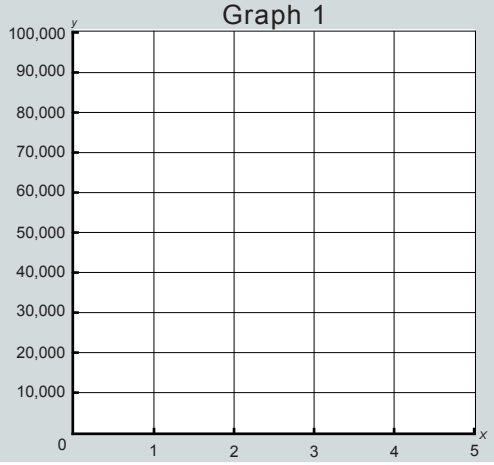
Over the course of time, scientific information has resulted in having to handle very large numbers. This was particularly important around the end of the 16th century when the amount and accuracy of data exploded with the scientific revolution. A mathematician named John Napier is credited for discovering a new technique to handle very large numbers, called logarithms. One wonderful aspect of logarithms is that their use can sometimes turn curved exponential functions into straight lines, which are much easier to deal with mathematically and logically.

Very simply put, a logarithm is a fancy way of saying, "what the heck is the exponent?" So for instance, if you were asked, what is the answer to the problem *log* 10^7? The correct answer would be "7." This next problem looks a little bit more complicated, but it's still simple if you go back to the original definition of a log. What is the *log* of 1,000,000? Well, 1,000,000 can also be represented as 10^6, so the *log* of 10^6 is "6."

Now let's see how logs can straighten out some curved data.
Plot the following data on Graph 1.

x	*y*
1	10
2	100
3	1,000
4	10,000
5	100,000

Graph 1



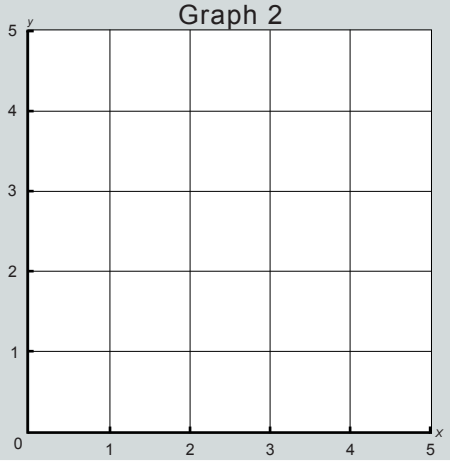
Convert each of the "*y*" values in the table to base ten.
For instance, $10 = 10^1$.

y	10^y
10	10^1
100	
1,000	
10,000	
100,000	

Find the *log* of each "*y*" value converted to base ten.
For instance, $10 = 10^1$.

y	*log y*
10^1	1

Graph 2



Now enter the *log y* values into the data table below, then plot the data on Graph 2.

x	*log y*
1	1
2	
3	
4	
5	

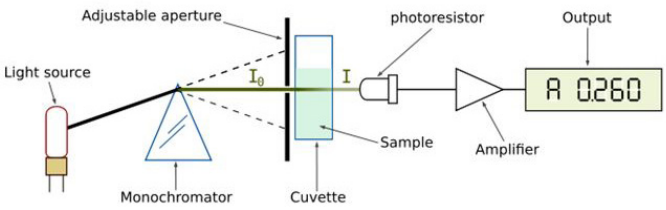
How do the two graphs compare? Is one easier to interpret than the other?

Spectroscopy

Who did it?

One of the most useful ways that spectroscopy is used is in the analysis of crime scene samples. It's not enough to only know what substance is at a crime scene, but also how much of the sample exists. For instance, let's say that a poison such as arsenic is found in a glass next to a person who police suspect has been murdered. Is this enough evidence to convict a person of the crime? Not at all! Police must also know the concentration of the poison to know whether a lethal dose of the arsenic was present. Spectroscopy can answer this and many other such questions.

Spectroscopy is the study of the absorption and emission of light by matter. To determine the concentration of a solute in a solution, the amount of light absorbed by the particles in the solution is most important. Light is "shot" through a liquid solution and collected on the other side of the solution. The more solute present in the solution, the greater the amount of light absorbed by the solute, the less light is transmitted through the solution.



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Answers: Page 2 Answers: 1) b, 2) a, 3) b, 4) c, 5) d. Page 3 Logarithms: Giving it to You Straight Answers: $100 = 10^2$, $1{,}000 = 10^3$, $10{,}000 = 10^4$, and $100{,}000 = 10^5$. $\log 10^2 = 2$, $\log 10^3 = 3$, $\log 10^4 = 4$, and $\log 10^5 = 5$. Logarithms can take exponential data and straighten the curves, making the data easier to interpret

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