AP Chemistry Daily Videos

3.13 Beer-Lambert Law

Video #1

1) Does a highly concentrated solution (which is darker in color) absorb more or less light than a dilute solution?

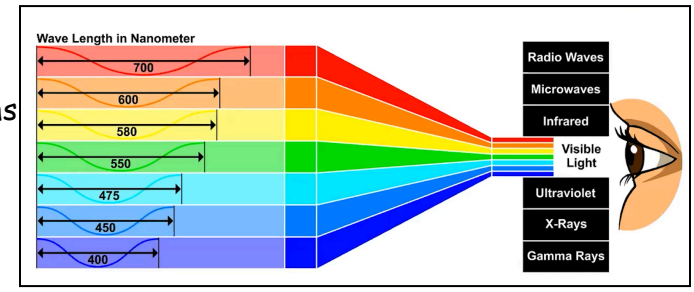
2) How does absorption of light change as concentration of a solution increases?

3) What units is wavelength of light measured in?

4) How does wavelength change as energy increases?

5) Which color ROYGBIV has the most energy?

6) When you see a green shirt, what colors/wavelengths are absorbed and which are reflected?



7) Draw a picture to describe how a spectrophotometer or colorimeter works.

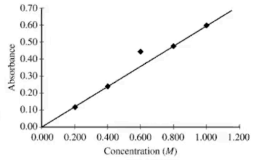
8) Explain each variable in the Beer-Lamber Law. $A = \varepsilon bc$

9) Rewrite this formula if the path length and molar absorptivity are held constant?

10) Does this formula support your answer in #2?

11) Pause the video at 2:35 and attempt the problem, then evaluate how you did and identify any errors.

Which of the following is the most likely explanation for the variance of the data point for the 0.600 *M* $CuSO_4$ solution?



A. The cuvette into which the 0.600 *M* solution was placed had some water droplets inside.

B. The cuvette into which the 0.600 *M* solution was placed was filled slightly more than the other cuvettes.

C. The wavelength setting was accidentally moved away from that of maximum absorbance.

D. The cuvette used for the 0.600 *M* solution had not been wiped clean before being put in the spectrophotometer.

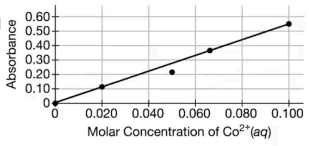
Source: AP® Classroom

12) Pause the video at 4:28 and attempt the problem, then evaluate how you did and identify any errors.

To spectrophotometrically determine the mass percent of cobalt in an ore containing cobalt and some inert materials, solutions with known $[Co^{2+}]$ are prepared and the absorbance of each of the solutions is measured at the wavelength of optimum absorbance. The data are used to create a calibration plot, shown below.

A 0.389 g sample of the ore is completely dissolved in concentrated $HNO_3(aq)$. The mixture is diluted with water to a final volume of 25.00 mL. Assume that all the cobalt in the ore sample is converted to $Co^{2+}(aq)$.

- What is the $[Co^{2+}]$ in the solution if the absorbance of a sample of the solution is 0.45?
- Calculate the number of moles of $Co^{2+}(aq)$ in the 25.00 mL solution.
- Calculate the mass percent of Co in the 0.389 g sample of the ore.



Video #2

1) Pause the video at 2:45 and attempt the problem, then evaluate how you did and identify any errors. Phet Simulation link.

Using the PhET Simulation:

Click on the $Co(NO_3)_2$ solution. What is the preset wavelength and why do you think that is? Set the wavelength to 491 nm. What do you notice as you increase and decrease the concentration of the solution?

Click on the $CuSO_4$ solution. Explain the preset wavelength. Set the wavelength to 712 nm. What do you notice as you increase and decrease the concentration of the solution?

Explain absorbance data that you observed for both solutions at 700 nm.

Stop the video here and try the problem on your own!

2) Pause the video at 4:40 and attempt the problem, then evaluate how you did and identify any errors.

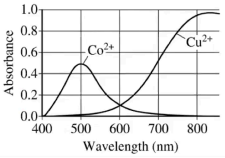
A student has 100. mL of 0.400 M $CuSO_4$(aq) and is asked to make 100. mL of 0.150 M $CuSO_4$(aq) for a spectrophotometry experiment. The following laboratory equipment is available for preparing the solution: centigram balance, weighing paper, funnel, 10 mL beaker, 150 mL beaker, 50 mL graduated cylinder, 100 mL volumetric flask, 50 mL buret, and distilled water.

(a) Calculate the volume of 0.400 M $CuSO_4$(aq) required for the preparation.

(b) Briefly describe the essential steps to most accurately prepare the 0.150 M $CuSO_4$(aq) from the 0.400 M $CuSO_4$(aq) using the equipment listed above.

The student plans to conduct a spectrophotometric analysis to determine the concentration of Cu^{2+}(aq) in a solution. The solution has a small amount of $Co(NO_3)_2$(aq) present as a contaminant. The student is given the diagram below, which shows the absorbance curves for aqueous solutions of Co^{2+}(aq) and Cu^{2+}(aq).

(c) The spectrophotometer available to the student has a wavelength range of 400 nm to 700 nm. What wavelength should the student use to minimize the interference from the presence of the Co^{2+}(aq) ions?



Source: AP® Classroom