

## Colorimetric Analysis Tutorial Answers

1. a) The limitations of the Beer-Lambert Law are:

- Deviations in absorption coefficients at high concentrations (>0.01M) due to electrostatic interactions between molecules in close proximity
- Scattering of light due to particulates in the sample
- Fluorescence or phosphorescence of the sample
- Refractive index changes with analyte concentration
- Shifts in chemical equilibrium as a function of concentration
- Non-monochromatic radiation (deviations can be minimized by using a relatively flat part of the absorption spectrum such as the maximum of an absorption band)
- Stray light
- Unmatched cells

See D A Skoog, F J Holler, S R Crouch, (2007) "Principles of Instrumental Analysis", 6th Ed., p 336-343 for a full description.

b) Colorimetric analysis of mixtures requires/assumes no interaction between the various species present i.e. they do not change each other's colour/absorbance spectrum.

2. Break the problem down into steps and use equations for propagation of errors.

	Value	SD
$A_1$	0.312	0.003
$A_2$	0.092	0.002
$l$	1.000	0.005
$\epsilon_{A1}$	70.660	2.165
$\epsilon_{A2}$	3.510	0.197
$\epsilon_{B1}$	16.910	0.786
$\epsilon_{B2}$	107.230	3.055

Step	Value	Error
$\epsilon_{B1} A_2$	1.5557	0.0798
$\epsilon_{B2} A_1$	33.4558	1.0060
$\epsilon_{A2} \epsilon_{B1}$	59.3541	4.3254
$\epsilon_{A1} \epsilon_{B2}$	7576.8718	317.0067
$\epsilon_{B1} A_2 - \epsilon_{B2} A_1$	-31.9000	1.0091
$\epsilon_{A2} \epsilon_{B1} - \epsilon_{A1} \epsilon_{B2}$	7517.5177	317.0362
$c_A$	0.004243	0.0002247

$$= 1.5557 \times \sqrt{[(0.786/16.91)^2 + (0.002/0.092)^2]}$$

$$= 33.4558 \times \sqrt{[(3.055/107.23)^2 + (0.003/0.312)^2]}$$

$$= 59.3541 \times \sqrt{[(0.197/3.51)^2 + (0.786/16.91)^2]}$$

$$= 7576.8718 \times \sqrt{[(2.165/70.66)^2 + (3.055/107.23)^2]}$$

$$= \sqrt{[(0.0798)^2 + (1.0060)^2]}$$

$$= \sqrt{[(4.3254)^2 + (317.0067)^2]}$$

$$= 0.004243 \times \sqrt{[(1.0091/-31.9000)^2 + (317.0362/-7517.5177)^2 + (0.005/1)^2]}$$

Step	Value	Error
$\epsilon_{A1} A_2$	1.0951	0.0624
$\epsilon_{A2} A_1$	6.5007	0.2442
$\epsilon_{B1} \epsilon_{A2}$	59.3541	4.3254
$\epsilon_{B2} \epsilon_{A1}$	7576.8718	317.0067
$\epsilon_{A1} A_2 - \epsilon_{A2} A_1$	-5.4056	0.2521
$\epsilon_{B2} \epsilon_{A1} - \epsilon_{B1} \epsilon_{A2}$	-7517.5177	317.0362
$c_B$	0.000719	0.000045

Therefore:  $c_A = 0.00424 \pm 0.00022$  M and  $c_B = 0.00072 \pm 0.00005$  M

# Colorimetric Analysis Lab Answers

**R. Scott Stricoff, Douglas B. Walters**



## **Colorimetric Analysis Lab Answers:**

*Practical Instrumental Analysis* Sergio Petrozzi, 2012-09-24 This practical book in instrumental analytics conveys an overview of important methods of analysis and enables the reader to realistically learn the principally technology independent working techniques the analytical chemist uses to develop methods and conduct validation What is to be conveyed to the student is the fact that analysts in their capacity as problem solvers perform services for certain groups of customers i e the solution to the problem should in any case be processed in such a way as to be fit for purpose The book presents sixteen experiments in analytical chemistry laboratory courses They consist of the classical curriculum used at universities and universities of applied sciences with chromatographic procedures atom spectrometric methods sensors and special methods e g field flow fractionation flow injection analysis and N determination according to Kjeldahl The carefully chosen combination of theoretical description of the methods of analysis and the detailed instructions given are what characterizes this book The instructions to the experiments are so detailed that the measurements can for the most part be taken without the help of additional literature The book is complemented with tips for effective literature and database research on the topics of organization and the practical workflow of experiments in analytical laboratory on the topic of the use of laboratory logs as well as on writing technical reports and grading them Evaluation Guidelines for Laboratory Experiments A small introduction to Quality Management a brief glance at the history of analytical chemistry as well as a detailed appendix on the topic of safety in analytical laboratories and a short introduction to the new system of grading and marking chemicals using the Globally Harmonized System of Classification and Labelling of Chemicals GHS round off this book This book is therefore an indispensable workbook for students internship assistants and lecturers in the area of chemistry biotechnology food technology and environmental technology in the basic training program of analytics at universities and universities of applied sciences

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Chunlong Zhang,2007-02-26 An integrated approach to understanding the principles of sampling chemical analysis and instrumentation This unique reference focuses on the overall framework and why various methodologies are used in environmental sampling and analysis An understanding of the underlying theories and principles empowers environmental professionals to select and adapt the proper sampling and analytical protocols for specific contaminants as well as for specific project applications Covering both field sampling and laboratory analysis *Fundamentals of Environmental Sampling and Analysis* includes A review of the basic analytical and organic chemistry statistics hydrogeology and environmental regulations relevant to sampling and analysis An overview of the fundamentals of environmental sampling design sampling techniques and quality assurance quality control QA QC essential to acquire quality environmental data A detailed discussion of the theories of absorption spectroscopy for qualitative and quantitative environmental analysis metal analysis using various atomic absorption and emission spectrometric methods and the instrumental principles of common chromatographic and electrochemical methods An introduction to advanced analytical techniques including various hyphenated mass spectrometries and nuclear magnetic resonance spectroscopy With real life case studies that illustrate the principles plus problems and questions at the end of each chapter to solidify understanding this is a practical hands on reference for practitioners and a great textbook for upper level undergraduates and graduate students in environmental science and engineering

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