

SI Chemistry - Full Discipline Demo

Digital Beer's Law

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match the electromagnetic sources with the correct wavelength.

Blue Light	$2.05 \times 10^5 - 10^9$ nm	1	
Green Light	620 - 760 nm	2	
Microwaves	470 - 550 nm	3	
Red Light	440 - 470 nm	4	
Ultraviolet Light	400 - 10 nm	5	
X-rays	1 nm - 1 pm	6	

Correct answers:

- 1 Microwaves 2 Red Light 3 Green Light 4 Blue Light
5 Ultraviolet Light 6 X-rays

Match the spectroscopic methods with the appropriate descriptions.

⚡ Circular dichroism	Molecular vibrational, rotational, and other energy states of a molecule	1
⚡ Mass spectrometry	Vaporizes molecules and produces ions to determine the chemical composition of a sample	2
⚡ NMR	The wavelength and intensity of the light absorbed by a sample	3
⚡ Raman	Aligns, spins, and excites chemical isotopes which are used to determine the structure of a protein	4
⚡ UV-Vis	The absorption of polarized light to determine secondary structure of proteins	5

Correct answers:

- 1 Raman 2 Mass spectrometry 3 UV-Vis 4 NMR
5 Circular dichroism

A student prepares 5 calibration standards of a red dye by mixing a stock dye solution ($M = 3.8 \times 10^{-2} \text{ M}$) with water in different volumes for a total of 10.0 mL for each. Order the solutions from lowest (1) to highest (5) absorbance.

1	5 mL water + 5 mL red dye	1
2	8 mL water + 2 mL red dye	2
3	0 mL water + 10 mL red dye	3
4	10 mL water + 0 mL red dye	4
5	3 mL water + 7 mL red dye	5

Correct answers:

1 3 2 2 3 5 4 1 5 4

Exploration

A solution is composed of ____ dissolved into a ____.

- ☒ a solute; solvent
- ☐ a solvent; solute
- ☐ water; solvent
- ☐ water; solute



The study of how electromagnetic radiation interacts with atoms and molecules is defined as ____.

- ☒ spectroscopy
- ☐ chromatography
- ☐ topography
- ☐ geometry



Absorbance is the measure of light intensity passed through a sample.

- ☐ True
- ☒ False ✓

A ____ is a type of spectrophotometer that measures the light transmitted through a sample at a specific wavelength.

- ☐ multimeter
- ☒ colorimeter ✓
- ☐ microwave
- ☐ cuvette

The constant(s) in Beer's law include ____.

- ☐ absorbance
- ☐ the molar extinction coefficient
- ☐ the path length
- ☒ the molar extinction coefficient and path length ✓
- ☐ All of the above

Exercise 1

In the Wavelength box, select "variable." Slide the scale to other colors aside from the preset option. What do you observe in terms of transmittance and absorbance? Why was the preset color the one that was chosen?

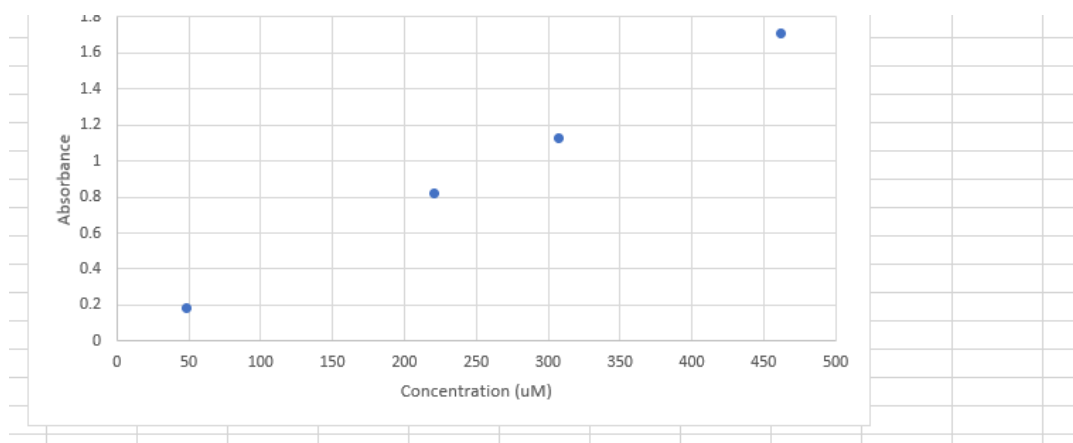
Solution identity:	CuSO4
Path length (cm):	1
Concentration (mM)	Absorbance
Line of best-fit for data points:	$y = .0096x + 0.0017$

Solution identity:	K2Cr2O7
Path length (cm):	1
Concentration (uM)	Absorbance
Line of best-fit for data points:	$y = .0037x + .002$

Copper Sulfate Beer's Law Plot

Concentration (mM)	Absorbance
20	0.18
60	0.58
100	0.98
185	1.78

Potassium Dichromate Beer's Law Plot



Data Table 3: Calculated Values for Copper Sulfate Solution
(SAMPLE ANSWER BELOW)

Concentration (mM)	Absorbance
Figure CV concentration:	156

Data Table 4: Calculated Values for Potassium Dichromate
(SAMPLE ANSWER BELOW)

Concentration (uM)	Absorbance
Figure KJ concentration:	226

Competency Review

Water is the most universal ____.

- ☐ solution
- ☐ solute
- ☒ solvent

✓

Determining the components and concentrations of the solute in a solution is an uncommon task of chemists.

- ☐ True
- ☒ False

✓

Spectroscopy is the study of how electromagnetic radiation interacts with atoms and molecules.

- ☒ True
- ☐ False

✓

The visible region of the spectrum is located in the wavelength range between 400 nm and 700 nm.

- ☒ True
- ☐ False

✓

In UV-Vis spectroscopy, the intensity of the light after it passes through the sample is referred to as ____.

- ☐ absorbance
- ☒ transmittance
- ☐ ultraviolet
- ☐ electromagnetic

✓

Beer's law mathematically expresses the relationship between ____ and sample ____.

- ☐ transmittance; concentration
- ☒ absorbance; concentration ✓
- ☐ absorbance; transmittance
- ☐ concentration; mass

A Beer's law plot is a graph showing the linear relationship between absorbance and concentration.

- ☒ True ✓
- ☐ False

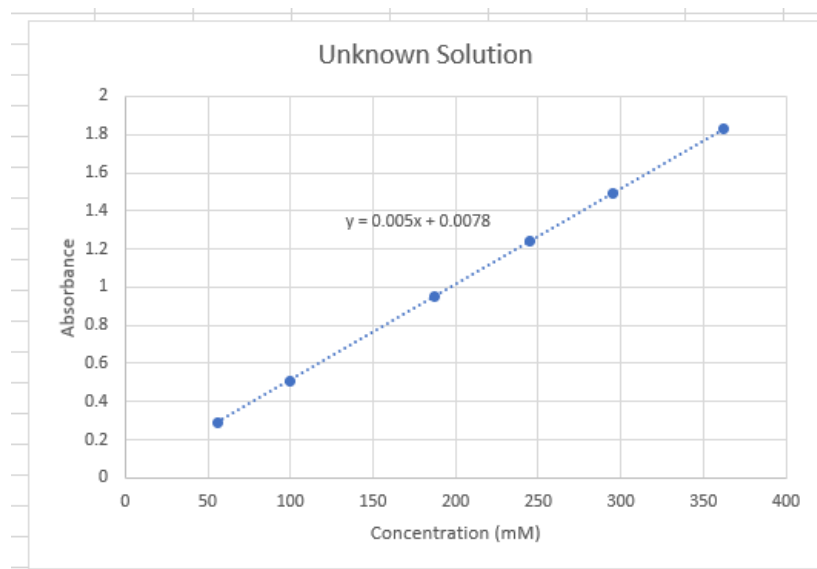
What information was not used in this experiment to construct a Beer's law plot?

- ☐ Concentration of solution
- ☐ Path length of cuvette
- ☒ Wavelength of light ✓
- ☐ All of the above were used

A multimeter measures light intensity, which functions as ____ in a Beer's law plot.

- ☐ transmittance
- ☒ absorbance ✓
- ☐ concentration
- ☐ solubility

Use the scatter plot and associated line of best fit to determine the concentration of an unknown sample with an absorbance of 1.73.



- ☐ 0.0164 mM
- ☒ 344 mM
- ☐ 221 mM
- ☐ None of these.



Extension Questions

At an environmental testing lab, a lab technician calculated the known concentration of the calibrating solution three times too high. How will this affect the results of the samples run using this calibration solution? What would be the possible consequences of reporting these results? (SAMPLE ANSWER BELOW)

The sample concentrations will be recorded too low. This will result in test results that give falsely low numbers. The client who receives these results may think his samples are at a safe concentration when they are not